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Testing the Predictive Power of Equity Valuation Metrics: A Minskyian Approach

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Abstract

Valuation process is at the core of finance. There are several methods that can be used to value a stock. Analysts, due to constraints in time, choose between a few metrics to obtain a target price for the stock. In this paper we analyze the predictive power of different valuation metrics when used to predict the S&P 500. We do so by first presenting theoretical discussions about the financial markets. The case that EMH is not a good model for finance and that behavioral finance, though useful, does not create a complete picture. Mainstream investment theories presented by Neoclassicals and Neo-Keynesians is argued against and Hymen Minsky's alternate non-equilibrium based interpretation of John Maynard Keynes is explained. Using Minsky's interpretation we explain a market where mis-pricing in stock is a normal phenomenon. The presence of mis-pricing in the market enables our reasoning for using fundamental analysis to identify the mis-pricings. Our results show that using daily data, Price to Sales ratio is the best predictor for the changes in daily returns and Price to Earnings ratio is the best predictor for changes in monthly returns for the S& P 500.

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Dedication

To Jahanara Begun, a loving and caring grandmother.

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1

Introduction

In late August 2008, Dick Bove, an Equity Analyst, upgraded Lehman Brothers' stock (LEH) to a *buy* rating and explained that the company was *undervalued*. One month later, the company went bankrupt. Mistakes like this can happen with Equity Analysts but they are even more common among regular investors. Predicting the stock market is no easy task. That is one of the reasons why investors turn to Equity Analysts, since they generally do a better job.

Equity Analysts use fundamental analysis to predict stock price movements. They use a wide range of predictors, valuation metrics, to do so. Looking back at historic results it is very easy to see which predictions were good. However, figuring out what is a good predictor is a challenge: a challenge we take on in this paper.

Even though valuation is a common process in the finance industry, it is a process that is considered by the mainstream finance theory, based on efficient market hypothesis (EMH), as fruitless. Fama's (1970) EMH claims that market participants are rational agents and all information about a stock is already priced in. However, since the 1990s, behavioral finance managed to shed some light on the flaws of EMH and presented an opportunity for investors to believe that slight mis-pricing in the market exists.

Behavioral finance, however, only attempts to fill the gaps in the logic for EMH. Even with the addition of behavioral finance, EMH does not create a fully functional explanation of the financial market. This is because EMH stems from incorrect assumptions set forward by Neoclassical investment theories. Even Neoclassicals who assimilated Keynes' perspective to create Neo-Keynesian economics, did so by keeping the incorrect assumptions of the original model. Minsky (1975) presents an alternate interpretation of Keynes to describe a dis-equilibrium based investment theory that incorporates debt accurately. Minsky's interpretation can be used to consider a financial market where mis-pricing is not only possible but is the norm.

In this paper we look at different valuation metrics and use a Minskyian approach to test the predictive power of each of these metrics. In Chapter 2, we provide a detailed understanding of how valuation process works and an analysis of the valuation methods used later in the paper. In Chapter 3, we look at EMH as the mainstream model for financial market. We present critiques to the EMH and then move to discussing behavioral finance and how it enables us to understand investor behavior better. In Chapter 4, we discuss the importance of macroeconomics and finance as a combined discipline and how mainstream investment theory used by both Neoclassicals and Neo-Keynesians separates the two by making incorrect assumptions. In Chapter 5, we look at Minsky's alternate interpretation of Keynes and discuss how Minsky's investment theory can be used to explain a financial market that is much more well founded on realistic assumptions. In Chapter 6 we discuss our model. In Chapter 7 we show the process of our analysis and present our results.

2

Stock Valuation

There are two kinds of investors in the financial world: active investors and passive investors. Passive investors believe there is no distinction between different stocks and that there is no value in attempting forecast price. They argue that the best way to invest is to buy a large number of assets based on asset classes or indexes and use risk analysis to create a diversified portfolio and hold the asset for the long term.

Active investors on the other hand believe that the best return can be made in the market by stock valuation, which is the method of calculating the theoretical value of a share. They believe that markets can mis-price assets from time to time leading to a difference between the value of a share and the price.

In this paper we accept the merits of passive investment strategy; however, we believe that active investment is the optimal method based on how financial markets really operate. We will explain this in greater detail in the chapters to come. For now we will focus on active investment strategy solely.

When active investing, the value of a stock tells a buyer the highest price he should pay and the seller the lowest price at which the stock should be sold for (Fernandez 2015). Stock valuation is a method investors use to predict future stock price movements. By using the information they gain from stock valuation, they can determine the best method to maximize their return on a given investment. They can do so by buying a stock when it is undervalued, or by selling a stock when it is overvalued.

When conducting security analysis it is important to consider macroeconomic factors, industry factors, and company-specific factors. Security analysts look at the past performance of the company when conducting their research; however, in security valuation it is not the past but the future that matters (Smart et al. 2014). The reason the past is important even though it provides no guarantees about the future is that it can provide a reasonable understanding of the company's strengths and weaknesses.

The value of any asset is dependent on its expected future cash flows and required return to equity. This is the same for a stock. The expected future cash flow for equity is dependent on expected return on investment and expected company growth (Fernandez 2015). The required return to equity is dependent on the risk free interest rate, market risk premium, operating risk, and financial risk.

Stock valuation is a very difficult task. Though there has been a large body of work surrounding it, the literature surrounding it has made considerably little progress (Bakshi 2005). The most prevalent problem of using stock valuation techniques is that there are a very large number of stock valuation techniques, and though most of them produce results that are useful, for an investor or a market analyst it is not possible to run all the methods. That is why individuals choose to go with only a few methods and make decisions accordingly.

SIn this paper we are focused on how analysts make these decisions and we and determine the best method to use when trying to value specific stocks. When trying to determine the best valuation technique to use, analysts choose look for a method that have the following properties (English, 2001):

- Produces results efficiently
- Scalable to large number of stock with ease
- Results should be quantifiable and comparable.
- Accounts for firms fundamental: Income Statement, Balance Sheet etc..

To determine the future value of a stock investors tend to perform either fundamental or technical analysis on the stock. Fundamental analysis investigates the core condition of a company by looking at its actual numbers as indicated by the income statements, balance sheets, cash flow statement etc. Technical analysis uses past data on prices and volumes as an indicator for future prices movements using concepts such as *prices move in trends* and *history tends to repeat itself*. For the purpose of this paper we will focus strictly on fundamental analysis.

The fundamental valuation techniques can be divided into two main categories: intrinsic valuation and relative valuation. Intrinsic valuation attempts to determine the real value of the underlying asset (Gottwald 2011). The valuation is based on the current economic position of the company. On the other hand relative valuation is a method of determining the valuation of a company by comparing its valuation with other companies that are from similar sectors or perform similarly.

It may seem at first that intrinsic valuation should be the go-to model for majority of research on stock valuation since it determines the true value of the stock. However, in practice a large majority of the equity research report published by analysts are done using relative valuation with P/E ratio being the most popular valuation tool in the stock markets (Gottwald 2012).

While it may be true that intrinsic valuation are able to give individuals a more realistic understanding about the stock, in the fast paced world of finance this may not be the only consideration to make. We know that analysts are largely concerned not only about the quality of the results but also at the pace at which they can obtain them. When using slower intrinsic methods analysts need to sacrifice time. In order to save time analysts who feel that relative valuation can do just as good a job or close enough will prefer this method over intrinsic.

It is important to note that though it is a faster method, relative valuation forces analysts to make two very difficult to accomplish assumptions:

1. There exists a company or a group of companies that on average can be used as a bench mark such that it has the exact same risk and growth profile as the company being evaluated.

2. The company or companies being used as benchmark is currently valued accurately.

To understand why these are hard assumptions to make we need to realize that it is very difficult to get two companies that have the exact same risk and growth profile. Equity research analysts sometimes use companies of the same sector or sub-sector or competitors as a benchmark. These can sometimes serve as suitable benchmarks but even then each individual company is vastly different.

For the second let's assume that we managed to obtain a perfect benchmark company. We can now use it to determine the value of our company. However, the value of the benchmark might not be trading at its true or intrinsic value. The benchmark may itself be priced up or priced down due to short term market speculations. If either of those are the case, by pricing our company using the benchmark, we will be either overvaluing it or undervaluing it. Both of which can lead to lower return on investment.

It then becomes easy to conclude that the assumptions needed to obtain a good relative valuation are difficult. For this reason it becomes theoretically more meaningful to apply intrinsic valuation methods solely. However, equity analysts who are more informed and experienced about the market can make very accurate judgment call regarding those factors and determine very meaningful ways to use relative valuation.

Since both have their merits and flaws the purpose of this paper is to determine the relative efficiency of the different methods in predicting stock price movement. We will look at different intrinsic and relative valuation models to see which metric best helps explain the movement in stock price. Before moving forward we will discuss the valuation techniques that will be later used in this paper in details.

2.1 Intrinsic Valuation

2.1.1 Discounted Cash Flow

The discounted cash flow (DCF) method of determining the price of a stock is simply based on valuing the company by calculating the present value of its future cash flows.

$$\text{PV} = \sum_{i=1}^{n} \frac{CF_i}{(1+r)^i} + \frac{T}{(1+r)^n} \tag{2.1.1}$$

The DCF model uses a firm's discounted future cash flows to value the business. The big advantage of this approach is that it can be used with a wide variety of firms that don't pay dividends, and even for companies that do pay dividends. There are several variations of this method.

The most common way to to perform this valuation method is to perform valuation based on Free Cash Flow (FCF). The first requirement for using this model is for the company to have predictable FCF, and for the FCFs to be positive. Based on this requirement alone, you will quickly find that many small high-growth firms and non-mature firms will be excluded due to the large capital expenditures these companies generally face. The target company should generally have stable, positive and predictable free cash flows. Companies that have the ideal cash flows suited for the DCF model are typically the mature firms that are past the growth stages. DCF methods are also done using capital cash flow (CCF) and equity cash flow (ECF) (Fernandez, 2013).

The DCF is calculated as shown in Equation 2.1.1. The DCF method contains three main variables, the discount rate (r), the individual cash flows (CF), and the terminal value (T). When doing the value of the firm the discount rate is the the weighted average-cost of capital (WACC). WACC is calculated using both the cost of equity and the cost of debt.

To calculate CF, first the cash flow from operations (CFO) is determined.

$$\text{CFO} = \text{Net Income} - \text{Noncash items in income} - \text{Increase in working capital}$$

$$\begin{aligned} CF = \ & \text{CFO} - \text{capital expenditures} - \text{preferred dividends} \\ & - \text{debt repayments} + \text{proceeds to new debt inssuance} \end{aligned}$$

Terminal values are the most critical aspect of a DCF valuation as it can be responsible for upto 70% or more of the value (English, 2001). Terminal value is the value a of the firm after n periods such that:

$$\begin{aligned} \frac{T}{(1+r)^n} &= \sum_{i=n+1}^{\infty} \frac{CF_i}{(1+r)^i} \\ &= \frac{1}{(1+r)^n} \times \sum_{i=1}^{\infty} \frac{CF_i}{(1+r)^i} \end{aligned}$$

An assumption made when working with T, is that CF growth beyond T does not contribute to value. This is a fair assumption to make since the long run competitive equilibrium brings future returns to a normal rate because we are assuming that the companies we are modeling have stable and predictable cash flows (English, 2001). Based on this the above expression can be simplified as :

$$\begin{aligned} \frac{T}{(1+r)^n} &= \frac{CF_{n+1}}{(1+r)^n} \times \sum_{i=1}^{\infty} \frac{1}{(1+r)^i} \\ &= \frac{CF_{n+1}}{(1+r)^n} \times \frac{1}{r} \end{aligned}$$

Therefore,

$$T = \frac{CF_{n+1}}{r}$$

To summarize, DCF method is a very important and common valuation technique. However, the nature of terminal values and the need have to stable and positive cash flows can lead to both irregularities in prediction and limited usable scenarios.

2.1.2 Dividend Discount Model

The dividend discount model (DDM) calculates the 'true' value of a firm based on the dividends. Dividends are the portion of corporate earnings that a firm gives out to its shareholders. In the DCF model we were valuing using the company's cash flow, in the DDM model we are valuing stocks directly. So in this model we will look at the incentives of an investor to buy shares, that is we will look at the stream of cash flows that go directly to the shareholders, which is dividends.

So, the first thing that should be checked in order to use this method is if the company actually pays a dividend. Not all companies pay dividends and that is because a lot of growing companies prefer to reinvest its earnings back into the company in order to ensure greater future earnings. Sometimes mature companies may also choose to reduce dividend payment in order to expand their business. Even within the S&P 500 there were 76 (15.2%) firms that choose not to pay dividends as of Oct, 2015. Figure 2.1.1 shows the data for the constituents of the S&P 500. It shows the change in number of dividend paying companies overtime and also shows the number of companies increasing their dividend payments over time.

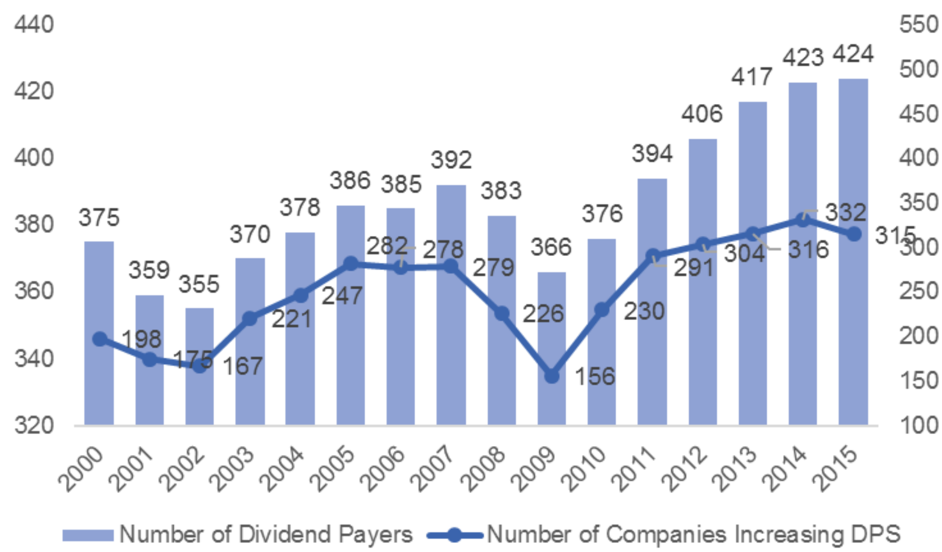


Figure 2.1.1: Shows the change in number of dividend payers and number of companies increasing dividends per share (DPS) over time for all stocks in the S&P 500

For dividend discount model it is not enough for the company to just pay dividend; the dividend should also be stable and predictable. The companies that pay stable and predictable dividends are typically mature blue-chip companies in mature and well-developed industries. In addition, investors also check the payout ratio of a firm to make sure the ratio is consistent. The payout ratio is a ratio of dividends per share with earnings per share. Consistent payout ratios indicate ideal candidates for the dividend model. The expression below shows how a DDM calculates the value of a stock.

$$P_0 = \sum_{i=1}^{\infty} \frac{D_i}{(1+r)^i}$$

The dividend discount model values the stock based on the cash received by the shareholders in the form of dividends. Theoretically this method is completely sound. However, in practice it requires the analyst to estimate future dividends for a large number of years and the model does not account for financial performance such as earnings or return on equity to the price. Gordon (1994) works on simplifying this method by assuming constant growth in dividends. The Gordon Growth model is:

$$P_0 = \frac{D_1}{(r - g)}$$

Here D_1 is next year's dividends, r is the cost of equity and g is the growth rate such that $r > g$. In this method the growth rate is the hardest to determine. Primarily because predicting long term factors is difficult in nature and this problem is exasperated by the fact that the model is extremely sensitive to the growth variable. Campbell and Shiller (1988), Bakshi and Chen (2005) all use historical dividends and earnings data to estimate future dividends growth.

2.1.3 Asset-Based Methods

One popular asset based valuation technique is the Net Current Asset Value (NCAV) which was introduced by Benjamin Graham in his book *The Intelligent Invstor* (1949). The method looks at overvalued and undervalued stocks based on the level of current assets of a firm.

To a stock holder the greatest risk of holding a stock is the bankruptcy of the company. In the case of bankruptcy a firm sells all of its goods as quickly as possible. Fixed assets usually sell at large discounts during a firesale associated with bankruptcy. Therefore the primary asset to consider for the worst case scenario is the current assets.

During bankruptcy all debts and preferred shareholders must be paid off before any value can be obtained by the common share holders. And since the primary way these debts will be paid off is by using the company's current assets. This method considers only residual current assets or net current assets.

The decision to invest in a stock relies on the following ratio:

$$\text{NCAV ratio} = \frac{\text{Market Capitalisation}}{\text{Net Current Asset}} < \lambda$$

$$\text{Net Current Asset} = \text{Current Asset} - \text{Liabilities} - \text{Preferred Stock}$$

where λ is the ratio factor which depends on the risk tolerance of individuals. For example Benjamin Graham used a $\lambda = 0.66$. If the NCAV ratio is below λ then it means that the stock is undervalued and therefore the investor can make positive return by investing in this method. The following can be used to determine the value of each stock using NCAV:

$$\text{Stock price} = \frac{\text{Net Current Asset} \times \lambda}{\text{Market Capitalisation}}$$

To gain even more accurate representation of firesale value of a company some analysts use even stricter methods such as:

$$\text{Net Current Asset} = \text{Cash and Short Term Investments} + \tau \times \text{Accounts Receivable}$$
$$+\sigma \times \text{Investory} - \text{Liabilities} - \text{Preferred Stock}$$

where $\tau, \sigma \leq 1$.

2.2 Relative Valuations

Relative valuation doesn't attempt to find an intrinsic value for the stock like the previous; it simply compares the stock's price multiples to a benchmark to determine if the stock is relatively undervalued or overvalued. The rationale for this is based off of the Law of One Price, which states that two similar assets should sell for similar prices.

2.2.1 Price to Earnings Ratio

Price to Earnings Ratio or PE is a relative valuation tool and even withholding the major theoretical drawbacks associated with relative valuations discussed before, it is still the most popular stock valuation technique used in the market (Gottwald 2012). The ratio shows what the price the stock is trading at in relation to earnings.

$$\text{Price to Earnings} = \frac{\text{Market Value per Share}}{\text{Earnings per Share}}$$

Valution based on PE can only be done on companies that have the following qualities:

- positive earnings
- stable earnings
- acceptable accounting practices

The company should be generating positive earnings because a comparison using a negative PE multiple would be meaningless. The earnings quality should be strong;

earnings should not be too volatile. And the accounting practices used by management should not drastically distort the reported earnings.

To determine the value of a stock using the PE ratio we take the ratios of the stock under consideration and other similar stocks. Similar stocks are from companies from the same line of business and/or stocks of companies whose performance is affected by similar factors. Companies with higher than average PE in relation to competitors tend to indicate that the stock is overvalued unless the company has very high growth expectations because of some specific comparative advantage it has over its competitors.

PE ratio also plays a critical role as a supplemental analytic tool to other valuation techniques. It is often used as a conjunction with intrinsic or relative valuation techniques. Watsham (1993) uses PE combined with a profit model. Halsey (2000) used PE ratio and Price-to-Book ratio to categorize different companies into groups: high performing company[1], declining company[2], improving company[3], and poor performing company[4].

Gordon's (1994) model can also be used to derive another expression for the PE

$$P_0 = \frac{D_1}{k-g}$$

$$P_0 \times \frac{1}{E_1} = \frac{D_1}{k-g} \times \frac{1}{E_1}$$

[1]High performing companies are those with expected positive residual income, increasing income. These are companies which usually have high PE and high PB

[2]Declining companies are those with expected positive residual income and decreasing income. These are companies which usually have low PE but high PB

[3]Improving companies are those with expected negative residual income and increasing income. These are companies which usually have high PE but low PB.

[4]Poor performing companies are those with expected negative residual income and decreasing income. These are companies which usually have low PE and low PB.

$$\frac{P_0}{E_1} = \frac{D_1/E_1}{k-g} = \frac{d}{k-g}$$

where d is the dividend payout ratio.

2.2.2 Dividend Yield

The dividend yield is a percentage of the annual dividend per share and the current stock price per share such that:

$$\text{Dividend Yield} = \frac{D_1}{P_0}$$

Again remember that steady, mature businesses are mostly known for paying the most dividends. According to English, companies given a constant cost of equity, k, there is an inverse relationship between the dividend yield and long term growth g. This makes sense because new companies with large growth potential tend to not pay dividends and instead reinvest the earnings for future growth. This can also be explained mathematically by combining the dividend yield equation with the Gordon growth model. The result is as follows:

$$\frac{D_1}{P_0} = (k-g)$$

Investors will perform several valuations to create a range of possible values or average all of the valuations into one.

2.2.3 Price to Book Value

The price to book value (PB) is a measure of the shareholders' equity in the balance sheet. It is a ratio of the market price of a stock to the book value of the equity.

$$\text{Price to Book Ratio} = \frac{P_0}{B_0}$$

where B_0 is the present day book value of equity. The PB is still the best measure of determining the underlying value of the asset held by each share (Branch, 2014). This ratio gives a clear indication of how much that market values the assets as a *going concern*[5] firm versus just plain assets.

Branch notes that the effects of PB are not universally accepted; however, it is still an important concept in understanding return. PB has also been shown to anticipate growth by Brief and Lawson (1992) as well as profitability by Feltham and Ohlson (1995).

The price to book value can also be combined with the Gordon growth model in a similar way as the PE ratio such that:

$$\frac{P_0}{B_0} = \frac{D_1/B_0}{k-g}$$
$$D_1 = d \times E_1$$
$$\frac{P_0}{B_0} = \frac{d \times E_1/B_0}{k-g}$$

where E_1/B_0 is the return on equity at period 1, ROE_1. Therefore,

[5] Going concern is an accounting concept. It assumes that a company will be able to continue operating for a period of time that is sufficient to carry out its commitments and goals.

$$\frac{P_0}{B_0} = \frac{d \times ROE_1}{k - g}$$

2.2.4 Price to Cash Flow

Price to cash flow computes the following ratio

$$\text{PCF} = \frac{\text{Market Capitalization}}{\text{Operating Cash Flow(CF)}}$$

Similar to other price ratios a comparatively lower PCF indicates that the company may be undervalued. PCF becomes a useful tool in valuation when the firm has positive cash flows but negative profitability.

2.2.5 Price to Free Cash Flow

Price to Free Cash Flow (PCFC) is similar to Price to Cash Flow but instead of CF as the denominator, PCFC uses Free Cash Flow (FCF) where

$$\text{FCF} = \text{Operating Cash Flow} - \text{Capital Expenditure}$$

2.2.6 Price to Sales

The price to sales ratio simply computes the market capitalization of a firm to its net revenue. This ratio is again useful for companies that are known to make losses. That being said, for companies making losses price to sales ratios are only able to interpret correct valuation if the company is able to eventually turn the high level of sales to earnings as well. Again a low ratio means stock is undervalued.

The main advantage of using sales instead of earnings is that sales is an untampered top line number in a company's income statement whereas earnings is a bottom line number and hence is exposed to a large number of manipulations and also short term fluctuations. This means that growth in sales is much more easier to calculate for analysts.

One major drawback with price to sales, however, is that debt plays a very strong role in how meaningful the ratio is. A firm with no debt and low PS is of course attractive and does not cause any complications; however, if a firm has debt the PS ratio may be a poor choice. This is because a firm with debt may need to issue new shares which can increase PS drastically and even if high debt is leading a company towards bankruptcy, the company may still show a low PS ratio.

Because of the debt issue, in our model for PS we will using the following instead:

$$\mathrm{PS} = \frac{\text{Enterprise Value(EV)}}{\text{Sales}}$$

where

$$\begin{aligned} EV = &\text{ market value of common stock} + \text{ market value of preferred equity} \\ &+ \text{market value of debt} + \text{ minority interest} - \text{ cash and investments.} \end{aligned}$$

This method also helps compare companies that have significantly different debt structure as well.

2.2.7 Enterprise Multiple

There are two main enterprise multiples and these are the ratios of the enterprise value (EV) of the company with the earnings of the company. The EV of a company is the measure of a company's total value. That is the EV of a company is the sum of the market value of the common stock, preferred stock, and debt minus the cash and investment.

$$\text{Enterprise Multiple} = \frac{EV}{EBITDA}$$

or

$$\text{Enterprise Multiple} = \frac{EV}{EBIT}$$

where EBITDA is the earnings before interest, tax, depreciation, and amortization and EBIT is the earnings before interest, and tax. This measure is similar to the PE ratio in the sense that it also measures the cost of a stock as a ratio of the earnings of the company.

One advantage the EV multiple ratios have over the PE ratio is that the EV ratios are not affected by the capital structure of the firm, since PE ratios give firms with higher debt relative to equity a higher value.

Also since EV does not include investments, it means it puts firms that require higher initial investment and firms that require low initial investments into the same level and thus makes comparison between firms easier.

2.2.8 Return on Equity

Return on equity (ROE) is simply:

$$ROE = \frac{\text{Net Income}}{\text{Market Capitalization}}$$

An increase in ROE indicates that for a given market capitalization the firm is producing greater earnings. So this ratio becomes a great tool when valuing stocks.

However, just as the PE, ROE too can increase when the the company takes on additional debt and decreases number of shares outstanding. So if one was to solely use this metric a company with higher leverage would appear to be worth more.

The solution to the problem is addressed by the simple means of rearranging the ROE using DuPoint Calculation such that:

$$ROE = \frac{\text{Net Income}}{\text{Market Capitalization}} \times \frac{\text{Sales}}{\text{Sales}} \times \frac{\text{Assets}}{\text{Assets}}$$

$$= \frac{\text{Net Income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Assets}} \times \frac{\text{Assets}}{\text{Market Capitalization}}$$

$$= \text{Net Profit Margin} \times \text{Asset Turnover} \times \text{Equity Multiplier}$$

By breaking the ROE into component multipliers we can gain a better insight into its movements. Essentially we expect ROE changes caused by Net Profit Margin and

Asset Turnover to have a positive relationship with stock price whereas an *ROE* caused by Equity Multiplier could cause can have the reverse effect.

2.3 Summary

In this chapter we have discussed the importance of stock valuation techniques to active investors. We demonstrated the importance to both intrinsic valuation techniques and relative valuation techniques to market analysts and how they decide between them. We then looked at detailed descriptions of a few intrinsic valuation and relative valuation techniques which we will be using in our analysis later in the paper.

Recall that we mentioned that we primarily support active investment strategy over passive. To support a strategy we need to understand the financial markets and how they operate. Applying a strategy without understanding the market would most likely yield poor results regardless of how good the strategy is. In the next chapter we explain the context of the financial markets and how behavioral finance introduced itself in a world of efficient markets.

3

Financial Markets

Before we begin discussing the model for valuation of a stock, we need to first clear our understanding on how the boarder financial markets operate. We need to understand what the price of a stock really means and how investors interact with one another in the market to determine this price. The purpose of stock valuation is to be able to exploit the difference between a stock's price and its value. Therefore, for fundamental analysis to be able to produce value, the market must be such that a difference between stock's price and its value exists. The difference must also be reasonably persistent, and they also have to be discoverable by quantitative methods. To understand the stock market and price movement, in this chapter we will explore the Efficient Market Hypothesis (EMH). We will argue why EMH is not able to accurately describe the market and then move to discussing the developments in behavioral finance.

3.1 Efficient Market Hypothesis

The believers of the EMH trust that the market price of stocks always reflects all available information about the market security, an explanation to the apparent random nature of the stock market offered first by Eugene Fama (1970). The random walk model of the EMH is largely based on that of Louis Bachelier's applied probability theory dissertation called *The Theory of Speculation* where he showed that there is a statistical independence between stock return, signaling to the idea that today's valuation cannot be used to predict future returns (2006). The hypothesis is based on the idea that investors or stock market participants are rational beings. When new information becomes available about a given stock, these rational investors buy or sell the stock based on the opportunity presented by the new information. By doing so the rational investors push the price of the stock up, if it is a good news, or down, if it is a bad news. According to the hypothesis these investors have effectively moved the price of the stock to now reflect the new information available. (Bodie, Kane and Marcus, 2013).

Since EMH assumes that the market price reflects all available information about the stock, one of the core tenants of EMH then becomes that spending time and money on gaining information provides no additional benefit to an investor. The market's reaction to news with time is presented in the figure below. This shows that once new information becomes available, investment based on the news become ineffective since the price has already adjusted to the news. That means that investment managers who are always trying to be ahead of the market cannot beat the market. They may do so in the short run but it will always balance out in the long run. Since all public information is available and reflected in the price the only way to make additional

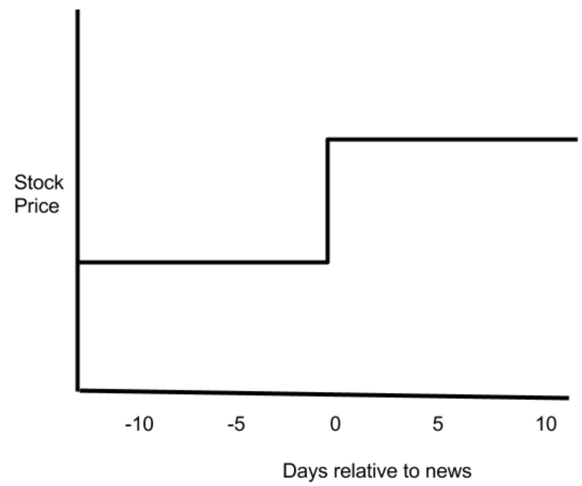


Figure 3.1.1: A crude model of how Efficient Market Hypothesis assumes the markets operate prior to, during, and after new positive information is announced.

return by managers is by used insider information, which is illegal. Figure 3.1.1 shows a representation of the EMH expects stock prices to behave prior to, during, and after new positive information is announced

The popularization of EMH took place primarily in the 1970s. In 1973 Malkiel authored the *Random Walk Down Wall Street*, which was written to a wide range of audience, and helped publicize the importance of EMH to average investors. The 1970s was also a time when a large amount of research using the EMH at its core produced incredible results which also helped increase faith in the model. For example, Merton (1973) in his paper *An Intertemporal Capital Asset Pricing Model* used the EMH to generalize the Capital Asset Pricing Model (CAPM) to an equilibrium model using an aggregate market demand function for assets to show that uncertainty in future investments affects investor demand and that risky assets are different from riskless assets even in the absence of systematic and market risk. These findings led to the model being recognized as an almost infallible fact.

It is important to note that even if you believe in an efficient market, the degree of efficiency does vary depending on the market and the stock being considered. Market efficiency is a theory that can be considered for countries with an advanced and secure financial system such as the U.S. In the U.S. the stocks are extensively analyzed and the accounting disclosure requirements are extremely rigorous. However, in other countries such as Bangladesh, these are not always the case; lack of professional analysts and strict control on rules create large inefficiencies in these markets (Nguyen and Ali, 2011).

Even within the U.S. the efficiency between a large cap stocks such as Wal-Mart (NYSE: WMT), Microsoft (NASDAQ: MSFT), and General Electric (NYSE: GE), versus small cap stocks such as Angies List (NASDAQ: ANGI), and Dave & Busters Entertainment (NASDAQ: PLAY), vary widely as well. This is because large cap companies receive a large amount of coverage from sell-side analysts in Wall Street and hence their prices usually reflect more information versus small cap companies which receive very little coverage (Pattinson, 2015). Large cap companies also trade in significantly larger average volume which increases the liquidity in the market adding to further efficiency in the market.

3.1.1 Forms of Hypothesis

Even among believers of the EMH there are three main forms of it: the weak, semi-strong and strong forms (Bodie, Kane and Marcus, 2013).

- The weak-form hypothesis argues that the stock price reflects all past news and all information obtained by examining market trading data. Essentially, according to weak-form, technical analysis would yield no additional return to investors.

- Semi-strong form holds true all the conditions for the weak-form and adds the condition that all information regarding the prospect of the firm, such as the fundamental data on the firm's product line, quality of management, and balance sheet, are also reflected in the stock price. Essentially believers of Semi-strong form would also argue against the value of fundamental analysis and say that even fundamental analysis can provide no additional return.

- The strong-form goes even further than the semi-strong, stating that stock prices even include information only available to company insiders. Meanings that even insider trading cannot provide additional gains for an investor.

Very few actually argue for the extreme strong-form of the EMH honing to the fact that there are a large number of people that have made large sums of money through insider trading. If insider trading did not provide any unfair advantage to investors then we would not have heard of famous insider trading cases such as that of Raj Rajaratnam, Jeffrey Skilling, or even Martha Stewart. These cases offer only a small sample of the large number of people who benefitted from large gains in the market through the use of insider information. It is only because of the widely accepted unfairness that insider trading provides that much of the activity of the Securities and Exchange Commission is focused at preventing insider trading.

3.1.2 Acceptance and Application

Unlike the strong-form, the other two concepts are very widely accepted by among most economists such as Eugene Fama, Paul Samuelson and John Cochrane. It is not just the wide range of literature that validate the place of EMH as an accurate representation of the financial market, a large body of market-participants such as investors and analysts -essentially people who make a living by trying to gain additional information and using it to increase their return- also believe that additional information is always priced in. Widely used market models such as Black-Scholes' equation for pricing options and the CAPM making suitable portfolios have EMH at the core of its design.

Market participants who abide by the EMH believe that active management provides no additional return over passive investment, which is simply an allocation of a well-diversified portfolio. This is because they believe that the small increased return they will obtain from increased activity and research will be outweighed by the increased transaction costs associated with broker fee, since active management involves more short term trading versus passive which is more along the lines of buying and holding for the long run.

According to the hypothesis even though stock valuation techniques will be able to consistently identify underpriced stocks, rational passive managers are still able to increase return by catering the diversification of the portfolio based on the specific conditions associated with the investors such as age, tax bracket, risk aversion, and employment. Passive managers, for example, will order investments according to their relative risks, using beta as a measure in the CAPM and according to the CAPM the only way to generate higher return is by taking on higher risks.

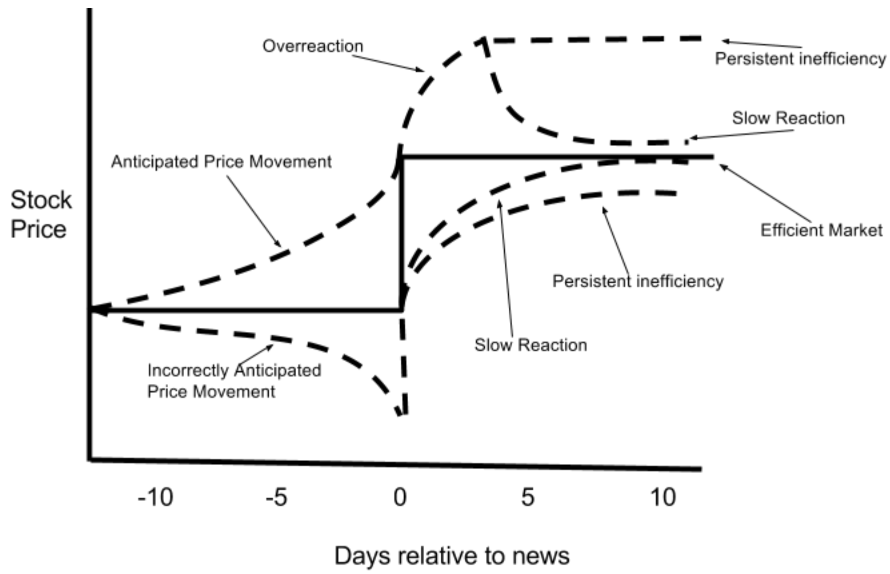


Figure 3.1.2: A crude model of how Market markets actually move prior to, during, and after new positive information is announced. The dashed lines shows different possible movements in the market and the solid line shows that efficient market hypothesis assumes the prices move.

3.1.3 Critiques

While EMH has a great deal of support, it also has its fair share of criticisms at its inability to properly explain a wide variety of market phenomenon. We saw in Figure 3.1.1 how the efficient market hypothesis depicts market reaction to news. Figure 3.1.2 shows the wide variety to ways the market actually moves. These observation and many other things led to the hypothesis being questioned more and more.

- **Biased Market**

  EMH describes the market as unbiased, that is, in an efficient market the stock price is an unbiased indicator of value. However, recent research has shown that biases not only exist in the market but also that they can also be persistent. Researchers such as Daniel Kahneman, Amos Tversky, and Richard Thaler have explained individual's biases such as overreaction, calendar effects, fluctuations in volatility. We will look at these in greater detail in Section 3.2.2.

- **Beauty Contest**

  Another argument against the EMH was laid by Keynes (1953), who uses a beauty contest example to argue that rational investors don't always have an incentive to correct the market; it is profitable to a rational trader in the short run to trade on the same side of the market as irrational traders do. It is not only regular investors who pick stocks according to what they believe other will, large fund managers also do this. Fund managers mimic other managers behavior in a effort to ensure similar returns.

- **Speculative Bubbles/ Booms and Busts**

  Another criticism faced EMH is the presence of speculative bubbles such as the Tulip bubble of the 17th century, South Sea Bubble of the 18th century, Tech bubble of the late 1990 and the housing bubble of 2007. These bubble seem to be in stark contrast to the foundations of the EMH which strongly argues against the possibilities of speculative bubbles. Kindleberger (2000) describes these phenomena as only natural and describes the business cycle by 6 characteristics :

  1. An accelerating inflation
  2. A financial crisis
  3. A sharp thrust towards lower income
  4. Government Intervention
  5. A sharp braking of downturn
  6. Expansion

  Minsky (1984) describes that the modern business cycle is a financial cycle saying that lending amplifies the business cycle, increasing instability. According to Minskys financial instability hypothesis, which we will explain in greater degree in Chapter 5, during a period of prosperity, a stable financial system will tend to become more and more unstable: i.e. the fragility of a financial system increases as the economy develops. This is because a growing economy creates optimism, which leads to increased risk taking and speculations. Banks try to optimize the expansion and in doing so take on greater leverage and reduce liquidity.

According to Minsky this leads to changes in the proportions of Hedge finance , Speculative finance and Ponzi finance . During expansion the level of Speculative and Ponzi finance firms increases. Kindleberger (2000) in his book *Manias, Panics, and Crashes* views financial crises as the culmination of a process where expectations, financed by excessive credit creation, often leads to speculative excesses or manias followed by panics and crashes. This makes booms and busts a natural part of the market flow, something that starkly contradicts beliefs laid forward by EMH.

- **Mean reverting prices**

  EMH indicates that the financial ratios should be good indicators of dividends and earnings growth; however, Campbell and Shiller (2001) discover that ratios are a poor forecaster of those and instead are excellent predictors of price. They argue that valuation rations are mean reverting and fluctuate within historical ranges. EMH explains this phenomenon by asserting that as the ratios revert to the means it is the other variable (and not price) that changes in order for the mean reversion to occur. However, Campbell and Shiller discover that it is not the case, and instead find that prices are what changes. This indicates that prices have a mean reverting tendency as well.

- **Difference between value and price**

  In an efficient market prices are supposed to represent value of a given asset, yet Lee, Shleifer and Thaler (1991) find that the close-end mutual funds don't trade at price equal to the per share market value of its underlying assets.

  There are two types of mutual funds: open-end and closed-end. We know that all mutual funds hold publically traded securities; however, closed end funds also themselves issue shares that are publically traded. Since prices always reflect value, the market cap determined by the shares issued by a close-end fund should equal to the market value of the underlying assets held by the closed-end mutual fund. However, Lee, Shleifer and Thaler find that is not the case and instead funds have been seen to both trade at a premium or a discount. Thaler (1993) in his book *The Winners Curse* also explains that the consistently different price and value of a closed-end fund is evidence for noise trading and failure of arbitrage.

- **Volume and Price**

  Another criticism of the EMH is based on the relationship between volume and changes in price. Karpoff (1987) finds that there is a positive relationship between volume and the change in price of securities. Smitters and Wright (2002) add to this and claim that the relationship between volume and change in price exist because of noise traders. If markets were truly efficient the volume of the trade on an asset should have no relationship with the price of the asset.

- **Calendar Effects**

  Thaler (1987) discusses the effects of calendar on the stock market. Calendar effects traditionally refers to the consistent change in price in stocks that depends on the month of the year, the day of the week and even the hour in the day. The two most important of such anomalies are the January Effect and the weekend effect. Thaler (1987) also observed that the return on stock in the month of January is almost always much higher than any other month of the year. French (1980) found that return on Mondays are consistently less than that of the rest of the week. Other Calendar effects include: intra-day, intra-month, quarterly, daylight savings, Halloween, holidays and more. These calendar effects are of course inconsistent with the EMH.

3.1.4 Defending Efficient Market Hypothesis:

Due to overwhelming attacks on the EMH many proponents of the theory stepped up in order to defend the theory against critics. Malkiel (2003), who is known for making the EMH popular among the general population with his book *A Random Walk Down Wall Street*, was one of the primary defenders of the EMH.

Against technical analysis, Malkiel argued that active managers who have spent time and money are not able to beat the market consistently. He used this to argue against the bandwagon effect as well, saying that investors may follow the trend to an extent but such trend is not sufficient to provide consistent and persistent returns which he said was due to the increased transaction costs associated with momentum trading. Instead he said that the best investment strategy is one which involves buying and holding for long term. According to Malkiel stocks may be overvalued or undervalued in the short-term but would readjust to normal price over the long-term due to a reversal in the value. He argued that the reason stocks may appear overvalued or undervalued, is not due to mis-pricing or irrational behavior of investors, but rather due to the fact that it reflects macroeconomic trends over long term, such as interest rates which has a tendency to revert towards the mean in the long-run. Malkiel also rejected the notion of season patterns associated with the stock pricing. He argued that once a pattern is discovered, it will be exploited by arbiters and thus the trend will disappear.

As for fundamental analysis such as initial dividend returns, PE ratio, value stocks and more, Malkiel assumes that these are due to different ways of computing risk. He explains for example that using PE as a metric for analysis does not work. Let us recall that when a company has a low PE ratio with respect to its competitors, it is considered to be undervalued in the short term and thus investors should expect the price of the stock to rise. Therefore, Malkiel effectively claimed that the results obtained by researchers, such as Basu (1977) which showed PE ratios as being a good indicator of stock price movement, had biased company selection. Malkiel explains that when tests for effectiveness of PE is done, only the known successful companies are used in the sample which leads to the false interpretation that firms with low PE increase in value. Instead, Malkiel argued that the return associated with the investment that is used in those analysis was actually due to risk premiums. He explains that the companies with low P/E ratios also have higher risks initially thus it is expected that they will give higher return.

Also, to the critics who point out crashes and bubbles, Malkiel responded that these are all exceptions rather than the norm. Although the market prices might deviate from fundamental values in the short-run, it reverts back to normal in the long run. Also, government policies and macroeconomic shocks affect stock prices as outside variables. He gives an example of 1987, which was initiated by an increase in interest rate on bonds. Such shocks are the new information that get reflected in stock prices.

Malkiel's arguments does present an interesting side to the discussion and provides background as to why individuals, even after such great evidence against the EMH still continue to support it. We don't, however, consider his arguments defending the EMH to be very strong based on the critiques already presented on the EMH. In the next section we will discuss behavioral finance and discuss the failures of the EMH in order to move towards a more reliable model.

3.2 Behavioral Finance

Even though EMH is the more mainstream viewpoint on how the market operates it is not the only viewpoint. EMH was at the peak of its dominance during the 1970s. During this period EMH was considered to be proven beyond doubt in the academic community. However, as economists started taking ideas from psychology and sociology in the 1990s, investor psychology became a key variable in determining the individual preference structure in financial research: this study is known as behavioral finance. Literature and studies in behavioral finance done by Daniel Kahneman, Amos Tversky, Richard Thaler, Nassim Taleb, Robert J. Shiller, Andrew Lo and Paul Slavic has shown that market participants are not always rational individuals and markets are not as efficient as was once thought. Literatures on behavioral finance show that EMH does not account for cognitive biases such as overconfidence, overreaction, representative bias, and information bias.

We saw that EMH was based on the idea that investors and market participants are rational beings. By showing that not all market participants are rational beings, behavioral finance argues against the EMH. Essentially behavioral finance argues that there are both rational and irrational market participants. It is true that some believers of the EMH will argue that of course there are irrational individuals; however, the actions of the irrational are outweighed by the actions of the rational. Behavioral finance goes even further and argues that not only are rational investors not able to properly counteract the actions of the irrational, sometimes irrational investors force rational investors to also behave irrationally.

To explain that market participants are not always rational, Barberis and Thaler (2003) described that for an investor to be rational when presented with new information, they must be able to update their beliefs correctly in accordance with Bayes Theorem and they must also be able to make choices that are normatively accepted such that they are consistent with the Subjective Expected Utility (SEU).

- **Bayes Theorem**

  Bayes Theorem states that

$$P(AB) = (P(BA)P(A))/(P(B))$$

- **Subjective Expected Utility**

  The subjective expected utility is a theory derived by Savage (1954). SEU is essentially a theory of decision making under uncertainty. Based on this principal, the investor making the decision should choose the decision that allows them to maximize their return.

Barberis and Thaler (2003) discuss how market participants constantly behave in a manner which is not in accordance with Bayes Theorem and is inconsistent with the Subjective Expected Utility. To understand how this is the case, that is, how individuals are irrational and how markets are biased, we need to look at a few key points associated with behavioral finance: limits to arbitrage and investor psychology (Shleifer and Summers, 1990). Shiller (2002) adds to this and discusses the importance of behavioral finance in defining the feedback model.

3.2.1 Limits to Arbitrage

We saw that EMH makes the argument that one way in which prices are always a perfect representation of all current information is that if irrational, or investors with less information, invest in a certain manner and cause the value of the share to increase or decrease, then rational investors will quickly come into the market and exploit the arbitrage situation and in doing so return the price of share to its true value. However, Shiller (2002) argues that theory does not necessarily tell us that rational or smart investment is able to counterbalance the effects of irrational or ordinary investors. The addition of behavioral finance to finance theory provided greater color into how the two groups of investors behave. Barberis and Thaler (2003) add by arguing that even when assets are overvalued or undervalued investments made by rational investors designed to correct the mispricing can be both risky, due to fundamental risk, and noise trader risk, and costly due to implemental costs. That means the return on the investment that pushes the security to its true value might not be high enough to make that investment strategy an appealing one to rational investors.

- **Fundamental Risk:**

  Fundamental risk is associated with the possible change in price of a stock due to a change in news regarding some fundamentals associated with the stock. However, this risk is assumed in any purchase normally and is usually hedged off by using a suitable substitute so it is not of major concern in this given argument.

- **Noise Trader Risk:**

  Noise trader risk is a risk of key importance in the argument presented by Barberis and Thaler (2003). This is essentially the risk that mispricing in a certain direction can lead to even further mispricing in that direction. That is, say a stock is undervalued because a certain group of investors became pessimistic about it. This would generally be an ideal point for arbiters to step in and make a profit on the price correction. However, there is a possibility that the pessimistic behavior will continue due to the fact that the price of the stock just dropped recently leading to even more people becoming pessimistic about the stock. It can be argued that even if that is the case the price of the stock will return to its true value in the long run so arbiters holding it will still benefit in the long run. This may be true if the entire investment is made using own funds. However, in reality since most investors invest on margin, in such a situation a decrease in the price of the stock may force a margin call which will force the arbiter to liquidate his or her positions in the stock.

- **Implementation Costs:**

  For rational investors to properly arbitrage the mispricing of a stock we require the investor to be able to buy the stock or borrow it for short sell. According to Barberis and Thaler, short-selling has two additional costs associated with it. The first such cost is the cost of stock loan which according to D'Avolio (2002) is 1% per annum for about 91% of the stocks and the mean rate for the remainder is about 4.3%. The second cost is primarily for smaller companies. While larger companies may have sufficient people willing to short them, that is not the case for smaller companies. This makes it harder for arbiters to loan stocks at a reasonable price.

It is not only the theory behind the limits to arbitrage that are apparent but also the evidence. Barberis and Thaler provide examples of two such cases in the form of the twin shares problem and the index inclusion problem. (De Long, Shleifer, Summers and Waldman, 1990). The twin share problem explains that sometimes two or more stocks are expected to move in a certain ratio of one another. For example, Royal Dutch and Shell who share net cash flows at 3:2 ratios should have their stock prices move at that relative ratio as well if the price is supposed to represent value. However, Barberis and Thaler find that is almost never the case. Again investors trying to exploit that difference in value are not able to do so since the difference does not always decrease. Instead its actually seen to increase a lot of times, which means that investors would have to hold out on a losing portfolio for a while before seeing positive returns.

They also discuss the change in price associated with the addition or removal of a stock from the market indices such as S&P 500 or Dow Jones Industrial average. Harris and Gurel (1986) show how inclusion of stock into an index raises its market value by 3.5% on average. This obviously contradicts basic tenants of EMH since stocks are not included in indicies based on their risk analysis. Indices add stock based on their specific need to explain the overall market. That is if internet companies now have greater percentage of market capitalization, the fund will add an internet company. Therefore, it says absolutely nothing about the value of the company so such a price increase could be considered irrational. Again this form of deviation from fundamental holds limits to arbitrage since investors expecting a return to value will have to hold out against noise traders, possibly indefinitely.

3.2.2 Investor Psychology

Barberis and Thaler explain that cognitive biases arise when people form beliefs and preferences. We will see that these preferences, unlike what was explained in the EMH are not such that market participants are able to choose among alternative stocks in accordance with some form of well-defined preference structure.

- **Status Quo**

  For any investor there are three possible decisions they can make: buy, sell or hold. In this case we are referring to holding as doing nothing or keeping a Status Quo. It is not necessary that buying and selling is always a good investment decision, sometimes the highest return is one which involves no change. However, behavioral finance reveals that investors disproportionately stick with Status Quo even when presented with investment opportunities with higher expected return (Samuelson and Zackhauser, 1988).

- **Framing Effect**

  According to Gonzalez, Dana, Koshino and Just (2004), sometimes individuals set their risk tolerance based on the how the risk is framed. They argue that when presented with a decision in the form of gain versus a decision in the form of losses, the conclusion is often contradictory and can be considered irrational. As an example Tversky and Kahneman (1981) discuss the example of an Asian disease problem and show that individuals are more risk averse in gains (positive framing) and more risk seeking in losses (negative framing).

- **Anchoring**

  Tversky and Kahneman (1981) explain that individuals when making decisions based on uncertainty they often do so with a preconceived estimate. That is when an investor begins to decide whether or not to invest in a specific stock they will start off first with a preconceived idea of how much to value the stock and from there any new discovery will add or subtract from that value. The argument here is that the preconceived estimate will hold a large percentage of the assumed value of the asset and holding to this is what is known as anchoring.

- **Hindsight**

  When presented with the good results or high returns on a given situation investors tend to attribute a greater deal of success to their past decision making skills than expected; this is known as hindsight bias. According to Biais and Weber (2008), by having hindsight bias, investors no longer learn from their mistakes and soon forget how much they actually didnt know when making the decision they did in the past. They explain that rational investors when experiencing an unexpected gain (or loss) would increase their volatility estimate for future investments. However, investors exposed with hindsight bias are not able to properly attribute the gain to mere luck and instead attribute it to their success investment strategy and in doing so underestimate the market volatility and risk. Seppala (2009) finds that investment managers in general are less exposed to hindsight bias than others and are hence able to make better judgements.

- **Overconfidence**

  Barber and Odean (2000) explain that investors are generally overconfident about their own skills and knowledge. They find that overconfident investors generally trade more often than others and in doing so reduce their return overall. According to them, men are generally more overconfident than women, at least when it comes to finance, and they find that men trade 45% more than women. They also find that overtrading reduces men's return on average by 2.65% and 1.72% for women.

- **Herding**

  Herding is the process when investors all tend to invest in a similar manner even if it deviates from the fundamentals. It is done by copying the investments of others primarily because it is thought that others may know something about the investment that they are unaware of. This is not only common behavior for irrational investors but also common among asset managers and traders. Asset managers and traders in order to ensure similar return, tend to have similar holdings. According to Bikhchandani and Sharma (2000) there are two types of herding defined as spurious herding, which will keep markets efficient, and intentional herding, which will not. They mention that the main causes for rational herd behavior include imperfect information, concern for reputation, and compensation structure of managers.

Investors are also prone to other forms of bias such as confirmation bias where individuals also tend to interpret results so as to confirm their own perspective, small group conformity bias where individuals act based on group dynamics due to either pressure or laziness, optimism bias where individuals assess their own risk exposure to be lower than actual, self-serving bias where individuals attribute success to their own ability and failure to external factors, and choice paralysis where the large number of investment opportunities presented to investors actually leads them to make no choice at all.

3.2.3 Feedback Model

According to Shiller (2002) one of the oldest observable driving forces for an increase in price of a stock is the increase in price of the stock also known as the price-to-price feedback theory. The way this works is that an increase in the price of stock leads to increased public attention and also expectations for further price increase which in turn results in a further increase in price. Shiller adds that if this behavior is left unchecked it could very well lead to speculative bubbles. Before behavioral finance no theory could explain this phenomenon. Behavioral finance explains that investors are not always rational and that even rational investors are also faced with limits to arbitrage. So when a stock price is increased investors (both rational and irrational) have an incentive to continue to invest in that manner due to herding and momentum trading. Even when investors know that the value of their investment is much less than the price, they will still continue to trade that stock since they all believe in the 'greater fool theory', whereby they believe that there will always be a greater fool in the market who will buy their stock at a higher price and that they will be able to exit the market right before the stock price reverts back.

3.3 Management in Inefficient Markets

One of the strongest and most widely used arguments against critics of the EMH is that if price change is not random why is it that investment managers do not consistently outperform the market. We will argue that this form of logic is flawed and also some reasons why managers do not consistently beat the market. We also argue that not all managers beat the markets but many using analysis do consistently beat the markets.

- **Logical flaw**

  Managers do not have to always beat the market to prove that the market is biased. Just because markets are inefficient does not mean that they can be always successfully exploited. Mis-pricing and market bias can also fool managers into wrong trades. For example, a manager might think that there is a limit to arbitrage in a certain trade as noise traders will price the stock even higher hence he invests in it; however, this call can simply be wrong in a given case leading to a loss in return or below market return. This does not however, prove that the markets are efficient, just simply proves the incapability of that specific manager.

- **Beating the Market**

  One of the main reasons why managers are not able to beat the market is because of how manager compensations are designed: managers are compensated based on return. In trying to maximize their returns in the short run managers take on investment decision that may not have particularly good future returns. Other than that managers also suffer from reliance on the cognitive bias, and lack of discipline in their strategy.

  Another important aspect to consider is that active managers are not always concerned about beating the market. According to the National Association of Active Managers (2013), active managers are also responsible for maintaining specific client's financial goals and ensuring clients are properly about to account for their level of fear and greed.

- **Benchmark not Passive**

  The performance of the active traders are consistently compared to passive benchmarks in order to access their rate of success. However, benchmarks are not exactly what one might call passive funds, since benchmarks are constantly changing their holdings. Figure 3.3.1 below shows how the consistency of the S&P 500 has changed over the course of the years. The graph shows that on average about 22 of the S&P 500 companies are changed every year and 25 companies being removed from the index in 2015. This shows that benchmarks themselves actively maintain their stock portfolio.

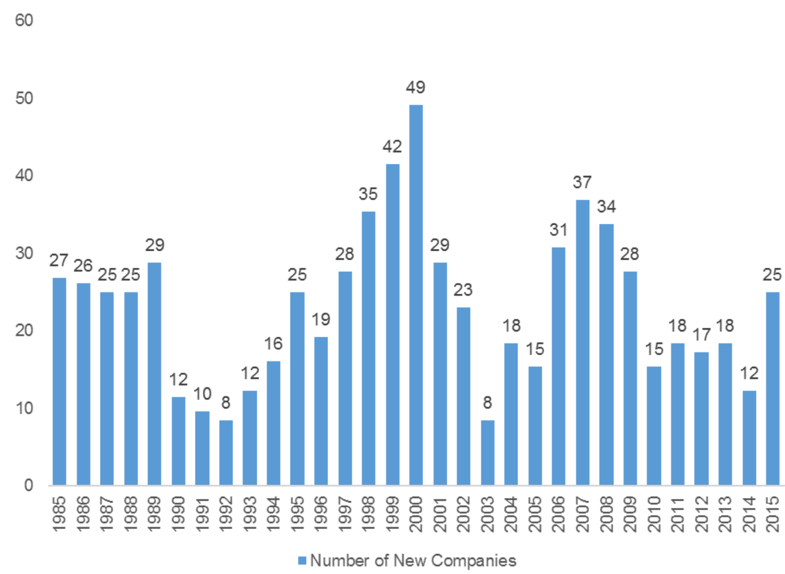


Figure 3.3.1: The number of new companies added to S&P 500 per year from 1985 to 2015

Given that active trading does not have to outperform the market to argue that markets are inefficient, and that benchmarks, which they apparently fail to beat are somewhat of active funds themselves, it is argued whether active trading has its value or not. We do acknowledge that most active managers do not necessarily beat the semi active benchmarks they are compared to. We attribute this to the fact that active managers are exposed to the same forms of biases that regular investors have and that market inefficiency does not mean that the inefficiency is easy to monetize on. However, that being said, Figure 3.3.2 below shows that active managers have consistently beaten the benchmark from 1992-2014 for U.S. small cap stocks and International large cap. Active managers were not able to beat U.S. large cap. So we can see that some active managers also do beat the market and do so consistently.

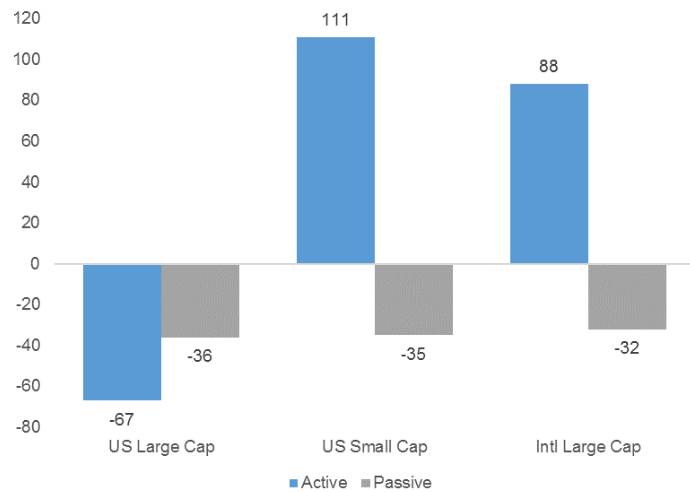


Figure 3.3.2: Average annual equity mutual fund returns for US Large Cap, Small Cap, and International Large Cap divided by Active investors and Passive investors for the years 1992-2014.

3.4 Summary

In this chapter we have seen how EMH assumes rational agents in the market to show that prices in the market always reflect all information available in the market, therefore, making all value investing a waste of time and money. This makes investors gain false hope about their investment decision and also about the market condition. If investors truly believe in efficient markets they will find no value in fundamental analysis and hence invest erratically. And why would they not, if they believe that a monkey randomly selecting stocks can do just as well a job as an active manager. This phenomenon can inherently itself lead to investors making irrational behaviors.

The EMH may be a good theory at getting first nab at the financial market and theoretical models of the EMH do well in explaining an ideal world; however, it fails largely when describing the actual market. In this chapter, we argued that markets do not always perform in an efficient manner as identified by the presence of booms and busts, mean reverting prices, difference between value and price for closed-end funds, relationship between volume and price and calendar effects. We also showed that individual agents are not always rational beings and are instead prone to biases such as status quo, framing effect, anchoring, hindsight, overconfidence, herding and more. In the chapter we also saw that even when the unrealistic assumption regarding rational behavior are made, we still find that rational behavior does not always bring price closer to value due to limits to arbitrage. Instead, rational behavior can actually push prices further away from value.

Thus behavioral finance allows us to paint a better picture around market operations and how the market participants interact with one another to value prices of assets. Since we understand that markets are not always efficient and are largely biased, investment strategy based on CAPM will produce poor analysis on actual returns. In this case risk according to betas will no longer be the only factor determining returns. This also provides us with enough ground work to validate the need for fundamental analysis to value assets and that fundamental analysis can be used to increase returns. However, behavioral ground work as laid out still only complements EMH which is grounded on largely inaccurate assumptions about the market. In the next two chapters we will discuss an alternate methodology for understanding the market using ideas presented by Minsky that will implement more realistic assumptions about the market.

4

Mainstream Investment Theory

To understand the price movement of the stock market it is important to understand the facts that affect investment. This is because an increase in investment is related to an increase in the value of the stock market. There are different theories of investment that explain market movements in the short and long term. In his Financial Instability Hypothesis, Minsky (1984) explains that profits are a function of investment, regardless of the type of economy. To understand investment theory we need to look at what macroeconomics tells us about investment first and how it is related to finance. Conventional macroeconomics has no link to finance. In the neoclassical investment theory money supply is exogenous and set by the central bank, which is treated as being part of the government and outside the real market. The only real link between the two disciples, macroeconomics and finance, is that as central bank changes supply of money it is able to affect the interest rate as well, but this is not enough.

Finance, as traditionally thought, also has no link to economics. We have seen that Efficient Market Hypothesis is at the core of traditional finance and we have already seen how the Efficient Market Hypothesis is set on non-realistic assumptions which do not apply to the real market. In mainstream finance, a firm's value is set by the Net Present Value of expected cash flow from investments and is independent of its capital structure (Modigliani and Miller, 1958). That is, the concept of how the investment is financed is ignored and considered to have no impact on the value of the firm. Firms which are financed 100% by debt and 100% by equity are both considered the same. Modigliani and Miller were able to forgo the importance of finance by claiming that the sole purpose of a firm is to maximize their market valuation at any given point in time.

The different conventional theories of investment stem from the different views of market regulation. One of the points where these views contradict is where the idea of an ergodic economic environment is concerned. The Neoclassical economists believed that future of market movement can be predicted with certainty using mathematical tools that have specific assumptions built into them. Keynes argued that the future is unpredictable and that there are fundamental incalculable probabilities and uncertainty that are impossible to account for. Finally, the Neo-Keynesian economists - who are essentially those economists who attempt to synthesize Neoclassical and Keynesian economics, which is the foundation of mainstream economics today - reject Keynes' idea of an unpredictable future and say instead that the uncertainty can be calculated through the simple addition of a risk premium to the rate of return of a risk-free asset.

The Neo-Keynesian school of thought includes economists such as John Hicks, Paul Samuelson, and Eugene Fama. Samuelson and Fama are also developers of the Efficient Market Hypothesis. Their perspective on future expectations shapes this model and from it comes the investment theories that Neoclassicals and Neo-Keynesians use.

4.1 False Assumptions of Neoclassical Perspective

According to Gordon, the Neoclassical Theory of Finance and Investment (NTFI)was a response to Keynes' General Theory which made the concept of uncertainty a cornerstone of investment theory. Prior to this existed the Neoclassical Theory of Investment (NTI) which stated that firms optimized returns and hence was carried out by a firm by equating its marginal rate of return to the cost of capital. Gordon argues that "there is a clear micro foundation for this assumption under the further assumption that the future is known with certainty, in which case the cost of capital is the interest rate" (1994, p. 12).

However, the main alterations made by NTFI through incorporating uncertainty is that now the cost of capital has two components; the risk free interest rate and the risk premium. The problems of assumptions associated with the original NTI model still persists. Gordon lists the assumptions made by the NTFI as follows:

1. Individuals hold securities only, while corporations hold all real assets of the system
2. At any time, corporations maximize the current market value of their shares without regard for the subsequent probability of bankruptcy
3. A corporation's market value is independent of its capital structure
4. A corporation's market value is independent of its dividend policy

5. A corporation's investment opportunity is independent of its history. (1994, p. 12-13)

Now it may seem fairly obvious that most of these assumptions are wildly incorrect. Gordon actually briefly outlines the arguments behind why each of these assumptions do not hold in chapter 2 and then goes in and explains his arguments more rigidly in the remained of his book *Finance, Investment, and Macroeconomics.* The first assumption is there in order to account for the absence of an absolute certain future and perfectly competitive capital markets. If the economy had a predictable future, it would be a case in which corporations need not exist. However this assumption does not hold because "real persons still own and invest in real risky assets in significant amounts," (Gordon, 1994, p. 14) it is not just corporations. The second assumption does not hold because bankruptcy is costly, and the probability of it increases through high debt ratios and dividend payout rates required to raise share prices today. The self-interest of management actively avoiding bankruptcy defies the assumption of a firm the will to maximize value.

In regards to the third assumption, Gordon explains that if Modigliani and Miller's (1961) theorem was right about the capital structure of a firm not being a factor in determining its stock price, then we would only see firms, in order to 'maximize value', take on a capital structure based solely on debt. In Modigliani and Miller's model this would maximize value since taking debt provides tax breaks for corporations. However, no evidence was of course found to justify that firms behave in such a manner. Masulis (1988) finds at 5% level of significance, there is a strong positive correlation between leverage rate and stock price and hence capital structure does matter. However, there is a maximum level of debt a firm can take. The third assumption is invalidated through the fact that a corporation's market value does in fact increase with leverage.

Gordon explains that the neoclassical theory on dividend policy is very different from practice. Unlike theory where firms can maximize value by choosing between retained earnings and dividends, in practice firms need to choose between earnings and dividends depending on their returns and market volatility. Gordon argues that corporation will not pay dividends when returns are low and/or leverage is too high, corporations also do not pay dividends when volatility in the market is too high. Gordon explains that the last assumption, which explains that firm's investment opportunities is irrespective of history, is so questionable that even neoclassical financial economists do not recognize it.

4.2 False Incorporation of Keynes

Gordon was able to address a lot of problems with the neoclassical model assumptions itself. However, he failed to see how the Neo-Keynesians incorporated Keynes into their model with additional incorrect assumptions. Crotty (1993) makes further criticisms of this mainstream model that still dominates, even though it has these false facts associated with it. Crotty summarizes the faults in three core incorrect assumptions in the model; the objective function of the enterprise, the difference between Neoclassical risk and Keynesian uncertainty, and physical capital as a liquid asset.

In the first assumption, Crotty makes clear the distinction between managers and owners of a company and the fact that they have different goals, which is why this assumption is not valid. Neoclassicals think that market value maximization is a standard objective for firms, however for managers, dividends and such are “a cost of maintaining managerial decision-making autonomy, a constraint rather than an objective to be maximized,” (Crotty 1993 p2). Keynes on the other hand, recognizes the two different agents and their different agendas; owners wanting capital gains in the short run and managers wanting growth and sustenance of the firm in the long run.

The second assumption mentions the incorrect incorporation of Keynes in the Neo-Keynesian model in terms of risk. As mentioned earlier, Keynes’ interpretation of future expectations is the fact that it is incalculable. The incorrect assumption that is used in the mainstream model is that “agents can assign numerical probabilities to all possible future economic states and, therefore, can associate probability distribution of expected returns with every possible choice available to them,” (Crotty 1993 p3). He supports Keynes view that this is not true and supports the alternate solution that Keynes provides to future expectations that is related to a “process based on custom, habit, tradition, rules of thumb, instinct, and other socially constituted practices” (Crotty 1993 p3).

Finally, the third assumption is regarding the idea that capital assets are reversible investments, Tobin’s q. Neoclassicals believe that a “well-coordinated and efficient system of markets assume that long-lived capital assets have perfect or near perfect resale markets,” (Crotty 1993 p4) which is simply incorrect. By having near perfect resale market, Neoclassical theory of investment assumes that all investments are reversible and so these models have no account for liquidity. This assumption not only falsely diminishes, or hides, a lot of risk that the firm takes on, but also promotes management behavior that can lead to bankruptcy due to a false sense of insurance.

In the world of uncertainty, Keynes envisioned a disequilibrium model for the economy. Minsky explains that “Keynesian economics differs from neoclassical economics in that it integrates into a model of system behavior the uncertainty inherent in a decentralized capitalist economy...[therefore] the significance of the idea of equilibrium, is diminished” (1975, p65-66). When the Neoclassicals adopted Keynes’ ideas into their model they did so in such a way that it only applies to the short run. They agreed that markets may be in dis-equilibrium in the short run because of short run shocks, but in the long run markets will correct themselves.

4.3 IS-LM Model

To incorporate Keynes’ idea into their investment model Neoclassical economist, John Hicks, derived an equilibrium model from investment using the IS-LM model. This was built using a downward sloping IS curve and an upward sloping LM curve. In this model the investment savings function (IS) and the liquidity preference-money supply market (LM) intersect at a point where both markets are simultaneously in equilibrium. The intersection of the two curves, for any level of money supply, gives Neo-Keynesians the interest rate.

Hick’s work on the IS-LM model is considered by mainstream economists as one of the best interpretations of Keynes. However, the IS-LM is not really a model of Keynes this as much has been acknowledged by even Hicks (1981) but most Neo-Keynesians still continued to use this as the primary model. The IS-LM model analysis does not account for time and omits debt as a factor which were both of primal concern for Keynes and Minsky. We have already discussed in the previous section how debt cannot be excluded from a model that determines the economy. Excluding debt becomes even harder now that we have understood the reasons behind the global financial crisis of 2007. Also investment is dependent on a time horizon and so ignoring this to make investment a contemporaneous event is an unrealistic assumption.

The IS model essentially takes Keynes' very comprehensive investment model and turns it into a function of just interest rate, with no specification to what this rate actually is (Minsky, 1975). Minsky explains that Keynes envisioned an investment model that is linked to the financial markets. The LM curve determines a market using a fixed exogenous money supply and a variable money demand function where money demand is a function of interest rate (negative) and income (positive). Exogenous money supply is the theory which describes money supply as a constant set by the central bank and then multiplied in the banking system using the money multiplier, which is simply the inverse of the reserve requirement in banks. A theory based on exogenous money supply fails to understand both the relevance of money in an economy with debt and also the impact financial institutions have on the economy.

4.4 CAPM

Before we move forward with our discussion on Neoclassical and Neo-Keynesian models for investments, we take a step back and look at the Capital Asset Pricing Model (CAPM) derived from both the EMH and the Neoclassical investment theory. CAPM is a method used by investors to determine the return associated with a risky asset. The model fundamentally describes a methodology for reducing diversifiable risk[1]The

[1]Diversifiable risk are the kinds of risk associated with an asset that can be reduced by combining diverse assets in a portfolio. These risks are generally considered non-systemic risks.

general model was introduced by William Sharpe (1964) and is given by the following equation:

$$r_a = r_f + \beta_a(r_m r_f)$$

Where r_a is the expected required return on the asset, r_f is the risk free rate, β_a is the β [2] of the asset, and r_m is the expected market return.

Once we understand that market biases exist it becomes apparent that investments made using a CAPM model would be inherently sub-optimal. Here we will discuss further why CAPM and financial model that does not incorporate debt structure is an inconsistent model.

One of the interesting aspects of the CAPM model is that it is based on an equilibrium structure for markets; however, drawing this conclusion required lots of assumptions to be made. Fernandez (2014) explains CAPM to be an 'absurd' model as its assumption, just as the efficient market hypothesis on which it is based, are unrealistic and only applicable in an ideal world. By basing itself on the efficient markets hypothesis CAPM draws the following unrealistic assumption based on Sharpe:

> First we assume a common pure rate of interest, with all investors able to borrow or lend funds on equal terms. Second, we assume homogeneity of investor expectations: investors are assumed to agree on the prospects of various investments- the expected values, standard deviations, and correlation coefficients. (1964, pg 433)

By looking at the assumptions that the CAPM model is based under, its inconsistency becomes quite clear. The model is based on aggregating individual investors where individual investors are all identical in their preference. Whereas in real life investors

[2] beta is a measure of the systemic risk associated with a given asset or a portfolio of asset relative to the market

have more heterogeneous expectation where investors are not only concerned about expected returns but also about individual booms and busts in the market.

Fernandez (2014) explains that the assumptions used in the CAPM are based on microeconomic concepts which economists assume to be made out of aggregation theorem whereas in reality the theorems in microeconomics are non-aggregation theorems. Therefore, these theorems cannot be used in the context of financial market pricing theory.

Initial research conducted on the CAPM tended to find suitable results, that is CAPM was able to fit real world projections better. Fama and MacBeth (1973) found empirical evidence to support the CAPM when they analyzed the market from 1926-1968. However later with more research, testing, and the greater availability of data CAPM's validity was placed into question. In 2004, Fama and French, in their paper *The Capital Asset Pricing Model: Theory and Evidence*, find that based on further analysis the empirical results indicate that the CAPM does not indeed provide reasonable results. They acknowledge that the primary reason behind the weakness of model is associated with its "simplifying assumptions" and hence they "invalidate the way it [CAPM] is used in applications"(Fama 2004, p25). Fernandenez and Bilan (2013) also found that market analysts have made considerable errors when working with the CAPM by either calculating wrong betas or market risk.

We have seen that CAPM is a model based on EMH and Neoclassical Macroeconomics, which designed it in such a way that the interaction between the two discipline remains at a minimum. The appeal of CAPM was that it would lead to a equilibrium based optimal results with idealistic simple assumption. However, we have seen that these assumption are in reality too idealistic and often very incorrect. Also, the

CAPM doesn't lead to accurate representation of the real data either. This means that investors investing using a CAPM model are gaining sub-optimal returns. Therefore we have established the need for a realistic model that allows for macroeconomics factors to affect the financial market decisions. This is exactly what we intend to do in the next chapter.

4.5 Endogenous Money Supply

When we want to understand the relationship between macroeconomics and finance we must also consider the relationship and importance of money in the economy. We saw that traditional Neo-Keynesian theory places money supply as an exogenous variable that is determined and set by the central back. This view of money takes away from the importance of money and reduces it to a simple tool for transaction where money is neutral[3] in the long run and with possible deviation in the short run due to adjustment period for price levels. To understand why money supply is not really how it is described we can look at the theory behind money supply.

Money supply is measured in M0, M1, M2, and M3. Where M0 is the monetary base or narrow money which includes any liquid or cash assets held within a central bank and physical currency in circulation. Each level of money supply contains the preceding. According to exogenous money supply the central bank controls the supply of M0 and in doing so effects the levels of M1 then M2 and then M3.

We know that if the money supply is exogenous then the changes in the money supply should have no effect on the real economy, it should only alter prices. Also changes in

[3]The Neutrality of money is a theory which argues that a change in the stock of money only affects variables such as prices, wages, and exchange rate, and have no effect on real GDP, real consumption and employment.

Type of Money Supply	Includes	Additional
M0		Liquid or Cash Assets in Central Bank and in Circulation
M1	M0	Demand Deposits Accounts Negotiable Order of Withdrawl Accounts
M2	M1	Savings Deposits Money Market Mutual Funds other time deposits
M3	M2	Large Time Deposits Institutional Money Market Funds Short Term Repurchase Agreements Other Large Liquid Assets

Figure 4.5.1: Different types of Money Supply and their components

the M0, which is the government controlled portion of the money supply, should be causation of changes in the M1, M2, and M3. That is, an increase in M0 should precede and increase in M1, M2, and M3 and vice versa for when M0 decreases. Kydland and Prescott (1990) find that "there is no evidence that either the monetary base or M1, leads the cycle, although some economists still believe this monetary myth. Both the monetary base and M1 series are generally procyclical, and, if anything, the monetary base lags the cycle slightly." Since the monetary base does not precede the cycle we cannot obviously make an argument that the monetary base can have a causal relationship towards the other forms of money. This would imply that the monetary base M0 is being determined by some factors in the economy making it an Endogenous variable.

Money as an endogenous variable would indicate a few deviations from the mainstream idea of money primarily the neutrality of money. According to this, money is not neutral both in the short and in the long run. Exogenous money also argues that velocity of money is stable whereas endogenous argues that velocity is variable.

Leo (2005) finds that velocity of money is unstable and is subject to shocks. He also finds that the velocity of money moves pro-cyclically. Since results support the argument that velocity is indeed variable and they also support theory of endogenous money supply. By money being endogenous it also interacts with real variables in the economy and has causal relationship that is in the reserve direction to mainstream economic theory associated with exogenous money supply.

Moore (1988) argues that the central bank's role is to primarily accommodate demands for liquidity of commercial banking system in the form of overnight lending. This is because when individuals or institutions use a line of credit to make payments they cause the money stock to rise. At this point central banks have no alternative and must accept those transactions. The only thing they can do is make the line of credit more expensive by altering the interest rate at which banks participate in the open market operations. Moore explains that because of this, "commercial banks are now in a position to supply whatever volume of credit to the economy that their borrowers demand"(1988,p. 1). Which would imply that the supply of money is in a sense related to the demand for money. Moore also explains that large corporations, when using line of credit to pay increased wages causes the money supply to increase which would imply that increase in wage and inflation is what caused growth in money and not the other way around as it is generally understood.

Wray (2007) has a Structural approach to endogenous money, he describes in a slightly different perspectives to Moore approach which is considered as the Horizontal approach to endogenous money. However, Wray agrees with the fundamentals associated with the theory set by Moore. Though, Wray argues that the horizontal approach seems to imply that financial institution are passive entities that supply loans on demand. Instead he explains that they "are profit-seeking firms that innovate to avoid constraints and to take advantage of new opportunities... continually creating new financial instruments to economize on reserves" (2007, p.12). Wray's understanding of the money supply is much more sophisticated than Moore and is founded on a Minskyian approach to money supply. However, for the purpose of this paper the distinction of the two is not necessary to address.

5

Keynes-Minsky and the Financial Market

Minsky was primarily influenced by the work of Fisher, Schumpeter and Keynes. Minsky describes a theory which explains that the market is fundamentally non-equilibrium based. Financial markets are ever changing due to changes in an individual's risk tolerance and expectations and due to constant financial innovations. Fisher explains that "It is as absurd to assume that, for any long period of time, the variables in the economic organization, or any part of them, will "stay put," in perfect equilibrium, as to assume that the Atlantic Ocean can ever be without a wave." (1933, p. 339). Minsky also argued that the economy is fundamentally monetary based, unlike the Neoclassical model which ignores the concept to money. In his Financial Instability Hypothesis, Minsky (1984) explains that a correct economic model is one which includes finance and has cycles and debt at the center of the model.

Schumpeter's (1934) work displayed his understanding of the role credit played in a business cycle. He also rejected Neoclassical view of money, where neutrality of money is not valid in a world with debt. In doing so Schumpeter was able to understand the role of money as more of an endogenous variable. Working under Schumpeter, Minsky was largely influenced by him. As Wray (2015) explains, Minsky's understanding of the banking system was well ahead of his time. And, based on the manuscripts in the Minsky archive it appears that Minsky understand the role of financial intermediaries in creating creating money supply.

Based on Minsky work it is very important to understand that booms, crisis and depressions are part of the general process of a capitalist economy. He also argues that the instability in the market is due to the characteristics in the financial market. And therefore financial crisis needs to be treated as normal events and not abnormal and any model that predicts market movements needs to be able to handle such a downward movement.

Minsky argues for a cyclical norm for the capitalist economy using an alternative interpretation from the Neoclassical synthesis for Keynes. He argues that the Neoclassical synthesis uses static production functions and invariant preference systems which are inconsistent with Keynes and in using Neoclassical methods to interpret Keynes, economists have 'distorted' the true meaning behind his work.

Minsky isn't the only one who criticized the neoclassical synthesis of Keynes and considered the synthesis to be inconsistent. Post-Keynesian economists generally argued against the synthesis, including Davidson (2011) who argued that Keynes' work centered around throwing away three critical axioms of neoclassical economics: axioms of neutral money, axioms of gross substitution, and axioms of an ergodic economic environment.

Minsky explains that in Keynes' view the demand price is determined by prospective future yields, depreciation and liquidity preference and supply price is determined by cost of production today. So in this model, known as the Duel Price Level hypothesis, investment will only occur if the supply price is less than the demand price and the gap between the two is the profit/return earned by the investor. Therefore, accordingly a correct interpretation of Keynes is one in which investment is not regulated by rate of interest but rather by the gap produced by the desire to obtain "those assets of which the normal supply-price is less than the demand price" (Keynes 1953: 228). The larger the gap the greater the scale of production. Keynes, in chapter 12 also explained this concept of the bias of confidence and uncertainty associated with the stock market. He explains that the uncertainty is not calculable unlike what we have seen in the CAPM model. Due to uncertainty investors form fragile expectations about the future which is why we see great volatilities in the financial markets

5.1 Financial Instability Hypothesis

The basic formulation of Minsky's financial instability hypothesis (1984) is that after a period of depression or recession, firms and banks remain conservative about debt to equity ratios and asset valuation. During this period only conservative projects are funded. The economy recovers as conservative projects succeed. It leads to more optimistic outlook about the economy and firms and banks revise risk premiums which leads to increased expected asset valuation and greater acceptable debt to equity ratio. This results in investment in riskier projects, and once those succeed as well risk premiums are altered again. This process continues till another depression or recession is attained. Minsky explains two aspects to this, first that the increase in risky projects in unavoidable, and second this will eventually lead to an economic downturn

The reason it is unavoidable is that this process is unavoidable as expectation of increased return on projects tends to have feed itself. In the sense that as risk aversion decreases it causes increased investment and we know that increased investment causes increased economic growth. This leads to increased asset growth which then leads to a speculative environment of assets. This in turn feeds the process for further investment and further growth in the economy.

To describe why this leads to a downturn, Minsky (1984) describes that as risker projects are accepted the acceptable conditions for financing a project changes. Initially, firm's finance their positions using what Minsky describes as *hedge* finance where the cash flows from the investment is always greater than the cost of financing that investment. As the economic condition becomes better it leads to more *speculative* financing where short term cash flow does not cover the cost of financing but since economic conditions are expected to improve it is expected that future cash flows will be able to cover the costs of financing. As the economy continues to grow and asset prices continue to rise because of the self-fulling prophecy associated with it, firms are now willing to accept projects where the cash flows don't cover the cost of financing even in the long run. In this state which Minsky describes as *Ponzi* finance, firms purchase assets for the sole purpose of reselling and making capital gain. The only way for a firm using Ponzi finance to pay their debt is by taking on additional debt.

Minsky (1984) explains that as the market shifts from hedge finance to higher and higher proportions of speculative and Ponzi finance, it leads to an unstable financial system which eventually leads to crash. This is because since Ponzi financed investments are designed to make losses, they are good as long as they can be sold for more to the 'greater loser', who also know the investment produced net negative cash flow but are still willing to buy it because of the same reason as their previous owner. However, there comes a point where this investment can no longer be sold or eventually fails. Simultaneously as supply and demand for finance increases during this euphoric period, market interest rate rises and causes once conservative investment to now become speculative and speculative now Ponzi. This leads to more firms selling their assets in order to generate positive return on capital gain. As the market gets flooded with assets the price of assets eventually plateaus off or decreases. At this point with the market highly filled with Ponzi financed assets, which generate negative net negative cash flow when we are not accounting for selling price, will start to lose value. Owners of these assets will panic first and cause greater increase in rushed sell order for assets.

At this point the asset prices will fall rapidly, which will suddenly increase the debt/equity ratios. The endogenous expansion of money supply will now move in the opposite direction. Investment will decrease which will lead to reduced economic growth or even negative growth. And the economy will now be in debt-induced recession.

Minsky established this financial instability hypothesis by correctly understanding the relationship between asset prices and the stream of cash flows they represent, to the Neoclassical model, he adds the importance of residual cash flow and debt to this model. By correctly modeling how asset prices are determined, Minsky was able to envision a more accurate investment model for the economy. Using this model Minsky was able to lead to the conclusion he has in his theory. In the remainder of this chapter will look at the theoretical development of his models for asset price and his investment theory.

5.2 Asset Pricing Theory

According to Minsky (1975) when Keynes (1953) discussed investment theory in *The General Theory* he made a few inconsistencies which led to the possibility of the Neoclassical synthesis. Keynes in his book was unable to properly explain the importance of finance to the degree Minsky later explains. Keynes used interest rates as a methodology to explain the concept of portfolios, which Minsky defines as "the set of tangible and financial assets it [the person holding the portfolio] owns, and the financial liabilities on which it owes" (1975, p. 70). Minsky also explains how when explaining relative price of capital and financial assets, Keynes in the *General Theory* reverts back to using an equilibrium-growth perspective which leads to incorrect assimilation by the Neoclassicals

In his alternate interpretation, Minsky (1975) argued for the importance of price of capital assets in a liquidity preference function and how the price of capital assets, along with the terms for loan, determine portfolio. Minsky also argued for a cyclical model to explain the price of capital and financial assets. Minsky explained the need for an analysis of capitalist finance in the context of uncertainty. Minsky derives that capitalist finance affect the valuation of the stock of capital assets and hence can vary the pace of investment.

5.2.1 Capital Assets and Financial Assets

Minsky primarily discusses the price of capital assets and we are primarily concerned about financial assets, specifically common equity. So before going forward we wish to address the similarities and differences between these two asset classes and understand that for the context of pricing equity we can consider the two assets to be equivalent. Both assets determine the net worth of a company and are instrumental in generating future cash flows for both individuals and businesses. Financial assets generally consist of cash, shares and bonds. Capital assets are essentially physical items that are used by a business to generate cash flow. They can range to anything from land and building to precious metal and oil.

The main difference between the two asset classes is the level of liquidity. Capital assets are extremely illiquid compared to financial assets. Cash is the most liquid assets and bonds and stocks can be extremely liquid as well. Even though there is a sharp difference between the level of liquidity between capital assets and common shares, liquidity is still an important consideration to make when investing in a common share. This is because while common shares may be very liquid the level of liquidity does vary among different common stocks and this difference does play a role in the price of the common stock.

Since the valuation of an asset is determined by the cash flow represented by the asset, for the purpose of our exercise the two are quite similar. In his model Minsky also makes the assumption that “all assets- real and financial- are equivalent in that they are expected to generate cash flows” (1984, p209). Not only that, both capital assets and financial assets are exposed to uncertainty when predicting the future cash flows. Furthermore it is important to note that we are specifically dealing with common shares which are the residual claim on the real assets and properties of another business, making common shares even more similar to real assets. Minsky makes the argument that the stock market is a volatile but good approximation for the valuation of the capital assets as collected in corporations. Minsky explains that the "implicit price of capital is a function of the explicit price of common stock modified by... the firm's special market and management traits." (1984, p. 216).

5.2.2 Price, Liquidity, Money Demand

Money can be considered to be the most liquid financial asset and hence when considering a portfolio of assets, for both individuals and companies, it is important to consider the level of money that should be correctly allocated to the portfolio. We will define liquidity as the cost of trading an asset, that is how much of the selling price of the asset has to be sacrificed in order to sell the asset. This can be easily thought of as how easy is it to sell an asset. Because money is highly liquid, holding it accounts for almost zero liquidity risk but the return on holding money is also very low. Stocks differ from money in the sense that they are slightly less liquid and have higher return; stocks also have other risk associated with them. So holding money and stocks in a portfolio allows for the diversification of a portfolio.

Based on Fisher's (1911) quantity theory of money when the money market is in equilibrium, the demand for money can be expressed as $M_dV = PY$ and in the Cambridge form it is written as $M = kPY$, where V is velocity, P is price level, k is the proportion of income demanded in money, and Y is the real final output. Keynes (1953) and Minsky (1975) argues the demand for money held by an individual is based on a liquidity preference function "which fixes the quantity of money which the public will hold when the rate of interest is given" (Keynes, 1953, p. 168). So interest rate is an important factor that should be incorporated into the equation.

To clarify his views on the factors that affect money demand, Keynes (1953) explains that there are three main motives behind holding money: transactions purpose, necessary for buying and selling items, precautionary purpose, necessary for unexpected purchase, and speculative purpose as a store of value in case other forms of assets are expected to produce negative return. Keynes makes a very important modification to the money demand function previously mentioned by including interest rates in it, such that the demand for money and interest rates have an inverse relationship. In doing so Keynes makes the claim that money demand is actually a function of income and interest rate such that

$$M_d = L(Y, r)$$

To understand this, we need to consider the three different reasons for holding money that Keynes mentioned see how they can be affect by each of the variables. When people earn greater income they engage in more transactions. Higher income also allows individuals the option of holding more money as a precaution. Keynes (1953) then argues that the opportunity cost of holding money, be it for transaction, precaution or speculation, is the interest rate since holding money provides no additional return. Hence for all three reasons for holding money Keynes argues that an increase in interest rate decreases the demand for money and an increase in income increases the demand for money.

Minsky (1975) then extends Keynes' definition for the money demand function by explaining that the expected price of capital asset is also a determinant for the speculative demand for money. Such that

$$M_d = L(Y, r, P_K)$$

Where P_K is price level of capital assets. He argues that the inclusion of the price of capital allows the proper explanation for changes in price levels when demand for money or uncertainty changes using a liquidity preference function. A change in the demand for money causes a shift along the liquidity preference function whereas a change in the uncertainty shifts the function itself. By having P_K in the model, these shifts in and off the liquidity preference function causes a correct representation of the sequential change in P_K.

5.2.3 Price and Financing

Minsky (1975) explains that Keynes failed to emphasize the importance of the liability structure when explaining the factors that affect the price of a capital asset. Minsky understood that individuals and firms invest using not only their own money but also borrowed money. The cost of financing this borrowed money plays an important role in the total return associated with the investment.

In the equity market, investors prefer using external financing to increase their total investment. Borrowing allows investors to leverage their positions and amplify their return on investment when the stock return is positive. By using borrowed funds investors are also able to use the interest rate for tax reduction purposes. However, in such high leverage trade investors are also exposed to greater losses when return on investment is in the opposite direction. Investors are also exposed to interest rate risk.

Minsky (1975) argues that the expected return on an asset is determined by the expected cash flow generated from the asset, the quasi-rent q, and the financing cost, c. He explains that in predictable world where all assets have maximum liquidity q-c would be the underlying value of the asset. However, this does not apply for real assets, it doesn't even apply to financial assets. So a measure for liquidity is necessary to model asset value.

To proxy for liquidity, Minsky used the quantity of money supply. He argued that an increase in money supply "decreases the liquidity premium on money". He also adds tha's increase in money supply will continue to have less and less effect on the price of capital assets. That is, there exists a maximum price, Pk^*, such that any additional increase in money supply has no noticeable impact on the price of capital asset. Minsky combines these ideass in his price of capital asset function such that

$$P_K = K(M, q, c^* - c)$$

where

$$\frac{dP_K}{dM}, \frac{dP_K}{dq}, \frac{dP_K}{dc^*} > 0$$

and c^* represents current acceptable debt requirements. Essentially what Minsky is trying to explain is that debt plays its role in the price of an asset in two ways. First by the nature of debt as being a cost of financing cash outflow, c, and second as what firms believe is an acceptable cost of financing outflow, c^*. When the economy is in an upward stride and firms take on additional debt to finance their assets it may at first appear that an increase in the costs of financing will bring price of assets down. But in reality what happens is that during these times of prosperity, c^* is what actually increases. As the difference between c^* and c increases, firms become more satisfied with taking on additional debt to invest which leads to greater increase in the price of the asset.

5.3 Keynes-Minsky Investment Theory

In the last chapter we saw the neoclassical synthesis model of the IS-LM curve, and we discussed in details how it fails to account for reality when presented with endogenous money supply which contradicted against the validity of the LM curve. We had also briefly mentioned how Minsky critiqued the IS curve arguing against the validity of the negatively sloped relationship between the investment and interest rate. In this section we will discuss Keynes' investment theory as interpreted by Minsky, that is the relationship between investment and the relative price of real and financial assets.

Minsky argues that general IS-LM interpretation of investment theory does not account for the real reason assets are bought and sold. Minsky explains that investment in asset takes place for two reason, first in hope for a future stream of regular cash flows associated with the asset and second for a capital gain in the selling of an asset or residual cash flow. The neoclassical model, however, does not account of the latter. Residual cash flow is a very important aspect to consider when trying to understand and model speculative behavior. It is of course no surprise that economists using a model that does not account for speculative behavior did not foresee the financial instability in the market. By ignoring the residual cash flows, the neoclassical synthesis model "attenuated the financial and cyclical traits of Keynesian theory" (Keynes, 1984 p204).

By first formulating a proper model for asset ownership, Minsky then describes a two market interaction model for determining investment on a per unit basis: the pricing of capital stock market and the pace of investment market.

5.3.1 Price of Capital Stock Market

The first market determines the price of capital goods and financial assets in the presence of uncertainty and a complex financial structure. Recall that we have discussed how price of capital asset is determine according to Minsky. It consists of an upward sloping price of assets function with respect to the money supply such that:

$$P_k = f(M_s) \text{ such that } \frac{dP_k}{dM_s} > 0 \text{ and } \frac{d^2P_k}{dM_s^2} < 0$$

One of the key assumptions Minsky (1984) makes in this function is the indifference between different asset classes based on valuation. We have already discussed why this is a valid assumption to make when working with valuation.

Since the neoclassical model excludes the residual cash from an investment and only includes the regular cash flow, the stream of future cash flows is only dependent on the state of the economy, the product and factor markets, and the management of the firm. By excluding residual cash flows and in turn removing speculative valuation, the model does not account for the costs associated with the resale of an asset, primarily the liquidity of the asset.

In Minsky's model liquidity of an asset plays a greater role. When assets are sold in the market the liquidity of the asset determines the cost of selling the asset. Liquidity of an asset determines how much below the actual price of the asset must the asset be priced for it to be sold in the market. This amount differs greatly between assets. Financial assets are much more liquid but even among them the liquidity varies significantly. Large cap stocks of Google for example has an average trading volume of 2.3 million, making it much easier to let go of than small cap stocks such as Boston Beer Co with only 168 thousand average trading volume.

Increasing function

Note that in the model presented above, the function is an increasing function with a decreasing derivative. Which means we can say three things from the model. First, an increase in money supply increases price of an asset. Second, the rate of increase is decreasing. And third, there is a maximum asset price $P_{k_{max}}$ at which any increase in money supply will have no effect on the asset price.

Shift in function

Minsky explains that macroeconomic fundamentals are very important determinants for the price of assets. He explains that successful economy performance will lead to greater price for every unit of money supply. The opposite is true during an economic downturn. Minsky uses this to explain that the liquidity preference function as described by Keynes is able to shift depending on market conditions.

5.3.2 Pace of Investment Market

The second market determines the pace of investment and consists of an upward sloping investment supply price (P_i) function and a downward sloping internal financing (N_c) function.

$$P_I = j(I) \text{ such that } \frac{dP_I}{dI} > 0 \text{ and } \frac{d^2P_I}{dI^2} > 0$$
$$N_C = k(I) \text{ such that } \frac{dN_C}{dI} < 0 \text{ and } \frac{d^2N_C}{dI^2} > 0$$
$$\text{where } N_C - P_I = F$$

where I is the level of investment and F is the surplus or deficit of internal funds per level of investment. Therefore, as investment increases so does F, the amount companies cannot fund through internal reserves. For this purpose, it becomes absolutely essential to include the money and capital market, which will determine the terms for financing the deficit F.

Therefore, money and capital market must be included in the investment model. Prior to the upward sloping function for P_I there is a horizontal portion of the curve which implies a region where an increase in level of investment output does not cause an increase in the price of supply of investment. Minsky explains that the horizontal portion "is at the minimum point of an average cost curve for each producing unit. This average cost curve contains variable and user costs" (1984, p217). This Keynesian user cost is the opportunity cost for the specific investment, that is the cash flow foregone.

The investment supply function has two shift parameters: wages and user cost. Changes in wages generally cause a shift in the supply function in the direction of the change; however, depending on how the change affects the user cost, the change in investment supply function associated with the change in wage rate may be smaller, larger, or have no effect.

A decrease in user cost causes the investment supply curve to shift downwards and verse versa for an increase in user cost. User cost is dependent on the interest rate, since an increase in the interest rate causes the user costs to decrease and vice versa for a decrease in interest rate.

5.4 Investment Preference

Crotty (1993) explains how the more realistic assumption made by Keynes and Minsky can be summarized into a firm's investment preference function which is dependent on two factors such that:

$$I = P(g, s)$$

where I is the investment preference, g is the growth objective, and s is the safety objective such that there exists a growth and safety trade off. Profits are a huge part of why a firm exists in the first place, that much Neoclassicals were right about. However, profit maximization is not its sole purpose. Firm are also concerned about the safety of the firm, from long run bankruptcies and from takeover. A firm cannot solely care about profit maximization, since "growth is attainable only through capital accumulation, but capital accumulation must be financed" (Crotty, 1993 p7). We saw that as a firm's pace of investment increases their internal capital becomes less sufficient to fulfill the requirements to fund such investments and firms need to borrow to make necessary investments.

When firms take on additional debt, they are essentially committing to pay a stream of future cash flow. Crotty explains that this stream of cash flow is fixed whereas the cash flow from expected profits are not. This means that as the payment commitment increases the risk of a firm not being able to fulfill its commitments from profits increases. This increased risk will lead to lower safety. So when firms operate in the market they do so in order to improve growth but at the same time do so in a manner which meets their safety objective.

The growth-safety preference for a firm can shift depending on the expected profits, interest rates, and uncertainty. An increase in expected profits increases the growth preference for every level of safety. A decrease in interest rate causes the safety of an investment to increase for every level of growth. A increase in uncertainty will decrease growth preference while causing an increase in safety preference.

From Minky's Instability Hypothesis we know that "financial market participants endogenously change their expectations and, therefore, their behavior over the course of a business cycle" (Crotty, 1993 p8). Times of Euphoria leads firms to take on increased leverage. In this model Crotty explains that the safety preference of a firm depends almost entirely on the current expectation of the market and the point of the business cycle we are on. During times of euphoria the safety preference of a firm decreases to the point where historically high debt-equity ratio may seem acceptable whereas during times of crisis even the normal debt-equity ratios will be considered too high. Because of this during times of euphoria investment preference will depend primarily on growth objective (since safety preference will be low) whereas during times of crisis it will depend on the safety objective.

5.5 Keynes-Minsky and Financial Markets

We have already seen that efficient financial markets appear as a rather absurd theory because it is based on unrealistic assumptions that bear little relationship to the real-world financial system. In the last chapter we saw the CAPM model which is largely based on the same unrealistic assumptions of efficient market hypothesis and Neo-Keynesians ideas. Not only this, Crotty (2011) discusses that CAPM is also not a model that is supported by empirical results. So as we move forward, it is no longer something we should base our models on. Behavioral finance played a key role in improving our understanding of the financial markets by explaining key market biases.

We note that behavioral finance does a good job at giving us a really good perspective on individual investors and their biases. It shows us how these biases leads to alter market movements unlike that predicted by EMH. However, Behavioral finance alone is not able to fix our understandings of the market. As introduced behavioral finance simply adds to the gaps left behind in the efficient market hypothesis (Crotty 2011). Behavioral finance allows us to correct for only two main errors associated with EMH model which is that expectations are exogenous and homogeneous. But knowing that markets expectations are endogenous and heterogeneous is not enough, we need a model that also allows us to incorporate macro conditions.

To do so we need a model of financial markets which is based on more accurate fundamental assumptions regarding the market. We have already discussed these ideas throughout this chapter. Both Keynes and Minsky had a better understanding of the market than the neoclassical economists and they also understood the importance of an accurate model.

Therefore we need a model that incorporates the ideas we discussed in behavioral finance and those presented by Minsky's interpretation of Keynes. Incorporating market bias in Keynes' model is not as hard to do as one would think since Keynes seemed to already have had a grasp on the concept. In Chapter 12 of the General Theory he uses a beauty contest example to show that market participants display *mass sentiment* such that don't always decide on their own preference but rather on a group's preference. Keynes was also able to clearly understand market biases.

Minsky as we have discussed was able to explain the real connection between macroeconomics and finance. To him the problem with rational individual's assumption was only one of the problems with the model. Minsky addressed other problems including lending practices and central bank policy; how debt plays a central role in the economy and in the determination of valuation. Minsky accounted for residual value of assets when looking at asset valuation and using this he modeled an investment theory that accounts for speculative behavior, debt, and liquidity.

Crotty uses the ideas presented by Keynes and Minsky to deduce a list of accurate assumptions that need to be made regarding a market:

1. The future is inherently unknowable. The world is characterized by uncertainty rather than calculable risk.

2. Expectations are endogenous and pro-cyclical. They become more optimistic in booms, more pessimistic in downturns, and wildly unstable in panics.

3. The degree of agent risk aversion is endogenous. Agents become less risk-averse in bubble and more risk-averse in downturn.

4. Agents are heterogenous: they have different expectations, different degrees of risk aversion, and different expectations. Agent's heterogeneity is the main reason why there is massive daily and hourly trading on security markets.

5. Financial market decisions affect real-sector outcomes and conversely in an interactive, dynamic and path-dependent process. Future cash flows are changed by agents' financial decisions.

6. There is no stable financial equilibrium, though there are periods of relative stasis. Financial markets centers of gravity are always being altered by endogenous changes in expectations and risk aversion, as well as by the creation and spread of real and financial innovations.

7. The degree of liquidity changes over time. There is excessive liquidity in the boom that pushes security prices to unsustainable levels, but liquidity evaporates in crisis, making the crisis worse.

8. Agents cannot borrow without limit at a risk free interest rate. Credit is cheap and widely available in a bubble, which accelerates the speed of security price appreciation. However, when the bubble ends, credit evaporates and interest rates spike.

9. Defaults (and therefore counter party risk) exists and are important. Defaults are highly counter-cyclical. Fear of default is a major source of downward price pressure in a collapse.

10. Financial institutions strongly affect the performance of financial markets. They are complex agents whose incentives, information sets, objectives and constraints differ from individual agents. (2011 p. 17-18)

We can compare these assumptions to those of CAPM and we notice the stark differences in the model. The major difference stems from Keynes' uncertainty. Which helps explain why individuals have different expectation which they derive based on past experiences. During times of economic prosperity individuals will set higher expectations for the future and become less risk averse, and the opposite is true for economic downturns.

Based on the assumptions built by Crotty using Minsky's model we can see that the financial markets are not efficient. Which means that there is indeed mis-pricing in the market which if calculated correctly can be used to exploit above average returns. However, this mis-pricing is hard to calculate because of the uncertainty in the model.

The uncertainty according to Keynes, is impossible to calculate due to incomplete information regarding the future. Therefore from an investor's perspective there is a stochastic or chaotic element associated with the movement of asset price. However, Keynes also discusses how investors are able to use current and past information to make predictions to a certain degree about the future. Because of this, we consider movements in financial markets to consist of two parts: a deterministic and a stochastic or chaotic part. In our model, which we will build and run in the next two chapters, we work primarily on the deterministic part of the model. We leave the stochastic part outside the scope of this project and we will leave it for future work.

In the future, we intend to use a random dynamical systems model and fractal dimension index to model the stochastic part of the model. Using a fractals model we are able to account for more outliers and extreme events.

6

Model

In the last few chapters we have seen that the stock market is not as efficient as some people would have us believe. We then discussed how rational behavior can cause price of stocks to move further away from value, due to limits to arbitrage, and how behavioral finance shows us that individuals are largely biased, because of which they cannot be considered to be rational beings.

We have also seen the standard Neoclassical and Neo-Keynesian model for investment, their interpretation of Keynes, and how the Neoclassical theory of investment separates itself from finance, where the debt structure of a firm would not affect the valuation of a firm. We also discussed how the neoclassical model is based largely on assumptions which have very little practical application. We then presented a more realistic model based on the work of Minsky, who interpreted Keynes' investment model using a combination of macroeconomics and finance.

In this chapter we will develop our model for analysis. We start by doing an empirical analysis on the efficient market hypothesis to validate that it is not just theory that argues against it but also the data itself. By proving the theory wrong, we lay the ground work for validating the use of our fundamental analysis tools. We will then proceed to discuss Minsky's function for capital asset price from section 5.2.3 and the modification we intend to make to it in order to extend the model to financial assets so that the model is able to use the valuation metrics as an input. We will then explain the variables we placed under consideration. We end the chapter by discussing the financial benchmark we choose to analyze in order to test the valuation metrics.

6.1 Empirical Results on Efficient Markets Hypothesis (EMH)

In chapter 3 we discussed the EMH and argued against its validity. We discussed how the EMH assumes unrealistic market behavior. We then mentioned how behavioral finance helps bridge the gaps laid by the theory. In chapter 5 we further discussed how the theories presented by Keynes and Minsky are better able to portray real market situations and that markets are not as ideal as EMH would have us believe.

Before we more forward into building our model using the assumption laid forward using Minsky's theory, we would like to test the empirical capability of EMH. This is important because one of the key argument that proponents of the EMH makes is that the model may not use realistic assumptions but the model still fits realistic data reasonably well.

Fama (1970), suggested three testing models for weak form efficiency in the market: the expected return model, the Submartingale model, and the random walk model. In the random walk model if markets are efficient, then prices should follow a random walk model and hence the changes in prices (return on stocks) be must be a Gaussian process where every input is a normally distributed random variable with a probability density function:

$$f(x;\mu,\sigma) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-\mu)^2}{2\sigma^2}} \text{ where } x \in \mathbb{R}, \text{and } \mu, \sigma > 0$$

To understand this recall that the efficient market hypothesis argues that price changes are a random phenomenon that follow a random walk, therefore if we have

$$Log(P_t) = \beta_1 Log(P_{t-1}) + \epsilon_t$$

EMH would say that, since, current price provides no additional information about future price, $\beta_1 = 1$. Therefore price at time t will be price at time $t-1$ along with a random shock which is captured by the error term ϵ_t. According to efficient market hypothesis ϵ_t is an independent random variable with $E[\epsilon_t] = 0$ and $E[\epsilon_t, \epsilon_j] =$ for $t \neq j$. Therefore with a large enough sample according to the Central Limit Theorem the error terms should be approximately normally distributed (Mandelbrot, 1963) . Also notice that the error terms can be written as

$$\epsilon_t = Log(P_t) - Log(P_{t-1})$$

$$\simeq \frac{P_t - P_{t-1}}{P_{t-1}}$$

$$= r_t$$

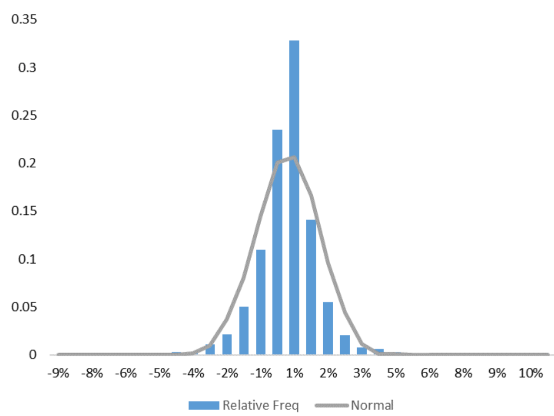
Therefore the error terms are very close approximations of the returns, r_t, (the approximation is especially appropriate for our model since we are using daily data). Since the error terms are normally distributed and the error terms are also the market returns, then it must be that the stock returns are also normally distributed.

So to disprove EMH we will discuss two different approaches. First we will test for the normality of the distribution of returns. We will then proceed to show whether or not there is a relation between returns and their lags. If we find that returns are non-normal and they are related with their lags, then we can safely say that efficient markets hypothesis does not hold.

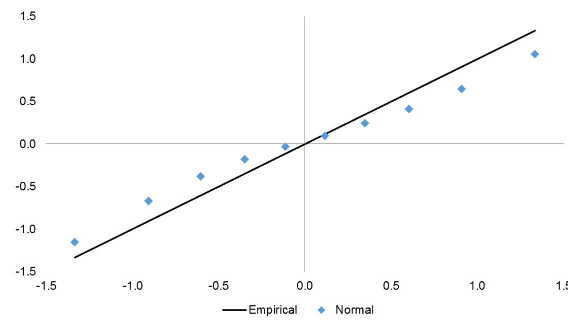
6.1.1 Normality Test

We conduct our analysis using the time range used in this paper; we will be using daily data from 2000 to 2016 with 4072 trading days. Based on this we find that the average daily return is $\mu = 0.0168\%$ with a standard deviation of $\sigma^2 = 1.27\%$. In addition we generate 4072 random number from a normal distribution with mean μ and standard deviation σ^2. We then compared the sample distribution of the returns with the sample normal distribution. The results of the comparison are shown in Figure 6.1.1.

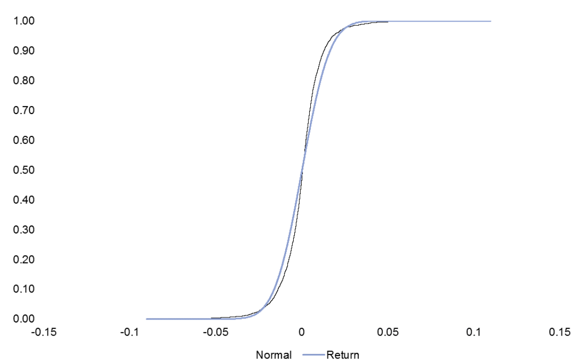
Figure 6.1.1 shows (a) the histogram comparison between the two distributions, (b) the quantile-quantile comparison, and (c) the empirical cumulative distribution function comparison. When comparing the figures, it may at first appear that the two samples may be obtained from the same distribution. However, first thing to notice is the excess peak in the histogram (a). Based on (a) it is hard to tell the differences in the outliers of the two samples. However, the ECDF (c) makes a clear distinction for



(a) Comparison between distribution of stock returns versus the Normal distribution.



(b) The Normal Quantile-Quantile plot for the stock returns.



(c) The Empirical Cumulative Distribution function for the stock returns (blue) and the normal distribution

Figure 6.1.1: Comparison of the sample distribution of daily stock returns, from Jan 2000 to Jan 2016, with a sample normal distribution with the same mean and standard deviation.

the outlier behavior. Notice how in the middle of the ECDF the two graphs behave very similarly. What to notice here is that at both ends of the ECDF, the normal distribution graph (black) ends significantly before the sample distribution of returns (blue). Meaning that the normal distribution largely misses the outliers present in a real financial data. Therefore, there are two major differences between the normal distribution and the real return: outliers and peak. These results are consistent with the findings of Mandelbrot (1963) as well.

In a financial data set, outliers which result in the greater positive and negative returns are not something that can be ignored. With the outliers in place, notice the range presented by the two data samples. The distribution of returns has a range of -9.0% to 10.9% whereas the range for the random normal is only between -4.3% and 4.4%, which indicates that the efficient model misses out on predicting crucial profits and is exposed to large losses. The normal distribution assumption also reduces the number of days assumed to have average returns, it does this by underestimating the peak in the distribution.

However, remember that proponents of the EMH can just shrug this off to random effects. However, notice the number of times the random effects occur. According to efficient model (random normal variables) between 2000 and 2016 the number of times the market should have had absolute returns of 4.5% and above should have been only 5 days, whereas the real data shows that the market had absolute return of 4.5% and above for 59 days. Based on this we can understand that the efficient model underestimates the market returns significantly especially in the outliers. Therefore for an investor relying on the efficient markets model, they will be exposed to large tail risks which could heavily lower their level of return.

For a final part of the test, we run a goodness of fit test between the sample return distribution and the sample normal distribution. The null hypothesis here tests whether the stock returns follow a normal distribution. The results of the Jarque-Bera test, which is a goodness of fit test of whether the return distribution matches the skewness and kurtosis of a normal distribution, is a p-value of 0.00% indicating that we can reject the null hypothesis that the distribution came from a normal distribution. We also run goodness of fit tests using the Chi-square test and the Shapiro-Wilk test. Both of these also yields a p-value of 0.00%. Therefore based on all the tests we conclude that the sample return distribution is not generated from a random normal distribution.

6.1.2 Lag Dependency of Stock Returns

Here we will be working on determining the relationship between current stock return and future stock return. The methodology we are using here incorporates ideas explained by Wooldrige (2013). To disprove efficient market hypothesis we need to show that the stock returns from different times are not related with one another. To do this we will model the equation shown below and show that $\beta_1 \neq 0$.

$$r_t = \beta_0 + \beta_1 r_{t-1} + u_t$$

Since according to the EMH returns, r_t, are supposed to be independent random variables such that $E[r_t|r_{t-1}, rt-2, ...] = E[r_t]$ we can assume that the returns are contemporaneously exogenous where $E[u_t, r_t] = 0$. Also according to Wooldridge in a AR(1) model (similar to the model we are using) as long as there is only one lag in the model based on law of iterative expectation, the errors must be serially uncorrelated.

Also since this is a time series model we can assume without reasonable loss that the homoskedasticity assumption of $Var(r_t|r_{t-1}) = Var(r_t) = \sigma^2 =$ constant holds (Wooldridge, 2013).

Now we use our daily data from 2000 to 2016 with 4072 trading days to compute this model. The results of the analysis is shown below:

$$r_t = 0 - .092r_{t-1}$$

The R^2 for the model is 0.0085. The p-value β_1 is 0.000 which is well below our accepted 5% significance level. Therefore we can reject the null hypothesis that $\beta_1 = 0$.

Not only that, we find that

$$r_t = 0 - .0961r_{t-1} - .0429r_{t-2}$$

where the p-value for the coefficient of r_{t-1} and r_{t-2} are 0.000 and 0.006 respectively, which is well below our accepted 5% significance level again. Therefore we can reject the null hypothesis that $\beta_1 = 0$ and $\beta_2 = 0$. The R^2 for this model is 0.0103.

We can therefore say that the EMH does not hold and also understand that market movements are not completely random. Mis-pricing is prevalent in the market and being able to correctly predict them can yield great returns.

6.2 Development

We found that markets are not completely random as EMH wants us to believe. And we have also seen the the real market has a much higher level of tail risk associated with it. The tail risk in the market arises from the fact that markets are more prone to extreme returns than what a random distribution would predict: both in terms of quantity and magnitude of those returns.

However, even though we showed that markets are not completely random we should understand that there are random elements in the market along with deterministic ones. The random shocks felt by the market are primarily due to uncertainty in the market, due to how the investors in the market interact with one another and due to the general macroeconomic feedback in the financial system.

In our paper, due to constraint in time, we will not be modeling the stochastic aspect of the financial system. We will focus primarily on the deterministic aspect and leave the stochastic aspect for future works.

For the deterministic aspect of the model we will look back at Minsky's definition of the price of a capital asset:

$$P_K = K(M, q, c^* - c)$$

where M is the money supply, q is the quasi rent, c^* is the acceptable cash payment commitments, and c is the payment commitments.

We will use this general model to develop our method for forecasting financial asset, namely a common stock. The reason we can do this is because as we have already discussed in Section 5.2.1, the value of a capital asset is similar to that of a financial asset especially when it comes to valuation since both assets are valued based on their expected future cash flow. Equity is also further similar to the capital assets in the sense that it can be considered a more volatile version of the stock of capital assets held by a firm.

However, recall that the main difference between equity price and the price of the stock of capital asset it represents is the level of liquidity and the price volatility of the assets. Equity stock are significantly more volatile and liquid than their underlying assets. Therefore to fully assimilate this model to equity valuation we will have to modify it slightly based on characteristics associated with equities. In our model we will use the variables explained in Minsky's model and we will also account for volatility in the equity market and the high level of liquidity. We will also have to account for the cyclical dynamics of the financial market.

6.3 Variables

6.3.1 *Quasi Rent*

The quasi rent in the model represented by Minsky is the expected future cash flow for a given asset. For a stock, future cash comes in the form of dividends and capital gain from the sale of the stock. Because of this, the most acceptable model for predicting future price of an asset according to theory are those that involve intrinsic valuations such as the dividend discount model and the discounted cash flow model. The values obtained from these analysis would thus be a perfect fit for quasi rent.

We know that equity analysts in the market also use relative valuation metrics such as Price-Earnings ratio to determine valuation of assets. Since in our paper we are trying to determine the validity of using these forms of valuation as well, we have to interpret Minsky's definition of quasi rent slightly differently to fit our model.

Since relative valuation metrics are used as an approximation for the valuation of a stock it can also be considered that these techniques also hold within them information regarding the future stream of cash flows associated with that stock. Therefore, we can use these valuation metrics, such as Price-Earnings and more, as a suitable proxy for Minsky's quasi rent.

In our methodology we will fix all other variables other than the quasi rent. We will use different proxies for the quasi rent such as Price-Earnings, Price-Book Value, Price-Cash Flow,Price-Sales, Price-Free Cash Flow, Dividend Yield, Earnings Yield, Free Cash Flow/Sales, Free Cash Flow Yield, Net Debt/EBITDA, Net Debt/(EBITDA-Capex), Asset Turnover, Dividend Discount Model, Bond Spread, FCF % Debt, and ROE. We will discuss our methodology in greater details in the next chapter.

6.3.2 Money Supply

Minsky explains that money supply affects the liquidity premium on assets and thus effects the price of an asset. As money supply changes relative to other assets, the demand for other assets increases, which changes how easy it is to trade the asset thus causing an opposite change in the liquidity premium on other assets. Hence an increase in money supply would decrease the liquidity premium in asset, making it possible to sell the assets at a higher price, closer to its actual value.

In our model we will use M2 money supply which contains the monetary base along with demand deposits, savings deposits, and money market mutual funds. The data obtained for M2 from FRED is on a weekly basis provided for each Monday. Since the remainder of our model is on a daily basis we had to modify the variable to obtain daily results.

A simple solution would have been to use daily values for M2 as being constant between weeks. However, since M2 is constantly changing due the to endogenous nature of money supply, we developed an interpolation model to obtain more representative values for the daily money supply. Interpolation is essentially the process of determining a suitable function between two points, using the knowledge that two points are in the function.

Between 2000 and 2016 the money supply M2 has a correlation of 0.988 with time, which means that the variable is reasonably linear in nature with time. However, since it is not completely linear we will add a slight stochastic variable to allow slight variations in the daily M2. Based on this we obtain the following linear model interpolation model for M2 such that:

$$M2_{(w,d,n)} = \begin{cases} M2_{(w,d,n)} + d \times \frac{M2_{(w+1,1,n)} - M2_{(w,1,n)}}{n} + \Omega & \text{if } d \neq 1 \\ M2_{(w,1,n)} & \text{if } d = 1 \end{cases}$$

where w is the week, d is the day in the week with $d = 1$ for Mondays, n is the number of working days in the given week and Ω is a stochastic variable associated with the money supply.

6.3.3 Liquidity Factor

Unlike capital asset, financial assets such as common stock have significantly greater liquidity. So these assets trade more freely than other capital assets. However, the liquidity premium associated with financial assets is still a determinant of the asset price. Individuals are always more willing to pay more for stocks that they can easily sell off during pressure versus stocks that are more likely to pause transaction in a similar situation.

The high level of liquidity in the equity market means that the variation of the money supply alone is not able to capture the level of liquidity associated with the stock. Because of this we will be using a liquidity factor as an additional variable which will be able to capture the effects of smaller changes in liquidity in the market.

To do this we will be using a liquidity factor developed by Amihud (2002) which is expressed as follows:

$$Liq_t = \frac{1}{Days_t} \sum^{Days_t} \frac{|Return_t|}{Turnover_t}$$

where $Turnover_t$ is the total value of the shares traded at time t. However, the problem with this model is that $Turnover$ is generally always increasing while the economy is growing. This means that the variable here will be inherently non-stationary. To account for this we proceed with the method presented by Acharya and Pederson (2005) which effectively normalizes the variable using past market capitalization.

$$LiquidityFactor_t = ln(Liq_t \times MarketCap_t)$$

This normalized liquidity measure should help us account for variation in the liquidity in the market while ensuring that there is no multicollinearity between liquidity and price.

6.3.4 Volatility

The price of all assets change over time. We see this in accounting when we depreciate fixed assets over time to account for wear and tear or obsolescence. The price of assets can also change due to changes in the demand and supply of the asset. For most assets the change in price is usually a slow process. A house bought today isn't really likely to drop 5% in value tomorrow and raise 20% the day after and even if it does, something like this would only occur if something such as a bubble bursts. However, this condition does not apply to stock markets. Since stock value tends to change very rapidly. It is a rapidly fluctuating asset in terms of price. Because of this we say that the stock market is an extremely volatile market in terms of prices.

It is worth noting, however, that the price of stocks may be volatile but the undying assets they represent are not. If we suddenly see a 2% jump in the asset prices today and a 2% drop the day after our conclusion will not be that the company asset value went up by 2% yesterday and then dropped back to 2% today.

The volatility in the stock market is primarily due to noise traders making trades based on sudden fear and greed. It has very little to do with the actual fundamentals of the asset. Since the true value of the company does not account for the volatility associated with the stock market, this excess volatility is missing in Minsky's model for asset pricing when we extend the model to financial assets.

To model volatility in the stock market we will be using the Chicago Board Options Exchange Volatility Index (VIX). VIX is a measure of the market expectation of near-term volatility for the S&P 500. It is a measure of the implied volatility and is not a historical or statistical volatility. This index approximates the level of possible movement for the S&P 500 over the span of one year within the confidence interval of one standard deviation. Generally the volatility output provided by VIX tends to rise during times of stress and decrease in value as the economy recovers.

Generalized formula for VIX:

$$\sigma^2 = \frac{2}{T}\sum_i \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i) - \frac{1}{T}\left[\frac{F}{K_0} - 1\right]^2 \tag{6.3.1[1]}$$

$$VIX_{Annual} = \sigma \times 100$$

To obtain daily volatility from this we have to obtain an approximate for daily based on 252 trading days in a year. Therefore we obtain that:

$$VIX_{daily} = \frac{VIX_{Annual}}{\sqrt{252}} \tag{6.3.2[2]}$$

[1] T is Time to expiration. F is Forward index level desired from index option prices. K_0 is first strike below the forward index level, F. K_i is the strike price of the ith out of the money option; a call if $K_i > K_0$; and a put if $K_i < K_0$; both put and call if $K_i = K_0$. ΔK_i is the interval between strike prices - half the difference between the strike on either side of K_i. R is the Risk-free interest rate to expiration. $Q(K_i)$ is the midpoint of the bid-ask spread for each option with strike K_i. For a more indept understanding of the generalized formula please refer to the White Paper on The COBE Volatility Index - VIX

[2] Another way to consider the function for the daily volatility is

While there is relationship in the market between volatility and liquidity we expect these variables to independently be able to explain different parts associated with the movements of the stock price.

6.3.5 Payment Commitments

The payment commitments, $c^* - c$, associated with an investor is related to the interest rate. This is because investors maximize their returns often by investing using borrowed money. By borrowing money investors are able to leverage their position and increase their return on investment, and of course at the same time they also expose themselves to greater downward risk and their loss on investment will also be increased. Minsky's investment model also explains that as the pace of investment increases, the non-internally financed projects increases. The same applies to financial assets such as stocks, researchers have found that interest rates have had considerable effects on stock price (Fernandez 2015). Studies have shown that as interest rates fall, it leads to an increase in price of stocks and similarly a rise in interest rates causes a decrease in the stock price.

Based on Minskys' investment theory, what we are concerned with is not the rate of interest but rather the amount of interest expense a firm is willing to hold in relation to its ability. To account for this we will be using a ratio of the firm's last twelve month (LTM) pre tax income over the LTM Earnings Before Interest and Tax (EBIT).

$$\text{Interest Burden} = \frac{\text{Pre-tax income}}{\text{EBIT}}$$

Recall that in accounting

$$\text{EBIT} = \text{Revenue} - \text{Operating Expense} + \text{Non Operating Income}.$$

Where operating expense is the costs that a firm incurs due to the on going operations and does not include interest expense. Whereas pre-tax income does include interest expense. So intuitively we have to think of this ratio as pre-tax earnings *after* interest expense over pre-tax earnings *before* interest expense. So the value of this ratio will be 1.00 for a firm with no debt or financial leverage.

Since we have already discussed Minsky's idea of a financial market we know that as the economy and markets improve we expect firms to decrease their safety objective and take on additional debt to fund their projects. This means interest burden will become smaller in an overall bull market or a time of financial prosperity. This increased debt will fuel additional investment which will lead to an increased asset price, and the reverse situation for when markets are doing poorly.

6.4 S&P 500 Index

Our intention with our model is to test the ability of the valuation metrics to predict stock prices. To test this, in this paper, we will be focusing solely on the ability of the valuation metrics to predict the movement of the prices in the stock market as a whole. After this is developed we expect this model to be easily reproducible for smaller sectors and other sub categories in the market including individual stocks. However, for the purpose of this paper we will stick to the overall market. And in order to proxy for the entire market we will be using the S&P 500. In this section we provide background on the S&P 500 and explanation regarding why we assume it to be a good proxy for the market.

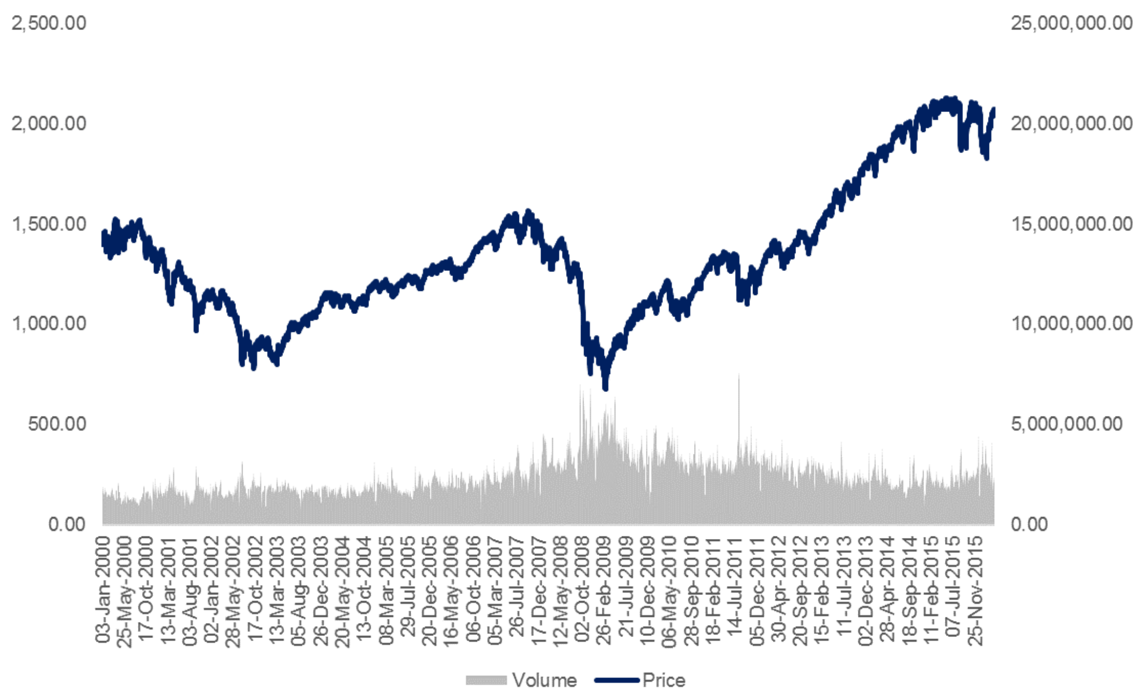


Figure 6.4.1: The price and volume movement of the S&P 500 from 3rd Jan, 2000 to 31st Dec, 2015.

The Standard and Poors 500 (S&P 500) is a U.S. stock market index with 504 constituents from the New York Stock Exchange (NYSE) and the National Association of Securities Dealers Automated Quotations (NASDAQ).

There are other indices such as the Dow Jones Industrial Average (DJIA) or Nasdaq. The DJIA consists top 30 U.S. companies (adjusted for sector) and the total market cap represented by DJIA is approximately only a quarter of the total U.S. market. The weakness of the Nasdaq in properly representing the market arrives due to the fact that the index is very technology heavy. The S&P 500 on the other hand has a market capitalization of about 80% of the U.S. stock market and the index also has a better composition of both growth stocks and value stock. Because of this, the S&P 500 is considered by most as the index that accurately portrays the U.S. stock market.

As of April 2016 the S&P 500 has a market value of $17,837,110 and its constituents can be broken down into 10 different sectors according to the Global Industry Classification Standard (GICS): information technology, financials, healthcare, consumer discretionary, consumer staples, industrials, energy, utilities, materials, and telecommunication services. Out of the 68 industries in the GICS, S&P 500 consists 65; the three missing industries are Marine, Transportation and Infrastructure, and Water Utilities. The breakdown of the sectors by market capitalization for the S&P 500 is shown in Figure 6.4.2 below. Figure 6.4.2 also shows the difference between the market capitalization of the market versus the market capitalization of the of S&P 500: as we can the sector proportion in the S&P 500 is very similar that of the market.

Market capitalization is the sum of the market value of each company assigned to the applicable GICS sector or industry. The market value is calculated by multiplying

Sector	Market Weight	S&P 500 Weight	Difference
Information Technology	20.89%	20.82%	-0.07%
Financials	15.66%	15.56%	-0.10%
Health Care	14.37%	14.53%	0.16%
Consumer Discretionary	12.88%	12.88%	0.00%
Consumer Staples	10.46%	10.52%	0.06%
Industrials	10.08%	10.06%	-0.02%
Energy	6.63%	6.61%	-0.02%
Utilities	3.44%	3.40%	-0.04%
Materials	2.83%	2.82%	-0.01%
Telecommunication Services	2.76%	2.80%	0.04%

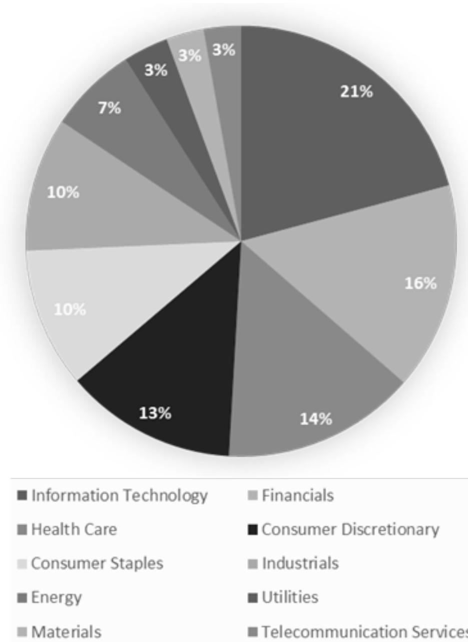


Figure 6.4.2: Sector breakdown in terms of market capitalization for the S&P 500 and its relationship to the actual overall market.

the number of common shares outstanding by the market price per share at the end of each trading day.

There are currently 10 sectors and 68 industries. Three of the 68 industries do not have companies represented in the S&P 500 Index.

The S&P 500 tracks large cap companies that are primarily the most held stocks by investors. In order to be included in the index, the following conditions have to be met:

- the company must be a U.S. company
- market capitalization of the company must be at least $4 billion,
- at least 50% of the company's stocks must be available to the public,
- must have adequate liquidity
- the market price of the stock must be minimum $1 per share,

- the addition of the company must maintain the sector balance
- the firm must have at least four consecutive quarters of positive GAAP earnings.

The S&P 500 is a capitalization-weighted investment and reflects the capitalization of the listed firms. The net market capitalization of all the listed firms in the index are summed up and then divided by an Index Divisor to obtain the Index Value. Due to this method any change in price for a specific stock will only affect the index in a proportion relative to its market value. Essentially, price changes in bigger firms will have a stronger impact, and in smaller firms it will have less impact.

7

Analysis and Results

In the last chapter we discussed that we will be using Minsky's model for asset prices to develop our model. In this chapter we will discuss the methodology we will be using, and the intuition behind it. We will then move to discussing the process of our analysis in detail to provide a systematic approach to how we obtained our results.

7.1 Methodology

The purpose of our model is to determine the relevance of different valuation metrics. We will look at the relevance of the variable as an ex-post forecaster of stock price. The ex-post forecaster model is such that the input observations also include current information. That is we will use information available on Jan 1, 2015 to predict the price on Jan 1, 2015. This may seem at first not a very good model for forecasting but it still serves its purpose and the information it provides will be valuable to analysts. We will explain the importance of this model in greater detail in Section 7.2.

The process of forecasting we will be using is a regression based process. From the regression results we will look at the R^2 results to determine how much of the variations in the change in stock price is described when using each specific valuation metric. For each model we will obtain a set of forecasting capabilities for each valuation metric. We will compare the results from each metric and hence validate or disqualify its usefulness in stock price valuation.

7.2 Intuition Behind Model

The first thought that should come to a readers' mind when reading the methodology is why such a forecasting matters and is this even forecasting. To answer both of these questions we need go back to what our analysis is after: we are trying to determine how the valuation metrics perform relative to one another. To understand how well valuation metrics perform, let us first look at how analysts use valuation metrics.

In the market, analysts use information available to them in time, t, to determine a correct measure for the valuation metric of their choice. Let us consider this as the information set, $I(t)$, which we are considering as all information available at time t. Then using this information set, analysts make an estimate for the future. For example, an analyst working with PE_t ratio will run fundamental and technical analysis on a stock or portfolio to gain an approximate for PE_{t+1}, such that $\hat{PE}_{t+1} = f(PE_t|I(t))$. Then based on their estimated $\hat{PE}_{t+1}$ and what they believe is the relation between PE and the actual market price of stock, P_{t+1}^A at time $t+1$, these analysts will set an estimated price target, P_{t+1}^T for the future. Then we have that

$$P^T_{t+1} = f(\hat{PE}_{t+1}|I(t))$$

In this section what we are really testing is - if we assume that the analysts predict an accurate value for $\hat{PE}_{t+1}$ such that $\hat{PE}_{t+1} = PE_{t+1}$ - how much information about the actual stock price, P^A_{t+1}, is the analyst able to withdraw from that correct estimation of PE_{t+1} and how should he be factoring this information in terms of price. So essentially what we are testing is, given a specific metric, how close of an approximation is P^T_{t+1} of P^A_{t+1}.

To account for this we will be using the actual value available for each metric obtained at time $t + 1$, since this is the most correct approximation an analyst can make regarding the metric. We will then see how using this value enables us to determine the variation in price at time, $t+1$. In the remainder of this chapter we will be working on building a regression analysis to test the relationship discussed.

7.3 Data

For our analysis we will be primarily looking at the S&P 500. Since we believe that the S&P 500 is the best representation of the market in general. In our analysis we have used daily data going from Jan 2, 2002 to April 4, 2016. The data used is for trading days only, so does not include information about after hours trading and only includes information for all weekdays excluding holidays. The valuation data used in the model are all trailing twelve month numbers. The data obtained, where relevant, have all been converted from nominal to real amounts. The data used in the analysis were obtained from the Federal Reserve Economic Data (FRED) and FactSet Research Systems.

7.4 Ordinary Least Square Methodology

In our analysis we will be using a linear ordinary least square (OLS) regression methodology to determine the relationship of our variables to the price of stock. The regression model is done by using a linear function to describe the relationship between the dependent and independent variable in such a way that the squared distance between each point and its corresponding point on the line (the error terms) is minimized.

In our model we choose OLS methodology because according to the Gauss-Markov Theorem, OLS is the best linear unbiased estimator such that it is both a consistent and efficient estimator. It is consistent because as the number of observations is increased the probability of the estimate being equal to the population parameter increases such that with large enough sample that probability reaches 1. It is efficient because among all other linear unbiased estimators the OLS has the smallest variance. It is unbiased because if we have multiple samples from a population the mean of the estimates obtained from each sample will equal the population parameter.

However, there are conditional requirements for the OLS to be unbiased, consistent, and efficient.

1. The expected value of the error term in zero for all observations

$$E(\epsilon) = 0$$

Statistic	Mean	Std. Dev.	Variance	Skewness	Kurtosis	Median	Min	Max	Obs
Price	1,342	339	109,040	.784	2.980	1,281	677	2131	4,072
Liquidity	.742	1.266	1.604	-1.177	5.526	.954	-6.012	4.019	3,574
Money Supply	7,965	2,247	5,046,872	.402	1.994	7,569	4633	12641	4,064
VIX	1.299	.557	.310	2.023	9.685	1.171	0	5.09	4,020
Interest Burden	.829	.127	.016	-2.021	6.638	.874	0.40321	0.98	3,750

Figure 7.5.1: Summary Statistics for the unchanging variables in the model. (All non-quasi rent variables)

2. The error terms are mean independent in terms of the independent variable

$$E(\epsilon|X) = 0$$

3. The variance of the error term is constant for all variables over time

$$Var(\epsilon_t) = E(\epsilon_t^2) = \sigma_\epsilon^2$$

4. The error terms are independently distributed and they are not correlated

$$Cov(\epsilon_i, \epsilon_j) = E(\epsilon_i \epsilon_j) = 0, \text{ where } i \neq j$$

An additional condition that is placed on the OLS to improve statistical inference from the model is that the estimated coefficients must be normally distributed.

7.5 Summary Statistic

In our model we will be using the variables described in Section 6.3 shown in Figure 7.5.1. The valuation variables we will be using as a proxy for the quasi rent are listed in Figure 7.5.2. The two figures contain the summary statistic associated with all the variables used in our tests.

Statistic	Mean	Std. Dev.	Variance	Skewness	Kurtosis	Median	Min	Max	Obs
Earnings Yield	.0536	.0168	.0003	-.4124	2.355	.0569	.0155	.0929	4,072
Earnings Per Share	79.310	23.340	544.762	.173	1.738	78.528	46.467	118.127	4,072
Dividend Yield	1.883	.420	.177	1.563	7.483	1.850	1.100	3.770	4,072
Dividend Payout Ratio	31.196	2.854	8.146	.402	2.617	30.777	25.992	38.113	4,072
Dividend per Share	24.883	7.632	58.249	.795	2.756	23.370	15.532	43.819	4,072
Free Cash Flow (FCF)	623,135	125,049	1.56E+10	-.390	1.769	671,257	402,887	826,482	2,073
Cash Flow from Operations	1,184,254	214,010	4.58E+10	-.209	1.469	1,242,549	787,749	1,472,151	2,073
FCF/Sales	.06446	.00854	.000073	-3.038	21.283	.0675	.0000	.0776	2,086
FCF Yield	5.658	.865	.749	.516	2.739	4.173	5.592	8.399	2,086
FCF per share	79.251	11.931	142.352	-.422	2.054	82.532	56.094	99.736	2,073
EV/EBIT	13.396	2.143	4.593	.435	3.466	13.508	8.723	21.050	3,574
EV/EBITDA	9.696	1.514	2.291	.301	2.979	9.795	6.366	15.396	3,821
EV/Sales	2.140	.292	.085	.871	4.672	2.106	1.487	3.286	4,072
Price-Earnings	17.538	3.907	15.266	1.185	4.334	16.722	9.969	31.449	4,072
Price-Book Value	2.725	.606	.367	.782	4.047	2.767	1.503	4.943	3,873
Price-Cash Flow	11.857	2.646	7.000	.645	3.366	11.665	6.316	19.906	4,072
Price-Free Cash Flow	1.511	.317	.101	.643	4.312	1.495	.746	2.644	4,072
Price-Sales	18.108	2.611	6.818	.051	2.156	17.925	12.276	23.428	2,073
Net Debt/EBITDA	1.193	.233	.054	.363	2.105	1.159	.825	1.755	3,783
Asset Turnover	0.384	0.032	0.001	0.892	3.501	0.384	0.332	0.474	4072
DDM	2.025	0.838	0.702	0.408	1.914	1.811	0.712	3.697	3750
Bond Spread	1.626	0.452	0.204	-0.338	2.844	1.690	0.630	3.000	4064
FCF % Debt	11.969	3.029	9.175	-0.582	2.624	12.914	4.098	17.025	4064
ROE	16.077	1.354	1.833	-0.301	3.477	15.896	12.009	19.798	3865

Figure 7.5.2: Summary Statistics for all the different valuation metrics used in the model- all metrics that will be used as a proxy for quasi-rent

7.6 Pre-regression testing

Since we are working with time series data we need to be cautious about time trends and seasonal adjustments. The other problem we have to deal with is that in time series data, to maintain consistency, we have to ensure strict exogenity across time periods such that the error term, ϵ and all explanatory variable X, we have to have $Corr(\epsilon, X_t) = 0$ for all t in the data range. However, since we are working with large enough sample of 4000+ observations, to have consistency it suffices to show that $Corr(\epsilon_t, X_t) = 0$. Therefore all we have to show is that the explanatory variables are contemporaneously exogenous.

However, to be able to apply laws of large numbers and central limit theory in such a way we need to ensure two additional assumptions are met: variables are stationary, and weakly dependent (Wooldridge, 2003). To show stationarity we have to show that $E[X]$ and $Var(X)$ is constant over time and $Cov(X_t, X_{t+h})$ should not depend on t. To show weak dependence we have to show that $\lim_{h\to\infty} Cov(X_t, X_{t+h}) = 0$. Therefore to ensure consistency in the OLS we have to ensure stationarity, weak dependence, no perfect collinearity and zero conditional mean.

As we move forward to the regression we have to test for trends, stationarity and weak dependence for each of our variables. To test for time trends we will run a regression of each variable, X, with time, and if we obtain a p-value of less than 0.05 for the time coefficient β_1 then we will conclude that the variable has a time trend.

$$X = \beta_0 + \beta_1 \text{Time} + \epsilon$$

To check for stationarity we will check for the autocorrelation in the model. For this we looked at the auto-correlation and partial auto-correlation of each variable. We also ran the Dickey-Fuller test to determine whether or not there was a unit root in the variable. In the following equation:

$$X_t = \alpha + \rho X_{t-1} + u_t$$

we have a unit root if $\rho = 1$. To test the unit root we will be using the Dickey-Fuller test which is a test with the null hypothesis that $\rho = 1$. We use this method over a simple coefficient check using a regression model due to the possibility of serial correlation in the variable.

The results of both tests are shown in the Figure 7.6.1. Based on the results we can see that all variables we are concerned with have a time trend and most values have a unit root problem. To fix the unit root problem we will work with first order differences. This should also eliminate any time trend present in the data. To confirm we will rerun the test we discussed above on the first difference of each variable. We have also run the partial auto correlation test (PAC) on each variable to gain an understanding of how the lag structure in the variables behave. The results for this is shown in the figure below.

Notice in the figure that by taking the first differences of each variables we have weeded out the problem with the unit root; however, unlike what we had hoped we were not able to completely remove the time trend from all the variables: there are still 8 variables with a time trend. For these variables we will adjust for time trend

Variable	Time Trend Coefficient	Time Trend p-Value	Time Trend Trend	PAC	Lag Dependence Coefficient	Lag Dependence Dickey-Fuller	Lag Dependence Unit Root
Price	0.178789	0.000	Yes	1	1.000	0.865	Yes
Liquidity	-0.000154	0.000	Yes	13	0.106	0.000	No
Money Supply	1.890710	0.000	Yes	2	1.000	1.000	Yes
VIX	-0.000108	0.000	Yes	1	0.974	0.000	No
Inflation	-0.000026	0.000	Yes	1	0.984	0.000	No
Interest Burden	0.000017	0.000	Yes	1	0.997	0.005	No
Earnings Yield	0.000012	0.000	Yes	1	0.998	0.162	Yes
Earnings Per Share	0.018375	0.000	Yes	1	1.000	0.995	Yes
Dividend Yield	0.000199	0.000	Yes	1	0.998	0.285	Yes
Dividend Payout Ratio	0.000112	0.003	Yes	1	1.000	0.993	Yes
Dividend per Share	0.005929	0.000	Yes	1	1.001	1.000	Yes
Free Cash Flow (FCF)	197.88	0.000	Yes	1	1.000	0.962	Yes
Cash Flow from Operations	343.38	0.000	Yes	1	0.999	0.032	No
FCF/Sales	0.000011	0.000	Yes	1	1.000	0.960	Yes
FCF Yield	-0.000899	0.000	Yes	1	0.997	0.378	Yes
FCF per share	0.018115	0.000	Yes	1	1.000	0.981	Yes
EV/EBIT	-0.000892	0.000	Yes	1	0.998	0.007	No
EV/EBITDA	-0.000811	0.000	Yes	1	0.998	0.011	No
EV/Sales	-0.000122	0.000	Yes	1	0.998	0.180	Yes
Price-Earnings	-0.002308	0.000	Yes	1	0.998	0.005	No
Price-Book Value	-0.000357	0.000	Yes	1	0.998	0.004	No
Price-Cash Flow	-0.001523	0.000	Yes	1	0.998	0.064	Yes
Price-Free Cash Flow	0.002992	0.000	Yes	1	0.998	0.480	Yes
Price-Sales	-0.000104	0.000	Yes	1	0.999	0.201	Yes
Net Debt/EBITDA	-0.000145	0.000	Yes	1	0.999	0.670	Yes
Asset Turnover	-0.000023	0.000	Yes	1	0.999	0.268	Yes
DDM	0.0006752	0.000	Yes	2	1.000	0.991	Yes
Bond Spread	0.0000719	0.000	Yes	1	0.997	0.160	Yes
FCF % Debt	0.0014767	0.000	Yes	1	0.997	0.082	Yes
ROE	-0.0004357	0.000	Yes	1	0.999	0.016	No

Figure 7.6.1: Results of a time trend and unit root test for all variables

	Time Trend			Lag Dependence			
Variable	Coefficient	p-Value	Trend	PAC	Coefficient	Dickey-Fuller	Unit Root
Price	3.09E-04	0.129	No	1	-0.071	0.000	No
Liquidity	-9.21E-07	0.973	No	13	-0.524	0.000	No
Money Supply	4.76E-04	0.000	Yes	1	0.775	0.000	No
VIX	-3.76E-07	0.830	No	2	-0.171	0.000	No
Inflation				N/A			
Interest Burden	-9.47E-08	0.825	No	0	-0.026	0.000	No
Earnings Yield	-1.13E-08	0.303	No	1	-0.115	0.000	No
Earnings Per Share	1.82E-06	0.159	No	7	0.236	0.000	No
Dividend Yield	-1.39E-07	0.632	No	3	-0.133	0.000	No
Dividend Payout Ratio	3.11E-06	0.000	Yes	9	0.062	0.000	No
Dividend per Share	3.96E-06	0.000	Yes	0	-0.003	0.000	No
Free Cash Flow (FCF)	3.69E-02	0.628	No	0	0.013	0.000	No
Cash Flow from Operations	-2.25E-01	0.001	Yes	5	0.116	0.000	No
FCF/Sales	6.22E-09	0.446	No	0	0.025	0.000	No
FCF Yield	-1.94E-06	0.425	No	3	-0.146	0.000	No
FCF per share	1.05E-05	0.278	No	0	-0.005	0.000	No
EV/EBIT	4.29E-06	0.003	Yes	1	-0.060	0.000	No
EV/EBITDA	2.35E-06	0.018	Yes	1	-0.046	0.000	No
EV/Sales	2.88E-07	0.132	No	0	-0.013	0.000	No
Price-Earnings	4.64E-06	0.019	Yes	0	-0.070	0.000	No
Price-Book Value	8.14E-07	0.015	Yes	0	-0.074	0.000	No
Price-Cash Flow	2.61E-06	0.056	No	0	-0.034	0.000	No
Price-Free Cash Flow	6.87E-06	0.250	No	0	-0.070	0.000	No
Price-Sales	3.38E-07	0.063	No	0	-0.029	0.000	No
Net Debt/EBITDA	3.75E-09	0.978	No	0	0.024	0.000	No
Asset Turnover	1.19E-08	0.360	No	0	-0.001	0.000	No
DDM	1.71E-07	0.258	No	1	0.754	0.000	No
Bond Spread	-0.02591	0.016	Yes	0	-0.026	0.000	No
FCF % Debt	-2.66E-07	0.936	No	0	0.000	0.000	No
ROE	1.42E-06	0.002	Yes	2	0.076	0.000	No

Figure 7.6.2: Results of a time trend, unit root, and partial auto correlation test for the first order differences of all variables. (Except Interest Burden)

in the following manner. For each of these variables, X, we will run the following regression:

$$X = \beta_0 + \beta_1 time + \epsilon_X$$

In this model the error term ϵ_X is the part of X that is not explained by the regression. Meaning it is the part of X that is not related to time. Therefore, in our main regression instead of X we will be using ϵ_X.

7.7 Regression

Now that we have adjusted the data for stationarity and weak dependence we can move forward with the actual regression. The regression we will be using in this test is:

$$\Delta \mathrm{Price}_t = \beta_0 + \beta_1 \Delta \hat{X}_t + \beta_2 \Delta \mathrm{Price}_{t-1} + \beta_3 \Delta \mathrm{M2}_t + \beta_4 \Delta \mathrm{Liq}_t + \beta_5 \Delta \mathrm{Liq}_{t-1}$$

$$+\beta_6 \Delta \mathrm{VIX}_t + \beta_7 \Delta \mathrm{VIX}_{t-1} + \beta_8 \mathrm{i}_t + \beta_9 \mathrm{Recession}_t + u_t$$

Where $\hat{X}_t$ is the estimated quasi rents - valuation ratios in this model - for time t. An analyst would calculate $\hat{X}_t$ using information available in time $t-1$, including but not limited to X_{t-1}. In this model we will assume that the analyst produces a perfectly accurate prediction of $\hat{X}_t$ such that $\hat{X}_t = X_t$. Recall that we do this because we want to test not the ability of the analyst to determine a correct estimation of

$\hat{X}_t$ but rather we are concerned about how well the valuation technique, if correct, describes the movement of prices.

In the model, $\mathrm{M2}_t$ is the Money Supply at time t, Liq_t is the Liquidity Factor at time t, VIX_t is the Volatility Index value for time t, i_t is the interest burden for the firms at time t. In this model *Recession* is used as a dummy variable which accounts for both the recent global financial crisis and the tech bubble of the early 2000, such that

$$\mathrm{Recession}_t = \begin{cases} 1 & \text{if (11 mar 2000} < t < \text{09 oct 2002) and (01 dec 2007} < t < \text{30 jun 2009)} \\ 0 & \text{otherwise} \end{cases}$$

Also notice that in the model we have included $\Delta Price_{t-1}$. We know that $\Delta Price$ in general is the absolute daily return in the stock market. Recall that in the last chapter we showed that efficient market hypothesis does not hold by showing that current returns are effected by previous returns. Hence, it is important to incorporate this relationship in our model.

Using our data and the model presented in this section we will run a regression. The results of the regression are obtained. However, before showing the results we wish to do some post regression tests.

7.8 Post Regression Analysis

We need to run a few more tests to validate the results obtained from the regression model in the last section. Before we can assume our regression results are correct we have to first ensure that the residuals are not serially correlated $E[\hat{u}_t, \hat{u}_s | X_t, X_s) = 0$ for all $t \neq s$ and also that they are homoskedastic $Var(\hat{u}_t | X_t) = \sigma^2 =$ constant. Since this is a time-series model serial correlation remains as the bigger problem we need to work on.

7.8.1 Serial Correlation

Since we already ensured that the model is stationary and weakly dependent, by showing the model also has no serial correlation we can also say that OLS estimators are asymptotically normally distributed which will make the standard errors and t statistic valid to use (Wooldridge, 2013).

The post estimation tests will focus on the estimated error terms $\hat{u}_t$. We will see if the residuals $\hat{u}_t$ are related with the predicted value $\Delta \hat{\text{Price}}_t$. Then we move to graphically look at the auto-correlations of $\hat{u}_t$. We then proceed to the Durbin-Watson test for auto-correlation and the Durbin-Watson alternative test. The Durbin-Watson test produces a value of $\simeq 2$, however, this assumes strict exogeneity in the model. The Durbin-Watson alternative, which relaxes that assumption and runs where no serial correlation is the null hypothesis, gives us a p-value $<< 0.05$ for 1 lag and p-value < 0.05 for up to 3 lags. Therefore, we know that the model has serial correlation and the following relationship holds:

$$\hat{u}_t = \alpha_0 + \alpha_1 \hat{u}_{t-1} + \alpha_2 \hat{u}_{t-2} + \alpha_3 \hat{u}_{t-3} + \mu_t$$

Before we process to fix this problem we need to ensure that the correlation between the lags do not have a unit root. To test this again we use the Dickey-Fuller test and we find that $\alpha_1 \neq 1$. This is good news but it still presents the problem that the model has serial correlation.

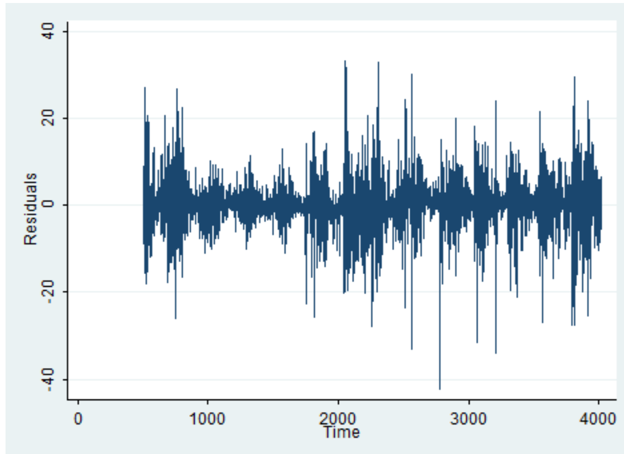


Figure 7.8.1: The relationship between regression residuals and time

7.8.2 Heteroskedasticity

Normally in time series heteroskedasticity is not an issue. However, we still need to test and show that it is the case. A close look at the visualization of the residuals over time shown in the Figure 7.8.1, we can observe that there are shifts in volatility in the residuals which we should not ignore. This indicates the possibility of variance changing over time.

For a more rigorous test we run the Breusch-Pagan and Cook-Weisberg test for heteroskedasticity with the null hypothesis that variance is constant over time. The result of the test gives us a p-value of 0.0985. Therefore with a 5% level of significance we can say that the results are homoskedastic. However, according to Wooldridge (2013) the formal test for heteroskedasticity is generally invalidated if there is serial correlation in the residuals. Therefore we cannot rely on this methodology.

7.9 Consistent and Asymptotically Efficient Estimator

In the last section we saw that due to serial correlation and heteroskedasticity in the residuals we have biased estimators for standard errors. Biased standard errors lead to large problems when dealing with hypothesis testing. Since in the model we use the standard errors for the estimate as the standard deviation of the estimate, any hypothesis testing such as the t or F statistic will be invalid.

There are multiple ways to go around solving this problem. The most common methods are Prais-Winsten and Cochrane-Orcutt estimation method and the Newey West standard errors.

7.9.1 Common Solution

The Prais-Winsten and Cochrane-Orcutt is an iterative quasi-difference data method which runs the regression model in a loop correcting for part of the serial correlation in the residuals each time till a model without serial correlation is obtained. This method provides the best linear unbiased estimates for this process but requires large samples of data due to the iterative nature of the process which leads to dropping of variables. The other problem with this method is that it requires that the explanatory variables are strictly exogenous. Strict exogeneity in our opinion is a very hard assumption to make especially when we are working with such a large sample of daily data.

The Newey-West method for calculating standard errors calculates a robust standard error that accounts for both heteroskedasticity and serial correlation in the residuals. However, the problem with Newey-West method is that it is not efficient. However, given the choice between Prais-Winsten and Cochrane-Orcutt, and the Newey-West, researchers generally prefer the latter primarily for the same reason we decided against the former: efficiency is an easier condition to forgo, and strictly exogenous variables is too strong an assumption to make.

7.9.2 Autoregresive Conditional Heteroskedasticity (ARCH) model

The primary reason we will not be using the Newey-West methodology either is because based on residual plot against time we can observe a more dynamic nature to the heteroskedasticity in the model, which won't be captured if we use a simple robust standard error. Engle (1982) models this form of dynamic heteroskedasticity by trying to determine the relationship between square residuals and their lags. He calls this the autoregresive conditional heteroskedasticity (ARCH) model:

$$E(u_t^2|u_{t-1}, u_{t-2}, ...u_{t-n}) = \alpha_0 + \alpha_1 u_{t-1}^2$$ [1]

where $\alpha_0 > 0$ and $\alpha_1 geq 0$ and if $\alpha = 0$ then there is no dynamic heteroskedasticity. Therefore the test for this also has null hypothesis:$\alpha_1 geq 0$. For this test we get a p-value of 0.00 which suggests that there is a dynamic heteroskedasticity in our model which we need to address.

Therefore, to solve our model we will be using Engle's ARCH regression model of order 2. By using an ARCH model we will be able to "get consistent (but not unbiased) estimators for β_j that are asymptotically more efficient than the OLS estimators" (Wooldridge, 2013, p. 437). In his model, Engle originally used a normal distribution

[1] This is a first order ARCH model. The model can be extended to multiple orders by adding additional lags. An ARCH model of order n is as follows $E(u_t^2|u_{t-1}, u_{t-2}, ...u_{t-n}) = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 u_{t-2}^2 ... + \alpha_n u_{t-n}^2$. To test whether in an ARCH model of order n there is dynamic heteroskedasticity we use the null hypothesis: $\alpha_1 = \alpha_2 = ... = \alpha_n = 0$.

to model the error terms. However, we have already seen that stock market returns are not normally distributed random variables, so we also expect the residuals to follow a non normal distribution which mimics the stock returns distribution better: higher peaks and fatter tails.

Due to limitations in Stata, which only allows normal distribution, t-distribution and, generalized error distribution to be used with the ARCH model, in our analysis we assume that the error terms are based on a t-distribution. We do this because t-distribution has fatter tails with lower peaks than a normal distribution. The underlying assumption we are making when we do this is that it is more important to model the fatter tails than the higher peaks. This is primarily because in stock valuation modeling outliers with larger irregular returns is more important than the mean returns.

7.10 Results

Our results for the ARCH model using t-distribution is shown in Figure 7.10.1. Along with the regression results the table also tells us the mean variance inflation factor (VIF) found when each of the metrics are added to the model. We note that overall mean VIF is less than 1.66 and the highest VIF for an individual variable was 2.31 and it was for ΔVIX_{t-1}. The VIF of 2.31 simply tells us that the standard errors are larger by a factor of 2.31 than would otherwise be the case, if there were no inter-correlation between the variable and all other control variables. According to Rogerson (2001) a VIF value of 5 and below is acceptable in a regression model. Therefore we can safely conclude that there is no significant multicollinearity in our model.

Variable	Coefficient	Std Err	p-value	Significant	R-Square	VIF	Obs
Earnings Yield	-22386	90.20	0.000	Yes	81.9%	1.66	3518
Earnings Per Share	5.80	0.957	0.000	Yes	55.6%	1.40	3518
Dividend Yield	-769	5.43	0.000	Yes	74.3%	1.59	3518
Dividend Payout Ratio	-3.54	2.34	0.129	No	55.4%	1.38	3518
Dividend per Share	11.92	4.00	0.003	Yes	55.4%	1.40	3518
Free Cash Flow (FCF)	3.93E-05	8.13E-05	0.629	No	56.4%	1.40	2018
Cash Flow from Operations	9.66E-05	8.40E-05	0.250	No	56.4%	1.40	2018
FCF/Sales	-92.8	723.4	0.898	No	56.3%	1.39	2030
FCF Yield	-183.6	3.76	0.000	Yes	72.9%	1.60	2030
FCF per share	2.20	0.630	0.000	Yes	57.0%	1.40	2018
EV/EBIT	122.1	1.38	0.000	Yes	74.1%	1.51	3518
EV/EBITDA	178.6	1.75	0.000	Yes	75.6%	1.53	3518
EV/Sales	1019	7.00	0.000	Yes	83.0%	1.57	3518
Price-Earnings	95.80	0.662	0.000	Yes	83.5%	1.59	3518
Price-Book Value	577.0	4.23	0.000	Yes	82.6%	1.58	3518
Price-Cash Flow	124.8	1.30	0.000	Yes	80.7%	1.57	3518
Price-Free Cash Flow	73.72	1.11	0.000	Yes	56.4%	1.40	2018
Price-Sales	1067	5.94	0.000	Yes	86.2%	1.59	3518
Net Debt/EBITDA	-7.89	17.46	0.651	No	55.3%	1.38	3518
Asset Turnover	-23.58	149.4	0.875	No	55.3%	1.38	3518
DDM	-37.39	17.62	0.034	Yes	55.2%	1.41	3502
Bond Spread	-8.84	3.92	0.024	Yes	55.7%	1.41	3520
FCF % Debt	0.97	0.42	0.023	Yes	55.3%	1.40	3520
ROE	2.162	4.844	0.655	No	55.3%	1.40	3520

Figure 7.10.1: Table of results for all the coefficients of all valuation metrics using ARCH model regression

From our regression analysis we find that the coefficient when using earnings yield, earnings per share, dividend yield, dividends per share, FCF yield, FCF per share, EV/EBIT, EV/EBITDA, EV/sales, PE, PB, PCF, PFCF, and PS as a proxy for Quasi Rent has a p-value $<< 0.05$. Therefore using our model these metrics are able to explain changes in $\Delta Price$. Also note that for the coefficients of net debt/EBITDA, asset turnover, dividend payout ratio, FCF, and CFO at 5% level of significance we were able to show a relationship with $\Delta Price$.

Since we are primarily concerned about the predictive capabilities of our valuation metrics, for the metrics with co-efficient p-value less than 0.05, we look at their R^2

value. The R^2 measure tells us what percentage of the variations in our dependent variable, $\Delta Price$, is explained by our model[2]. And the R^2 for these metrics is shown in Figure 7.10.2. The results tell us that the best metric to use is PS, Price to Sales, for which $R^2 = 86\%$. Otherwise we find that the following also have $R^2 > 80\%$: earnings yield, EV/sales, PE, PB, and PCF. The following have the $70\% < R^2 < 80\%$: dividend yield, FCF yield, EV/EBIT and EV/EBITDA. The metrics that performed the worst amongst the ones with a significant p-value were EPS, dividends per share, FCF per share, DDM, Bond Spread, FCF % Debt and PFCF with a $R^2 < 60\%$.

7.10.1 Monthly Data

To observe how our model functions with monthly data we run the regression analysis using monthly data. The process used in this resembles the entire process used in the analysis of the daily data. The monthly variables also had unit root and time trend which we removed using the first order differences. To our luck the residuals obtained using monthly data were not serially correlated and they were homoskedastic. The data also did not have dynamic heteroskedasticity like the daily data. Due to this we were able to use results directly from a OLS and obtain unbiased results which were both consistent and efficient. The results obtained from our monthly data is shown in Figure 7.10.3. The figure shows the R^2 values for all the regression models which had a p-value < 0.05 for the coefficient of the valuation metric. Based on monthly data the PE ratio with a $R^2 = 85.9\%$ is the best predictor of $\Delta Price$. Even in monthly data PS came out as a very good predictor with a $R^2 = 81.3\%$. Also notice that Earnings Yield is a considerably better predictor when working with monthly data than daily data.

[2]Note that the R^2 value in this model is inflated in general because of some of the other variables that may be very good at explaining $\Delta Price$. However, this does not alter our results in anyway since we are primarily concerned about the relative capabilities of each of these methods, which remains unaffected.

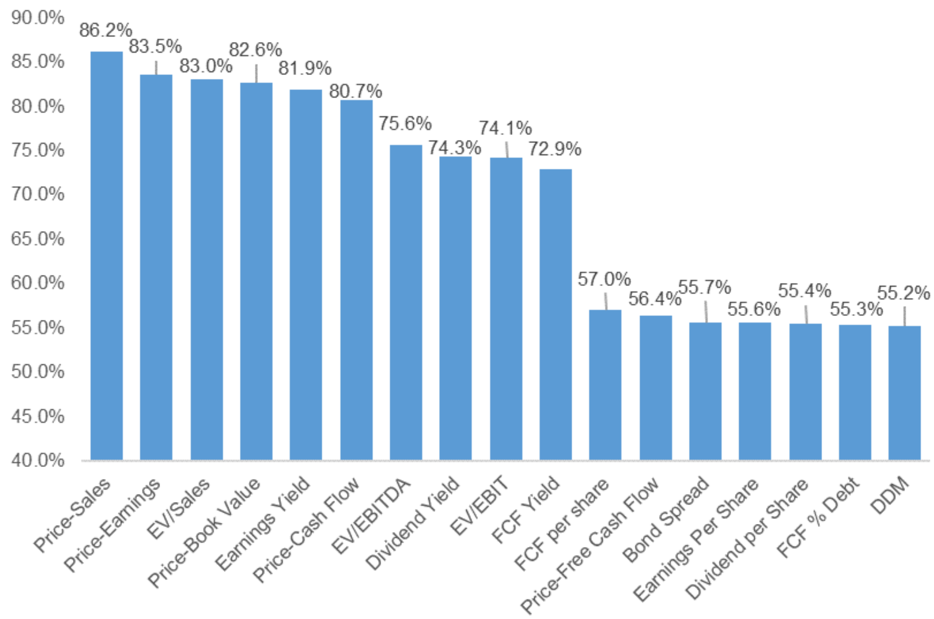


Figure 7.10.2: Comparative study of R^2 different regression obtained using different valuation metric on daily data from Jan 2000 to Jan 2016. (Only the metrics that had a p-value < 0.05 for their coefficient are shown here)

Another thing to notice is that when using monthly data the R^2 for both EV/EBIT and EV/EBITDA fall below the 70% level. Overall, however, other than these slight differences, notice that all the valuation metrics that came out as good predictors using the daily data were also very good predictors when using monthly data.

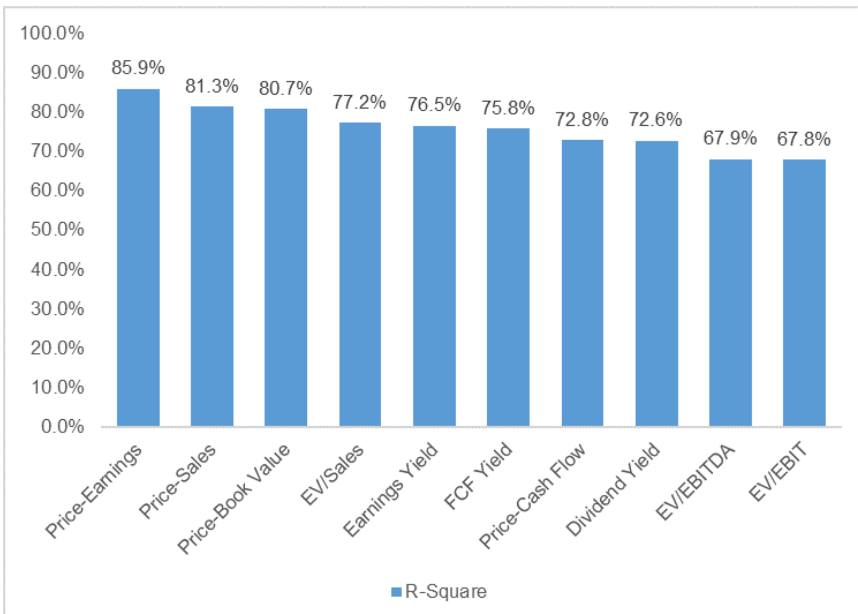


Figure 7.10.3: Comparative study of R^2 different regression obtained using different valuation metric on monthly data from Feb 2000 to April 2016. (Only the metrics that had a p-value < 0.05 for their coefficient are shown here)

8

Conclusion and Future Work

8.1 Conclusion

In this paper we have discussed the importance of active management and valuation techniques in light of new information about the inaccuracy of the EMH model. Using Minky's interpretation of Keynes we discussed a more accurate theoretical model for the financial market. We then designed our model around Minky's interpretation and conducted an ex-post forecasting analysis using our valuation metrics. We did this in order to test the predictive capabilities of each metric. The final results of our findings are shown in Figure 7.10.2 and 7.10.3. From our results, we see that Price-Sales ratio is the best predictor for changes in daily $\Delta Price$. Using the model with Price-Sales ratio, we are able to explain 86.2% of the variation in daily $\Delta Price$. From the monthly data we find that Price-Earnings ratio is the best predictor with $R^2 = 85.9\%$. So based on our findings, we would recommend that any analysts working on the S&P 500 use either the PE or PS ratio. Ideally we would suggest to use PE for longer term forecasting and PS for short term forecasting.

8.2 Future Works

For future work we intend to improve our model on three fronts. First, we wish to extend the model to smaller sectors and sub-sectors. Second, we wish to build a deterministic model for ex-ante forecasting. Third, we wish to develop a stochastic part for the model.

For the first part, we can use the model we currently have and run it on data obtained for different market sectors. Following this we intend to keep breaking the sectors down to more and more granular levels and running our analysis. We expect this to yield different results since companies in different sectors and sub-sectors are structured differently: the balance sheets, income statements, cash flow statements behave differently between sectors. The results obtained from this will be very useful for analysts. That is because analysts tend to usually follow a small group of companies from a sub-sector. By being able to show that one metric works better for a sub-sector, it will provide equity analysts with the guide to which metric they should be focusing on to determine a target price, and more so which metric to stay away from.

For the second part, we wish to develop a model where in order to predict the actual price, P_t^A, we use the information set $I(t-1)$ just as our model. In this, we relax our assumption that the analyst's prediction is no longer accurate, so now we have that $\hat{X}_t \neq X_t$, where X is a valuation metric. Since equity analysts are not making perfect prediction we intend to generate an approximate prediction and determine its predictive capabilities. In this model we will use the historical trends, seasonality, and other factors obtained from time 1 to $t-1$, in X to determine an approximate $\tilde{X}_t$, such that $\tilde{X}_t \simeq X_t$.

For the third part, we wish to develop a modification to the model that will account for the stochastic aspect of stock price. We acknowledge that we expect this to be the toughest part of our future work. However, to start this process we will look into dynamical systems analysis, primarily Fractals and Fractal dimension index using a Hurst Exponent (Peters, 1994).

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