Inquiry in Developing Trading Systems for FOREX and Equities Trading

An Interactive Qualifying Project

Submitted to the Faculty of Worcester Polytechnic Institute

In partial fulfillment of the requirements for the Degree of Bachelor Science

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Conducted from

October 25, 2016 to May 2, 2017

Report Submitted to esteemed faculty members

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1: Acknowledgments

On behalf of Sanjay Batchu, Michael Bahnan, and Dereck Pacheco, the IQP team would like to acknowledge the time and effort spent by Professor Radzicki and Hakim to create and organize this IQP. In addition, we would like to recognize the assistance they provided in teaching the team the fundamentals of economics, and trading. We also greatly appreciate the support and guidance they gave us during the duration of this IQP, which has enabled us to complete this project with the highest standards of excellence. The team would also like to recognize Worcester Polytechnic Institute due to their continuing support of the IQP project, thus enabling the team to broaden their horizons and gain knowledge of the financial industry. Finally, we would like to recognize TradeStation Inc. for allowing us to develop our system using their platform and further educating us on the financial industry.

2: Abstract

The purpose of this Interactive Qualifying Project is to scientifically develop a trading system that increases profitability and maximizes return on equity when compared to passive investing methods such as index funds. The goal of any trading system is to decide when to enter and exit trades based on fundamental or technical analysis of the underlying asset being traded. This project used three different trading systems that focused on trading foreign currencies as well as equities. The first strategy is based on value investing and focuses on equities where the "true value" of a stock is found by using fundamental analysis. The next system used is based on the CANSLIM method of stock screening that uses specific parameters to find stocks that have potential for high growth. The third system focused on currencies and used technical analysis as a basis for creating entry and exit conditions.

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4: Introduction & Research Overview

4.1 Problem Statement

Trading and investing have become increasingly important to common Americans with the end of pension plans and the integration of the 401k into the American way of life. Besides retirement, people trade and invest for other reasons such as extra income or as a profession. With the creation of computer technology in the financial services industry, trade systems and strategies are increasingly becoming the key to increasing the return on capital. There are two main problems this project aims to solve. The first major problem is most people are passive investors who mainly invest passively and do not actively manage their investments. Another problem is that most strategies are not based on science or economics, thus cannot be analyzed in a scientific manner. These two problems lead to loss in potential return on capital and leave most investors in a weakened position compared to other investors in the market.

4.2 Statement of Problem Importance

"It's so easy, even a baby can do it" (E-Trade, 2008). One might recognize this slogan from the baby commercial first broadcasted during Super Bowl XLII. Advertisements like this, as well as other factors lead the public to believe that trading is

easy and rewarding. Sadly, such notion is not the case. Due to false advertising like this, individuals become blind and fail to comprehend the correct way of trading. In order for someone to be successful in this profession, they must begin with an open mind. Also, they must prevent themselves from being easily swayed by publicity, and the conceptions brought forth by others. From above, we've distinguished between the two kinds of traders, passive and active. A passive trader is one who invests in indexes or exchange-traded funds without managing them. In contrast, active traders manage their own ship. They are committed to beating the market by implementing methods and techniques collected from past experiences. Here are some important aspects to think about for beginning traders.

"There's no point in trying to beat the market through active investing" (Kahler, 2016). The previous citation serves as propaganda for men and women who wish to spend their hard earned money investing passively. What they don't understand, however, are the wide varieties of issues that come with passively trading. These issues are of the utmost importance and one should know them before entering the world of trading for the first time. First of all, since investing passively requires the holder to invest without anticipating performance, they are relying heavily on the market. For example, when one chooses to invest passively in The Dow Jones Industrial Average (DJIA) index, they are buying as many funds as they can to replicate that index. Heavy reliance on the market is required because brokers aren't managing these accounts. Hence, if the stock market average is down, the passive trader will have to ride it out hoping that it won't continue to drop. Active traders do not have this problem. Unlike a passive trader, an active trader will manage their own funds by putting thought and attention into performance. Meaning that

they will watch for news updates, research companies, and/or implement testing strategies for investing. These tactics advocate for buying stocks when it's low, and selling when it's high. In the end, experienced active traders will produce higher returns and have more knowledge about the economy. This introduces the importance of our next problem, illogical trading. Just because active traders are labeled as the smarter bunch, doesn't necessarily mean they are. Most active traders will run strategies that consider zero economic or scientific factors, which makes analyzation very difficult. The active trader alone acquires high risk just from managing his or her own accounts. However, using a strategy that one cannot analyze creates an even higher risk. This is because it makes it difficult to learn from system mistakes. When one keeps making the same mistakes, it creates a margin of error that could've been profitable. All in all, it is important for active traders to run analyzable strategies to achieve higher returns, so that one could be just steps closer to beating the market.

4.3 Brief Summary of Literature

Since the very first day the stock market was introduced to the world, scientists and mathematicians have devised systems and algorithms that they believe will captivate the world and elevate their profits to new heights. As of recent, an increasing number of individuals have taken these older systems and modified them to find a possible parameter or two that might make the system more efficient and therefore lead to larger profits. The team has decided to use different systems for their stocks in order to get more diversity and examine efficient of profits across different systems.

In the case of Sanjay, he used a modified version of value investing derived from Ben Graham (Scott, AAII). This made changes such as including sector leaders and employing sector rotation to increase portfolio diversity. In addition to using the Graham method of finding intrinsic value, Morningstar analyst reports were used to decide on entrance and exit strategies.

On the other hand, Michael used a system that modifies the CAN SLIM method developed by William O'Neil (O'Neil, William J. *How to make money in stocks: a winning system in good times or bad*). His methodology includes different parameters for enter and exit methods as well as criteria to invest into a stock. He used a stock scanner to enter in the CAN SLIM parameters that William O'Neil deemed in his theory, but modified it by leaving a few out as well as adding other criteria that he believed would lead to greater profit. implemented two different approaches to trading. They were automated and manual. Each approachutilized the philosophy of Charlie Wright in his book *Trading as a Business*. Wright believed that successful trading systems result from well-structured strategies including entry and exit rules, as well as money management principles. Indicators such as simple were researched for these approachesStatisticians have used the SMA indicator since 1901 (McClellan, 2010), which set the foundation for future indicators. The RSI indicator was developed by J. Welles Wilder and was further explained in his book *New Concepts in Technical Trading Systems*. Finally, Gerald Appel and his discovery of the MACD, was publicized in his book The Moving Average Convergence Divergence Trading Method. Through Charlie Wright's philosophy these indicators were assorted in each approach in search for profitable results.

4.4 Conclusions

It is clear that investing is accessible to more people than ever and the number of investors continues to grow at a rapid rate every year. Most investors who invest on a casual basis are passive investors who do not monitor their investments on a regular basis. In order to combat this problem, trading systems based on scientific data need to be developed in order to increase return on equity and improve investor's mindset. Through the use of these ideas, our team was able to observe that when these systems utilized properly they can generate returns that exceed the market.

5: Trading & Investing

5.1 Trading Vs. Investing

Most people believe that trading and investing are similar and many get confused on the definition between trading and investing. Investors and traders both use the financial markets to gain wealth but do so using different methods. Investors use the market to gain wealth gradually by compounding assets and returns over time. Investors also believe that prices of their assets will rebound during downturns and thus hold their assets for long periods of time. Most investors also focus more on fundamental analysis and management data rather than specific price movements and technical chart analysis. In contrast, traders use the financial markets on a short term basis and frequently buy and sell their assets in order to outperform the market. Investors usually settle for small returns based on market movements but traders believe that by following the mantra of "buy low sell high" they can beat the returns provided by the market. Traders use mostly technical analysis to track asset prices to determine when to buy and sell assets.

In essence traders and investors both use the financial markets to further their financial goals. Investing carries less risk than trading but leads to lower returns over time as there are periods of time the price of assets changes over time. Traders buy and sell assets to avoid these price changes and maximize returns as much as possible.

(Investopedia, Staff)

5.2 Financial Market Theory

The difference between trading and investing is a well-studied concept in finance and is based on two theories founded by Nobel Prize economists Robert Shiller and Eugene Fama. Robert Shiller is the creator of Behavioral finance theory, which believes that the market contains inefficiencies that can be exploited by those with enough knowledge of the market in order to increase potential returns. In contrast Eugene Fama believes that markets are efficiently priced and that there are no inefficiencies that can be exploited for increased returns. This theory believes that the best way to obtain returns from the market are to simply invest in index funds that track market prices and simply allow the returns to compound over time.

5.3 The Four Main Asset Classes

Whether one classifies themselves as an investor or a trader, they will most likely be trading four main classes of financial assets. The four main asset classes include, Equities, Bonds, Currencies, and Commodities. In this section each asset is analyzed for its benefits and drawbacks as well as the time period in the business cycle in which the asset as the highest volume.

5.3.1 Equities

The equity market is usually the one that most investors and traders are most common with and includes most of the companies that people know about such as Apple, Google, Amazon, and Tesla. Companies enter the equity markets by offering the public

stock in themselves via an IPO or an Initial Public Offering which begins the process of being sold on one of the two large exchanges in the United States the NASDAQ or NYSE (New York Stock Exchange). Usually equities are bought by major financial institutions when the economy is in a bullish cycle as equities carry a relatively higher risk than some other classes of assets.

When trading equities, it is very important to understand the difference between an investor and a trader. As equities are extremely regulated, there are many tax regulations regarding the buying and selling of equities. If one is simply classified as an investor, they have to catalog each individual trade as well as pay long term capital gains tax on any gains made from their investments. With regards to liquidity of the market, the stock market is extremely liquid and transactions of most stocks are completed within microseconds.

Unlike other assets, due to the volatile nature of equities within the business cycle margin requirements are extremely high when compared to other assets such as currencies. This due to the fact that there needs to be a level of trust between the broker and client when borrowing cash on margin to purchase stocks. In addition, if the market has sudden dips, the client can lose an interminable amount of money and may not be able to pay off the margin when necessary.

The actual process of creating a brokerage account to trade equities is extremely dependent on whether one is classified as an investor or trader. If a person is classified as an investor they usually pay a commission to a brokerage firm and must pay a fee for each trade made. The entry requirements for investors are very little, as equities are the most notorious class of financial assets and thus are heavily advertised by most brokerage firms.

In contrast, since traders have high amounts of capital to trade with most brokerage firms will offer traders low commission amounts for each trade and make their money from volume. If one is a trader for a large firm which has a seat on each of the exchanges, then there is no broker is involved and one can trade directly on that exchange.

There are many factors that need to be considered before investing or trading including margin, liquidity, commissions, taxes and etc. These requirements make equities complicated to trade on a regular basis as a trader thus opening the window for traders to specialize in other assets such as currencies, futures, bonds or commodities.

5.3.2 Bonds

Bonds can be considered the opposite of stocks as they represent debt repayment while stock shares are essentially claims on the company's profits and also allow for voting rights on major decisions. Stocks are priced based on the company's potential for increased profits in the future while bonds are priced based on the company's ability to repay its debts. A portfolio using traditional methods of investing consists of a mix of bonds and stocks in order to diversify risk, as bonds are usually more conservative than stocks. Thus, most bonds are issued by governments and corporations in order to borrow money in order to fund expansions or perform capital investments. They play a large role as an alternative to banks as they decentralize the lending process and allow for large amounts of people to become lenders.

There are four main types of bonds present on the bond market and are bought and sold by investors and traders. One of the safest types of bonds are government bonds and they are classified as sovereign which means that these bonds obtain value by that nation's

ability to raise taxes and print notes of currency. Debt offered by developed nations such as those in Western Europe or the United States are considered essentially risk free because they have strong credit histories and are stable nations. On the other hand, some developing nations have considerably increased chances of risk due to decreased stability and an increased chance of not repaying the debt. Government bonds are usually rated by the three main rating agencies that also rate corporate bonds.

Besides sovereign bonds of nation-states, local municipalities also sell bonds called “muni bonds” that are used to fund infrastructure projects and other capital intensive projects such as new schools or libraries. These bonds are riskier than sovereign bonds since municipalities cannot print their own currencies and thus have the potential to go bankrupt. However, the interest paid on these bonds to investors is usually tax-exempt at the federal, state, and local levels. Thus investors who want to make returns that are better than simply holding cash without increasing their tax burden may use municipal bonds.

Besides government, corporations are the other main issuer of bonds in the market and are preferred by investors who want to obtain higher yields. Corporate bonds have higher yields due to the fact that a corporation simply has a higher chance of default than a governmental entity and this is directly reflected in the yield offered. Corporate bonds are divided by length into different categories just as those issued by the government. Short term bonds usually have a maturity rate of less than 5 years, intermediate bonds mature between five to twelve years and long term bonds mature after twelve years. Corporate bonds are also rated by the three agencies in a similar manner to that of government bonds and are done by the same companies: Moody’s, Fitch, and Standard and Poor’s.

Corporations can offer normal bonds with a variety of interest rates and maturity dates, but they can also issue special bonds called convertible bonds. Convertible bonds are unique in that investors or traders can convert these bonds into stock at a certain date in the future based on a pre-determined conversion rate.

Regarding taxation, there are some basic rules regarding tax regulations on income from bonds. The fixed income gained from the quarterly interest payments are considered normal income and are taxed based on the numerous income brackets. However, if the bond appreciates in price and is sold, then the income gained from that transaction can be considered capital gains. This is an important factor due to the fact that tax laws play a large role in determining asset allocation for investors and traders.

Bonds and equities can be considered two sides of the same coin in the sense that bonds represent an entity's ability to pay its debts and equities represent an entity's ability to obtain profit in the future. Both of these assets play similar roles during trading or investing as they have similar brokerage requirements. One issue with both of these classes of assets is the fact they are tradable only on exchanges, which have defined sessions and cannot be traded at night or on weekends. Thus investors and traders may also choose other assets in order to mitigate tax liability or reduce losses via commissions. (Investopedia, Staff)

5.3.3 Currencies

Trading currencies is also considered FOREX trading due to the fact that trading or investing currencies is simply buying money in different countries. FOREX trading is sometimes seen as being too complicated or hard to enter, but it is actually extremely

simple due to the fact there are minimal regulations as well as the fact that the market is extremely liquid. The New York Stock Exchange is one of the biggest exchanges in the United States where equities are sold and it pales in comparison to the FOREX spot market that has a liquidity value of 1.5 trillion USD. A fundamental notion of FOREX trading is that the price of a country's currency is related to the condition of its economy relative to other countries.

Most traders and investors choose to trade six main currencies as these nations have the most liquid currencies on the spot market. They are the USD (US Dollar), EUR (Euro), JPY (Japanese Yen), GBP (Great British Pound), CHF (Swiss Franc), CAD (Canadian Dollar), and AUD (Australian Dollar). When purchasing currency, one is actually buying one currency and selling another, which creates the basis for a currency pair. Most investors and traders use only the major currency pairs, which are shown in the table below.

Table 5.3.3A: Major Currency Pairs

Currency Pair	Countries Involved
EUR/USD	Eurozone Nations and United States
USD/JPY	United States and Japan
GBP/USD	United Kingdom and United States
USD/CHF	United States and Switzerland
USD/CAD	United States and Canada
AUD/USD	Australia and the United States

When compared to other asset classes such as stocks or bonds, there are few margin requirements when trading on the currency markets. In addition, the spot market has tremendous amounts of liquidity with regards to the major currency pairs in the table above. The limited margin requirement is due to limited regulations of the FOREX market as well as the fact that FOREX trading is extremely decentralized. Many traders and investors in the currency market trade at margins such as 50-1, which means that they can trade fifty dollars worth of currency for every single dollar they spend. Thus, one only needs to use two thousand dollars in order to purchase one hundred thousand dollars' worth of another foreign currency.

Like bonds currencies are traded on the OTC (Over the Counter) market that means that independent buyers and sellers make transactions based on market information. This means that there are limited commission costs as there is no need to fund large exchanges or expensive brokerages, which enables a large amount of traders and investors to join the market.

5.3.4 Commodities

Most financial instruments are electronic in nature and represent monetary value yet they do not usually have any connection to tangible assets. However, the commodities market is an amalgamation of four main sectors of physical goods that can be traded in a market environment. The four main categories or sectors of commodities are the energy sector, metal sector, livestock sector, and the agricultural sector. The commodities market relies on rigid standards to ensure global transactions and ensure trust in the system. In

addition, trading commodities is one of the purest forms of economics possible today as pricing is based largely on supply and demand.

In the United States, there are numerous exchanges participating in the transaction of commodities and usually each exchange specializes in certain commodities, which simplifies transactions. The largest exchanges in the United States are listed below:

- The CME Group
- Intercontinental Exchange
- Kansas City Board of Trade
- The London Metal Exchange

The CME Group operates the Chicago Mercantile Exchange that trades mainly agricultural products as well as wood pulp and timber products as well. The ICE or Intercontinental Exchange is another exchange based in the United States and trades futures and options on commodities such as Agriculture, Crude Oil, Crude Oil products, Electricity, and Natural Gas. Investors and traders can also purchase contracts on metals such as Aluminum, Steel, and Nickel through the London Metal Exchange.

(Investopedia, Staff)

5.4 Stock Exchanges

A stock exchange is a market where stock buyers and sellers trade stock in various companies across one or more of the several exchanges throughout the United States. The exchange allows individuals to liquidate their stocks, while allowing others to trade for these stocks and vise versa. Often individuals wonder when to enter/exit the market or

how to gage how well the market is doing. And to answer simply, it truly depends on the company or industry that an individual is looking to invest in. Each sector and company peaks at different points and profits can be made at different times for different companies. A company could have an upward trend, where each one of its stocks gains more value at the specific time, while another company could downward trending at the exact same time and that is the nature of the market. In another instances, a stockholder could experience what is known as trading sideways, which means that the current stocks for this specific company is experiencing neither an upward nor downward trend and rather an oscillating trend between the two.

Now although there is no simple to track the entire market as a whole, there are certain ways to gage the performance of the top companies for each sector and the top companies in general. Simply put, indexes are these collections of stocks that measure a portion of the entire stock market. Of course the largest and most known index is the Dow Jones Industrial Average (DJIA), which accounts for 30 of the largest and most dependent companies in the US. Another well-known index is the Standard and Poor's 500 (S&P 500), which covers 500 companies that are compiled together based on its market size, liquidity and industrial sector. The S&P 500 is neck and neck with the Dow Jones for the best overall indicators of the position of the market and with both of these indexes in place, it is the job of a mutual fund manager to beat it! (Staff, Investopedia. "Index Investing: The Standard & Poor's 500 Index)

When the stock exchange goes live each morning, a battle begins between the bulls and bears of the market with each side trying to pull the market in their direction while making the other side go in the opposite direction. Often, stockholders must view charting

volume, new high/lows and advance/decline indicators in order to see which direction the prices of the market will travel. Without these necessary indicators, traders would be lost in the market and unable to know whether stocks are on the upward trend and reaching new highs or selling stocks and reaching a new low.

5.5 Derivatives

Another dimension of the stock exchange are these legal agreements called contracts. Now there are different kinds of contracts but the main two are futures and options. A future's contract, first off, is an agreement to buy or sell a chosen commodity at a set time and price in the future. An individual can buy these contracts in everything from metals to oils and usually the contract is sold before the product is set for delivery. On the other hand, an options contract is an agreement between the buyer and seller that clearly states that when the shares or commodities reach a preset price then the option seller will fulfill their portion of the trade if the buyer wants to perform a call option and buy the shares or a put option to sell them.

6: Trading Systems

6.1 What is a Trading System?

After one gathers an overall view of the ideas underlying trading and investing, they should begin the process of determining how to implement them within the market. In general, the most common approach the average investor idolizes is the use of trading systems. “A trading system is simply a group of specific rules, or parameters, that determine entry and exit points for a given equity” (Kuepper, 2004). Developing a successful system could be time consuming depending on your expertise in the market. In some cases, one must acquire years and years of data to establish accurate readings, while others use modern technology to back test their methods, strategies, etc. just by looking at day-to-day trends. These systems could either be monitored manually for the hands on approach, or automatically for traders willing to conform their rules into the language of code. All in all, coming up with a working trading system is in no way, shape, or form a simple undertaking.

6.2 Trading Platforms & Brokerage Accounts

6.2.1 Trading Platform Basic Idea

Preceding the events of creating any system of trades, one must be conscious of the trading platform being used. “A trading platform is a software through which investors and traders can open, close and manage market positions” (Investopedia, 2010). Basically,

it’s a software provided by different trading companies, also known as brokerage firms, that allow investors to implement their systems, make trades, and manage their accounts.

6.2.2 Types of Trading Platforms

There are many different kinds trading platforms in our world today. Most of them offer unique format and easy accessibility functions, such as mobile apps to trade on the go, tools and alerts to advocate trading analysis, and even customization features to fit the organizational needs of each client. Some platforms specifically cover one asset, while others have the ability to trade multiple asset classes. For example, OANDA Fx is a trading platform strictly used for currency trading. Other platforms like TradeStation, Ameritrade, and Scottrade all offer different trading capabilities for assets like options, equities, stocks etc. Even though this falls to be true, each trading company has been categorized overtime as to what asset their platform best fits. Traders come to this conclusion by looking at every factor a platform has to offer, such as responsiveness, reliability, data security, trade commission, account minimums ($$), automated trading, and even promotional events. Other differences between trading platforms lie within their structures. Meaning each platform comes with their own friendly-user interface, as well as guidelines that will hopefully help their client’s trading to be fluid and simple. In the end, no matter what trading platforms have to offer they all perform the same job.

6.2.3 Brokerage Account Basic Idea

As previously noted, trading platforms are offered by trading companies call brokerage firms. A brokerage firm is a financial institution, similar to a bank, which

facilitates both buying and selling of financial assets for each of their clients. So whenever one trades on an online system, they are an account holder of a brokerage firm. “A brokerage account is an arrangement between an investor and a licensed brokerage firm that allows the investor to deposit funds with the firm and place investment orders through the brokerage” (Investopedia, 2017). In other words, when one decides to invest in a brokerage account they are entrusting a broker relay their investment orders within a timely manner.

6.2.4 Types of Brokerage Accounts

When opening this account, the first question to be asked is the type of account to utilize. There two different types of brokerage accounts to choose from, cash or margin.

Advantages/Disadvantages of a Cash Account

According to Investor.gov, “A cash account is a type of brokerage account in which the investor must pay the full amount for securities purchased”, meaning a broker cannot lend you money to pay your account expenses, such as commission on transactions. This could serve as a disadvantage because traders with little income, who can’t increase position size, will struggle to gain a higher profit. Advantages of implementing a cash account include not having to take as many risks. There is less risk because you are avoiding the chances to be indebted with the brokerage firm. If a trader has substantial debt within a margin account, they face the risk of the account being frozen. While the margin account is frozen, a cash account could still be trading while taking full advantage of new market positions.

Advantages/Disadvantages of a Margin Account

On the other hand, “A margin account is a type of brokerage account in which your brokerage firm can lend you money to buy securities, with the securities in your portfolio serving as collateral for the loan” (Investor.gov, 2017). Just like any other loan, interest costs will be encountered, especially when you buy securities on margin. Other costs that are factored in consist of the fees/commissions. Also known as a brokerage fee, these commissions are charged by the company to conduct transactions between buyers and sellers. These fees are either built into the trades, or charged separately. Whatever the case may be, fees could be a flat rate, a percentage of the transactions, or even a combination of both. In addition, there are many pros and cons with using a brokerage account. First of all, most of the pros and cons formulate from using margin accounts. The best advantage that meets the eye is having the ability to increase your purchasing power. For example, if one has very little money invested in the market but can predict outcomes, that person could increase their quantities leading to higher returns. However, for the average person who isn’t too familiar with the process, this approach could serve as a disadvantage. “Alexandra Lebenthal, president and CEO of Lebenthal & Company, says she wouldn't recommend that the average investor buy stocks on margin, noting that there is already a risk built into investing because you don't know for sure if the company is going to do well or even stick around” (Fox Business, 2012). Basically, Alexandra is saying that if stock prices were to drop, then greater losses would succumb to those who traded marginally due to interest payments and commission. In addition, not only could a broker freeze an indebted trader’s account, they could even shut it down and sell the open items to cover the shortfall.

6.3 Data Sources

6.3.1 Where Assets Are Traded?

The 4 Asset Classes	Common Exchanges to Use
Equities	*New York Stock Exchange (NYSE) *National Association of Securities Dealers Automated Quotation System (NASDAQ)
Bonds	*Citigroup BIG *Barclays Capital Aggregate Bond Index *Merrill Lynch Domestic Master
Commodities	*New York Mercantile Exchg. (NYMEX) *New York Board of Trade (NYBOT) *Chicago Board of Trade (CBOT) *Chicago Mercantile Exchg. (CME)
Currencies	*Oanda Fx *Thinkorswim (TD Ameritrade) *Forex.com *MB Trading (MetaTrader)

Table 6.3.1

6.3.2 Specialists & Market Makers

First of all, whenever someone trades, they are moving their money through market makers. What are market makers? Exactly what you think; they essentially make the market. According to Investopedia, “A market maker is a broker-dealer firm that assumes the risk of holding a certain number of shares of a particular security [asset] in order to facilitate the trading of that security”. Within market makers lie the members who make them up. For example, in a stock exchange the acting market maker is known as a specialist. Specialists’ work together to ensure the market stays liquid by holding stock inventory, posting bid/ask prices, and managing trades. Without market makers and their players, there would essentially be no means to trade because no one is there to facilitate the people trying to invest as well as stepping in when the times get tough. In other words, if large movements occur in the market, then it is up to the acting market maker to sell off

their own inventory until the gap between supply and demand narrow. This is just one example of how members like specialists thrive to keep the market liquid. Since a lot of people are involved in the market, all market makers must be labeled as large institutions. The most common market makers in our world today are brokerage firms. As previously noted, brokerage firms provide sale and purchase solutions in order to keep the markets running smoothly. One can now begin to see how all these aspects tie into each other.

6.3.3 How Assets Are Traded

Secondly, it is also important for newly found traders to understand how different assets can be traded. One could be "in the pits" of a trading floor hollering out bids and offers, while some could be in the comfort of their own home trading electronically. Back when the market first began, trading in the pits was generally the only method of trade. Due to the technical advances of modern society, the approach has slowly digressed and been replaced by electronic trading. However, it's always nice to know about the foundation that changed the way people invest.

Open Outcry Pits

This fading method is formally known as the "Open Outcry" technique. When the outcries take action, one may not be able to think. The uproar of verbal bids and offers just take over the atmosphere. Hand signals are also seen as tool for brokers to deliver important information from one another. In order for one to understand the process of how trades are made from the pits, they can refer to the following citation. "A contract is made when one trader cries out that they want to sell at a certain price and another trader responds that they will buy at that same price" (Investopedia, 2003). This is a very

complicated ordeal for traders who are not used to such environment, which is why the popularity of electric trading has begun to grow within firms.

Electronic Trading

Essentially, it increases the rate of making trades, while providing cheaper means of business. Savings are a result from the exclusion of human error. According to Yieldbroker, “Automation of pre-trade and post-trade data processing reduces the risk of re-keying error and streamlines settlement procedures – reducing costs”. Another reason for the sudden gross in popularity is because of its convenience. Most people never had the time to pick up a phone to order trades, but now anyone has the option to turn to any mobile device and trade on the go. In addition to the technological side, it eases the ability to check for news updates on the fly. This advocates for smarter trade decisions, as well as higher returns if executed correctly.

6.4 Stock Investing Styles

When the topic of conversation is how to properly invest in stock mutual funds, all investing styles are funneled into the styles of value investing, growth investing or a hybrid system of the two, in order to create a portfolio. Individuals will argue which of these methods is the “correct” way to invest in stocks, but each of these approaches have seen their fair share of success.

6.4.1 Value Investing

Value investing, a style of investing in stocks that trade for less than their intrinsic value, attract investors who believe the market is undervalued and is overly hyped by the

news, both positively and negatively. What is an undervalued stock? Well for different investor it can be a wide range of factors and ratios, but the simplest way to describe it is

"Undervalued stocks come about through investor irrationality. Typically, value investors seek to profit off this irrationality by selecting stocks with lower-than-average price-to-book ratios, lower-than-average price-to-earnings ratios and/or higher dividend yields" (Buffet, Investopedia). The numbers are then cross-examined with the intrinsic value, which the investor uses to properly assess whether he/she wishes to enter the market depending on whether the investor estimates around present earnings or future growth. In addition, value investors also refer to the concept of "margin of safety," which basically dumbs down to the principle that they must purchase the stocks at a low enough equity, in order to account for an error in the estimated value of the stock.

Warren Buffett, often referred to as the godfather of value investing, brought forth this idea of intrinsic value, which is an assessment of what are these stocks really worth based on their future earnings power. The intrinsic value of a company by Buffett's assessment estimates their future owner's earnings then reveres their discounts back to the current market. This process is referred to as "bond math" and is combined with a "moat," which is a company with an overwhelming advantage over the competition in the market, in order to give Buffett, the necessary information to value all the stocks and eventually invest in them.

The advantage to using value investing, first off, is the potential for lucrative profits due to the face that these stocks are bought at such discounted prices, which makes the potential to make a great deal of money even higher. In addition, because the stocks are bought at such low rates, the risk to lose large sums of money is lower. The value

investor must also research stocks that are on the turnaround or stocks projected to climb in the near future, which steers them away from hype or hot tip stocks.

On the other hand, some of the disadvantages include “value trapping” which basically means running the risk that the stocks will do well and then have the unfortunate situation of not being able to sell those stocks and therefore tying up his/her capital. Another disadvantage is the fact that a value investor may run the risk of buying a stock that continues to decline in value instead of gain value. In addition, another disadvantage includes the rollercoaster ride the value investor would need to be on before they make profits. Some of these stocks may take years before they turn around and the investor makes a significant profit to sell.

6.4.2 Growth Investing

Growth investing is a style of investing based on the growth of the investor’s capital with a focus on investing in stocks that are estimated to have large earnings based on companies that are projected to be above average in their respected industry or the market as a whole. And that is also one of the biggest differences between these value and growth investing because growth investors buy stocks that are trading higher than their intrinsic value with the hopes that it will grow increasingly higher from its current value.

When a growth investor runs through their criteria for a specific company they often measure it along the lines of “whether a company has strong historical earnings growth. Aside from this, they also look into a company's forward earnings growth, management's control on costs and revenues, management's way of operating the business,

and whether the asset has the potential to double in five years" (Staff, Investopedia. "Growth Investing.").

A great example of growth investing is the CAN SLIM method created by William O'Neil, which is a system that selects stocks based on a seven-part criteria that states when a stock fulfills all of these criteria, it is poised for their biggest gains. Later in this document, one of the authors, Michael Bahnan, will discuss his use of the CAN SLIM method and elaborate on the method and how he modified it to see success through his own stocks.

The advantages of growth investing include its focus on attractive or hot companies with above average growth and earnings, its more rapid success in investing in these stocks than the overall market and investors are exposed to booming companies that continually evolve and grow within the market.

The disadvantages of growth investing include its high risk and volatility, lack of dividends due to most of these companies reinvesting their money earnings, and the fact that some of these values are much higher than the market because they are projects that may never come to be.

6.4.3 Hybrid Systems

Hybrid systems on the other hand are just as it sounds because it is a combination of both value and growth investing. A great example of a hybrid system includes a GARP strategy, which on Investopedia is defined as "the GARP strategy is a combination of both value and growth investing: it looks for companies that are somewhat undervalued and have solid sustainable growth potential. The criteria which GARPers look for in a

company fall right in between those sought by the value and growth investors.” The balance GARP traders look for in a stock versus what value and growth investors look at separately are shown in the diagram below.

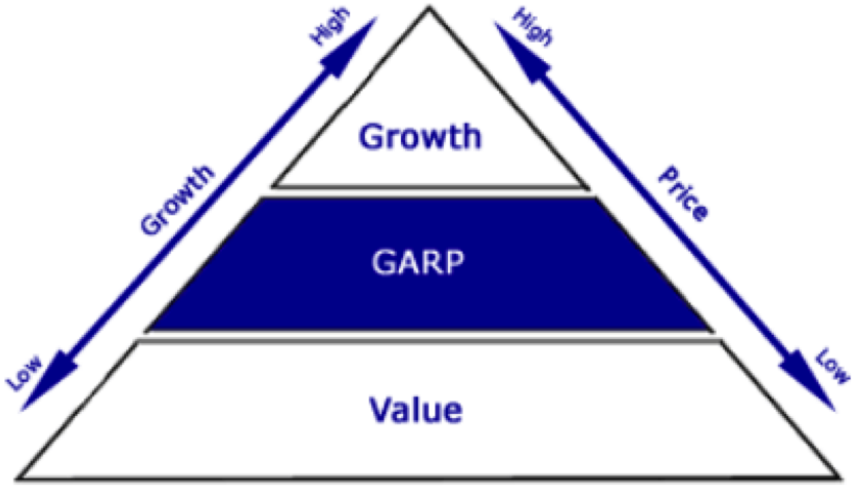

Figure 6.4.3A
(Staff, Investopedia. “Stock-Picking Strategies: GARP Investing”)

6.5 Trading Styles & Strategies

If one is a novice in the trading industry, investing their hard earned money is quite intimidating. Most of the time, the problem lies within the puzzling strategies offered by trading platforms. These strategies make up the technical analyses that were briefly discussed earlier in the report, fundamental and technical. Analysis tactics such as trend following strategies, stop & reverse strategies, volatility expansion strategies, and specialized strategies all provide means of relief when hoping for higher returns. First of all, trend following strategies continue to thrive while being one of the best long term trading methods.

6.5.1 10 O'Clock Bulls

The 10 O'clock Bulls is also a fine strategy to undertake when in the market. The founder, Goeff Bysshe, created this system to predict daily support and resistance barriers. Bysshe experimented with the most volatile parts of the day, and concluded that the locations of these barriers are found during the first thirty minutes of each session. Specifically, the highest high and the lowest low are assigned to the trendlines of resistance and support respectively. "Breakouts" occur when the prices shoot over the resistance. Bysshe inquires that if these breakouts are highly volatile, then the trend will continue to grow. Software called "HotScans" by MarketGauge, is also a large contributor for making it easier to detect unusual volume patterns, which in turn points out the right stocks to trade.

6.5.2 Moving Average Strategies

Moving average strategies are quite popular for investors. From simple to exponential moving averages, there are many different combinations a trader could use to predict market trends. For this project, our manual system implements simple moving averages for visual keys of trend shifting, while the automated system uses a double crossover simple moving average strategy. A simple moving average is displayed by taking each bar's average price and creating a line connecting the prices. Traders believe that when the line begins to belly indicates a trend shift. A crossover strategy also identifies market trends but is more concise by advocating a trader's decision to either to enter, or exit the market. Figure 6.5.9A below displays an example of a double moving average crossover strategy. The idea behind it is that one of the lines shows long-term

market trends, while the other portrays short-term trends. When both are applied, the indication to buy an asset would be when the short average crosses the long average from below. In order to sell, a trader would watch for the opposite.

Figure 6.5.2 *(Source: Investopedia.com)*

6.5.3 MACD Strategy

MACD is an acronym for *Moving Average Convergence Divergence*. It is a tool that also recognizes bullish or bearish by showing the differences between the closing price of the fast and slow exponential moving averages (EMAs). It's similar to simple moving averages due to the fact that it's essentially the average of a price over a certain period of time. Fast EMAs are typically considered to be used on a 12-day time frame, whereas slow EMAs usually represent 26-day time frames. The answer from the difference of the two is then plotted over the "signal line". A standard signal line is put into play so a trader can realize when to enter the market. The signal line is standard because it normally represents a nine-day period. Generally, when the MACD falls below

the signal line indicates a time to sell, whereas when the MACD rises above the signal line indicates a time to buy. This strategy was served as a foundation to the manual trading system that will soon be discussed.

6.5.4 RSI Strategy

The RSI is also an acronym, but is also known as the *Relative Strength Index*. It is a momentum indicator that compares total gains and losses over time. This measures speed and change of price movements of a security so that overbought and oversold conditions can be identified. When an asset is overbought or oversold, a shift in the market is bound to happen. RSI values range from 0 to 100, with overbought assets typically being above 70 and oversold asset being under 30. The data for the up and down periods are computed over the course of 14 days (standard). Sudden price movements has the ability to display false signals so one should be careful and have other indicators to back it up. This strategy is also used in the manual trading system.

6.5.5 Ichimoku Kinko Hyo Strategy

The Ichimoku Kinko Hyo (IKH) strategy is known as the most profitable strategy in currency (babypips.com). It was discovered by a Japanese man named Goichi Hosoda and published in 1969. Not only predict an assets trend, but also their momentum and support and resistance points without the need of any other indicator. After creation, it was mainly used for JPY currency pairs but it still works well with others. This is a strategy many people overlook because of its complexity, but sure enough it has the ability to make one rich. The idea of having support and resistance levels, crossovers, oscillators,

and trend indicators all in one simply makes IKH the most efficient stand-alone strategy. According to *babypips.com*, experiments were conducted to compare the top strategies used in foreign exchange. As a result, the Ichimoku Kinko Hyo strategy had the best returns. After five years trading EUR/USD this strategy alone accumulated a total profit of $30,341, and had a 6% yearly profit (see figure 6.5.12 for results).

Strategy	Number of Trades	P/L in Pips	P/L in %	Max Drawdown
Buy And Hold	1	-3,416.66	-3.42	25.44
Bollinger Bands	20	-19,535.97	-19.54	37.99
MACD	110	3,937.67	3.94	27.55
Parabolic SAR	128	-9,746.29	-9.75	21.96
Stochastic	74	-20,716.40	-20.72	30.64
RSI	8	-18,716.69	-18.72	34.57
Ichimoku Kinko Hyo	53	30,341.22	30.34	19.51

Figure 6.5.5 (Source: *babypips.com*)

6.6 Difference Within the Trading Styles

Traders are always contemplating on what strategies that best suit their needs. Table 2 offers a few tips to that may help encourage the average investor trade with other styles.

Table 1	Trend	S /R	Volatility
Time in the market	Always in the market	Not always in the market	A substantial amount of time out of the market
Winning trades	Small percentage of winning trades	Higher percentage of winning trades	High percentage of winning trades
Where is money made	Money is made on big moves	Money is made in sideways markets	Money is made in market explosions
Where is money not made	Money is lost in choppy periods	Money lost in trending periods	Money is not made in quiet markets
Biggest con	Many false signals, long drawdown periods	Difficult to sustain profit over the long term	Never get the big move
Biggest pro	Possibility of high profits	Higher percentage of profitable trades	High percentage of profitable trades
Profit	Average profit per trade high over long term, unlimited	Limited average profit per trade	Small profit per trade, limited
Philosophy	Buy high and exit higher, sell low and exit lower	Buy low and sell high	Very quick and short term trades
Emotional	Long sustained drawdown periods can be difficult	Easier to trade because you are buying low and selling high	Exciting to trade - trades are short-term
Type of Indicators used	Moving Average, ADX, price bands and channels	RSI, %R, Stochastics, Support/Resistance lines	Purely based on price

Table 6.6A *(Source: Wright, 2009)*

6.7 Time Frames

A major consideration that needs to be taken into account when designing the correct trading system is the time frame that the system will trade on. The time frame of a trading system dictates how long the system will sustain open trades on the market. A

trading system can involve numerous amounts of time frames but some of the most common are listed below.

- Scalping
- Day Trading
- Swing Trading
- Intermediate Term Position
- Long Term Position
- Active Investing

Each of the time frames listed above have their disadvantage and advantages and investors must choose a time frame that is best suited to accomplish their investment goals. In addition to matching goals, investors and traders must also choose a time frame that will allow them to reduce their costs as much as possible as this will optimize their return on investment.

6.7.1 Scalp Trading

Scalp trading is usually reserved for experienced traders with enough discipline to craft a strong and decisive exit strategy due to the fact that if a trade is mistimed then the trader can lose all the profits made during that session. The main method of generating profits while scalp trading is to use technical analysis to monitor small price changes and exit the trade when they are favorable. One of the biggest disadvantages of a scalp trading system is the extremely high commission costs unless one has access directly to an exchange when trading with equities.

6.7.2 Day Trading

The most common form of professional trading is day trading, which means that the trader or investor will always end the trading session in cash and close all open positions. Day trading comes with many advantages and disadvantages that can affect both investors and traders.

One of the main benefits of closing positions at the end of the day is that one can simply relax after the trading session and there is no need to worry about losing money on an open position. Besides ease of mind after the trading session day trading can also allow one for increased profits because intra-day movements can be quite large which can provide large amounts of profits.

Although day trading has large benefits it also presents significant downsides for traders and less proficient investors. One of the main tenets of day trading is that one should have a "risk" portion of their liquid assets that they are willing to lose on any day without significant grief. Although day trading enables career freedom and mobility, it is an extremely unpredictable source of income and is also extremely stressful as markets can be extremely volatile.

6.7.3 Swing Trading

Swing trading is similar to day trading except that swing traders hold their positions for longer periods of time in order to take advantage of price fluctuations within the market that are not possible to capture during intra-day trading. Swing trading involves both fundamental and technical analysis to find indicators that can detect an upcoming price swing.

When compared to day trading, swing trading requires a more conservative position sizing method due to the fact that holding positions overnight exposes the trader to increased risk. This is especially important when trading on margin as large losses can wreak havoc on a trader if there is a margin call.

In essence, swing trading can be beneficial due to the fact that it has a larger potential profit and can be done over long periods of time, which allows for traders to develop a more sophisticated trading strategy. However, it can also be risky due to the fact that it creates longer-term exposure to risk from the market as positions are held open for longer periods of time. In addition, swing trading places one at risk to lose more capital than initially thought due to the fact that price swings can be more volatile than those that occur during intra-day trading.

6.7.4 Intermediate and Long Term Position Trading

Intermediate Position Trading is a method used when the market displays long-term price signals rather than excessive fluctuations. The goal of position trading is to find the trend and hold positions in stocks that are following this trend and keep the position open until the trend subsides. The main advantages of position trading are limited commission costs as well as increased gains due to the larger price changes that occur during a trend period. Another advantage of position trading, is that there is no need to constantly monitor stocks as small fluctuations can be ignored as long as a general trend is still developing.

Some of the disadvantages of position trading include the reduction in liquid cash, and the need to perform fundamental analysis on specific stocks in order to find ones that match the targeted trend. When trading based on long or intermediate positions traders

also need to consider whether or not their capital can be tied up in open positions for long periods of time.

6.7.5 Active Investing

Active investing or active management is a portfolio management strategy that dictates that the investor used different strategies to choose unique stocks rather than simply choose an index fund that gives returns that match the market. One of the fundamental tenets of active investing is the belief that there are inefficiencies in the market that one can exploit via some additional piece of data or knowledge. Active investing is a long-term method that relies on choosing undervalued stocks via methods such as ratio analysis, DCF analysis, sector analysis, and, macroeconomic trend analysis. Active investing has numerous advantages, with the chief one being the ability to obtain returns that exceed the market. In active investing, returns are derived from exploiting inefficiencies in the market that directly opposes the efficient market theory. Most active investors believe they can beat the market by choosing certain high performing sectors or dig deeper and analyze certain companies that may be undervalued or overlooked by the market. This method has numerous advantages and disadvantages that are mainly dependent on the individual trader or investor.

The main advantages of active investing are the potential for higher returns via insights on certain sectors of the market. In addition, active management of a portfolio allows an investor to limit risk due to excessive correlation between stocks in a portfolio and thus increase diversity in assets. In addition to additional diversity and the potential for additional returns that surpass the market, an investor who actively invests gains large amounts of flexibility and can choose stocks that suit his expertise and interests rather than

become satisfied with mediocre market based returns. These advantages allow for active investing to be a favored option for investors who have the time and desire to perform basic research on their investment portfolios.

There are also some disadvantages of active investing due to the fact that it is inherently carries a higher risk than simply passively investing in an index fund. The main disadvantage is the investor or investment manager needs to be proficient in the financial markets and take an active interest in researching the financial asset being traded in order to receive an actual increase in returns. Another disadvantage is that if one's method of choosing equities or financial assets is incorrect, one can lose significantly more capital than if invested in a simple index fund.

6.8 Manual Trading Vs. Automated Trading

With the creation of trading platforms based on the internet there has been a surge in traders using automated trade platforms to make decisions regarding investments. There are two main types of traders and investors, some decide to trade their positions manually, while others decide to automate the process by programming indicators to create an algorithm that can trade positions automatically. With each of these approaches to trading, one must balance the benefits and the problems of each approach. The benefits of automated trading include the ability to maintain trade discipline, gather large amounts of data, and the ability to trade accurately and efficiently. However, a major issue with automated systems is that they cannot adapt to rapidly changing market conditions such as massive price fluctuations or improbable events. In addition, manual traders can have increased control in their record of profits and losses as they can see patterns and decide to deviate from rigid position boundaries to boost profit and minimize losses.

6.9 Fundamental Trading Vs. Technical Trading

A major consideration during the creation of a trading system is to determine whether the system will focus on the fundamentals of the market or the technical aspect. Fundamental traders usually make trades when company events occur that move prices in either direction and tend to employ a buy and hold strategy. In addition to focusing on company events, fundamental investors may also research a company's financial statements, management reports, corporate governance structure, and historic or future earnings reports in order to obtain a clear picture of the company's value.

In contrast to fundamental investors who look towards a company's future as an indicator of growth, technical traders and investors gather large amounts of information on the price history of companies to determine future price movements. The main premise of technical trading and investing is the use of numerous price indicators such as the moving average to make decisions on whether to enter the position. However, the sheer quantity of indicators for a given market makes it extremely difficult to choose several broad indicators, which makes a trader use different indicators for each sector. In addition, it is a common notion that past performance of assets do not indicate future performance, thus most investors do not use technical indicators as final decisive factor but rather use it as a screening tool for further analysis. Alongside the moving average several key technical indicators include the RSI (Relative Strength Index), support, resistance, pattern analysis, trends, and opening/closing prices.

Investors and traders use both technical and fundamental trading methods to enter and exit positions as each method has benefits and disadvantages. A trader who trades on mostly short term positions is most likely to use technical analysis as it can provide insight

on a position in a short period of time. In contrast, longer-term investors use fundamental trading strategies as it can provide more gains in the future than simply trading based on historic pricing indicators.

6.10 Personal Objectives of Trading Systems

When investors and traders design trading strategies and systems they have some concrete objectives, they desire to be fulfilled. These objectives vary based on each individual investor and trader based on their desire for either short or long term profits.

Long term traders and investors design trading systems that usually require minimal time commitments, high profit factors, sector robustness, and high annual return. The minimal time commitment objective is valued because most long-term investors have other passions or desires they would rather devote their time too rather than micromanaging their portfolio such as most day traders. The profit factor of a system is a universally vaunted objective and it determines whether a system is effective at generating return for a trader or investor. A profit factor of above one signifies that the system does not lose money and generates positive return. Sector robustness is an essential objective of long-term systems as market sector conditions can be volatile over long periods of time and thus sector diversification minimizes the effect of sector losses on the entire portfolio. Another key objective of a long-term system is the high annual return, due to the fact that the risk-free rate for a long-term portfolio is directly tied to the risk free rate of the S&P 500, which is currently at around 9%. In essence, if a trading system does not achieve an annual return of over 11% (inclusive of fees and expenses) it does not generate a noticeable return for the investor or trader as one can simply invest in an index fund and achieve the risk-free rate.

In contrast to long-term traders, short-term traders must consider different objectives that more closely align with their goals. The objectives of many short-term investors revolve around a high winning percentage, low drawdown, low market exposure, minimal holding period, and the profit factor. The profit factor is also essential to short-term traders as it signifies the profitability of the system. As is the case of a long-term system, a profit factor of above one signifies that the system can generate a positive return on investment. A high winning percentage is important in a short-term system due to the fact that it allows for the maximization of returns in the face of the high commission costs associated with rapid trading systems. Short term investors also prefer to minimize their exposure to the market as well as have low draw-downs in order to minimize their losses since the market can be extremely volatile when trading in short time periods such as minutes or even seconds. The desired objectives of a trading system play a major role in deciding which trading strategy to utilize for an investor or trader.

6.11 Fundamental Law of Trading Strategies

When designing trading systems, it is important to realize that it is impossible to achieve all desired objectives as stated by the fundamental law of trading strategies. The main tenet of this law is that as the profit factor increases or the trade ratio declines, the necessary winning percentage of the system or strategy increases in proportion. Due to this requirement, a trader or investor can avoid losses and set a desired winning percentage as long as the individual realizes that this will have an effect on the profit factor and trade ratio of the system as a whole. (Radzicki Topic #5 Slide 19)

6.12 Trading System Rules

Any trading system design is inherently a simple amalgamation of various rules that must be executed in a certain order to obtain the desired result. A proper trading system or strategy should contain the following components: entry rules, exit rules, loss rules, position sizing rules, order type rules and stock screening rules.

6.12.1 Entry Rules

Entry rules are a key component of a trading system as they determine the frequency with which the system trades on the open market. Trading frequency directly corresponds to commission costs as costs rise alongside an accompanied increase in trading frequency. When generating entry rules for a trading system it is important to be broad in terms of choosing indicators and triggers in order to minimize the risk of missing large market movements. For example, if there are too many entry rules one may miss a large price swing in a certain equity due to the fact that the system may have not entered the position since all entry rules were not met.

There are two types of main entry rules: set-up rules and trigger rules. The goal of set-up rules is to discover favorable conditions in the market that can increase return on an investment position. These rules can be based on a variety of factors such as Macroeconomics, Global Events, or Sector Rotation. Rules that are generated based on macroeconomics require that the trader be actively participating in the econ
omic calendar and understand basic macroeconomic theory. When generating rules based on world events, an investor must pay acute attention to news of global events. For example, if there is conflict in the middle east oil prices may rise which can signal an entry point into the energy sector. If using sector rotation to generate entry set-up rules,

one must carefully track the business cycle and change sector allocations in sync. One must also recognize that set-up rules are simply indicators that signal when the market is ripe for entry they cannot be used to automatically enter the desired position. The actual entry into a position is one only when trigger rules are present as well.

Trigger rules are used to signal the exact time in the market to enter the desired position. Most entry trigger rules use a combination of variable such as price patterns as well as informational indicators to determine when to enter the position. When creating trigger rules, it is also important to consider the order type being used as a trader can only determine the order price or if the order can be filled but cannot guarantee both conditions will be met. (Radzicki PPT#5 Slides 54-62)

6.12.2 Exit Rules

Exit rules are extremely essential to the design of a positive expectancy trading system and thus the utmost care must be taken when designing the proper rules. Exit rules are tailored to the mentality and goals of each individual trader or investor. Exit rules are designed in conjunction with the desired position sizing technique as they are intertwined in operation. In trading system design there are four main categories of exit rules: Discretionary, System Level, Position Level, and In-Activity.

Discretionary exit rules are designed to encompass uncommon scenarios and are mainly designed to prevent trading until the system can be implemented properly. In addition, these rules can be used to guide the trading system through unpredictable market moves where your system was not designed to perform.

Although, discretionary exit rules cover uncommon scenarios, system and position level exit rules will be used in the majority of cases when the trading system is properly

implemented. System level exit rules can be designed to exit a position when the trader is unable to monitor for a certain amount of time, or if the trader cannot get to a device to see all of his positions. System level exit rules can also be used to exit a position based on technical parameters as well as the sheer cost of the position. For example, system level rules can be designed to leave a position when the system is out of range, exceeds maximum drawdown, or if it gets too many entry signals. At the position level, a trading system can have rules that can dictate that the position exit occurs when the liquidity disappears, underlying asset or firm is sold or delisted, or if the system receives a new entry signal which demonstrates an excess return on gains. The new entry rule should only be used when the trader does not have enough capital to enter both positions.

Along with the decline in liquidity, an investor or trader can also decide to create exit rules that can leave a position when it does not perform as expected in a given period of time. This rule is extremely crucial due to the fact that a position that is undeforming for a long period of time simply generates risk and no reward. the length of time given before exiting a position depends on each individual system due to the fact that it is in proportion to the average trade duration of the system. Similarly, to the average trade duration, the threshold for the minimum profit/loss a position must generate before an exit depends on the volatility of the traded instrument.

The main purpose of any trading system is to maximize the profit of any position. When exiting from a profitable position the rules must be designed so that the exit happens at the point where the most profit can be extracted from the position. In addition, these rules usually intertwined with the position optimization and sizing process. They must be designed together in order to have the most profit possible. However, if a trader or

investor believes that they need to exit a position with a loss, the rules for loss exiting are applied. These rules are usually designed using pre-determined systematic risk parameters that can vary for each investor or trader based on their capital and their risk tolerance. The usual method of setting up a stop loss is to use a money management stop, which dictates the absolute most one is willing to lose in a trade if the market moves in the opposite direction. (Radzicki Slides 62-67)

6.12.3 Position Sizing Rules

Exiting a position with either profit or loss requires exit rules to be designed in tandem with position sizing rules. There are two main position-sizing techniques used in the design of trading systems: Martingale and Anti-Martingale. The martingale method of position sizing believes that it is prudent to increase the position size after a loss and then decrease it after a positive. The problem with this method of position sizing is that it assumes that different trades are dependent on each other. However, most trades are independent from each other and leads to the issue that trades cannot be determined to have a win or loss based on past trades. In contrast, anti-Martingale systems do the opposite of Martingale systems and they add to the size of a trade when it generates profits. An example of an anti-Martingale system is the Fixed Fractional Position Sizing system. The premise of this method of position sizing is to risk the same fraction of the account equity on every trade. The advantages of this method are that it can take control of trade risk, and can respond to changes in equity. The most essential component of this system is the fixed fraction portion, which can be found via Monte Carlo analysis or the secure f. This sizing method allows for traders and investors to maximize the gains and minimize the losses from trading on the open market. (Radzicki Topic #7 Slides 7-30)

6.12.4 Types of Orders

There are four main types of orders that can be placed when an investor or trader wants to enter a position. These different orders are as follows: market order, limit order, stop orders, and other types of orders. The market order is the simplest type of order and it guarantees that the position will be filled. The main issue with market orders is that there is a significant amount of slippage between the time the order is placed and executed due to the spread of the stock. In addition, since the orders are guaranteed to be filled, there will be some price slippage if there are issues with the volume or liquidity of the position. In contrast to the market theory, a limit order allows the trader or investor to only buy or sell an asset if a certain price is met. This allows for the trader and investor to set the entry price rather than the market. However, the issue with limit orders is that they do not have the guarantee of being filled. The stop order is similar to a limit order, however a stop order dictates that the asset cannot be bought or sold unless the price surpasses a certain set price.

7: Optimizing and Analyzing Systems

“Beginner's luck” is a term used throughout the English language. Many traders who created automated systems for the first time are subjected to this when cracks start to emerge and funds begin to tumble. No one has ever been recorded having a perfect system their first time around, which is why certain precautions started to emerge. In order to prevent such failure, traders began to implement different optimization and analysis techniques to test their system before putting it on the market.

7.1 Optimization

If one looks up optimize in the dictionary, they will find a definition similar to this. “optimize: to make as effective, perfect, or useful as possible” (Dictionary.com). Optimization within trading systems is simply holds the same idea. The idea behind it is to find the most profitable version of a strategy by back-testing it multiple times while changing its parameters at the same time. It is arguably one of the best techniques, as well as the last steps towards developing a trading strategy. The method involves putting the system in the market by using records of the past. Using historical data is the reason techniques like Optimization is controversial. This is because the market is completely random all the time and never repeats itself, so using records of the past seems redundant.

The results are executed depending on the assigned objective function. This means the investor is given a choice to optimize with options like net profit, winning percentage, sharp ratios etc. In addition, objective functions can also include combinations of different factors to eliminate drawbacks. For example, minimizing the number of consecutive losses on top of the search for highest net profit will sometimes increase a system’s performance.

Having too many objectives could depreciate the result; this is called over-optimizing. When over-optimizing a strategy, a trader must then be aware of curve fitting. Curve fitting occurs when a strategy is over optimized to past prices. “You know that a strategy is over-optimized and curve fitted if it misses the move for which it was designed” (Wright). Famous author/investor, Charlie Wright, continued his teachings by presenting a checklist one should follow to avoid over-optimizing. The following is located in “Trading as a Business”, by Charlie Wright (pgs. 89-91).

- DEVELOP YOUR STRATEGY BASED ON A MARKET THEORY OR IDEA
- KEEP THE STRATEGY SIMPLE
- USE THE CONCEPT OF SET-UP AND ENTRY
- MAKE SURE THE STRATEGY WORKS ON A VARIETY OF SECURITIES
- LOOK AT SURROUNDING PARAMETERS
- DO SOME FORWARD AND BACKWORD TESTING

Not only can assets be optimized individually, but they can also be optimized when grouped together. For example, Portfolio Maestro by TradeStation, offers a highly intelligent tool delivering “portfolio-level performance reporting, risk assessment and optimization for virtually any combination of symbols and strategies” (tradestation.com). One must be aware when developing portfolios that the assets should share similar qualities. For instance, indicators for each asset should produce somewhat similar results so that the system remains consistent with profit.

7.2 Expectancy, Expectunity, System Quality

After gathering the previous back-tested data, a trader would normally wish to know their expected profit from there on out. However, there are many traders in the market who carry out their methods without knowing their long-term profit. This attitude is not what a successful trader wants to have. Expectancy, expectunity, and system quality are three of the most fundamental areas that depict the science behind evaluating a system's profit.

7.2.1 Expectancy

Also known as the expected value, is a term that measures the average performance of a trading system. One first must begin with determining the R-multiple of a each trade. The R-multiple (c) is calculated from,

$$ABS(P) = cR$$

where the absolute value of P is the profit and R is the money risked (i.e. entry price). According to Van Tharp, having high R-multiples on winning trades and low R-multiples on losing trades is a good indication of a successful system.

From here, a simple calculation for expectancy can be completed given that there is enough trading history. In order to receive the most accurate results, one must have a large amount of trades. Expectancy is

$$E = \frac{\sum_{i=1}^{n} Ri}{n} \ ,$$

where n is the number of trades the system made, and Ri is the risk multiple of trade i.

7.2.2 Expectunity

Expectunity is simply the average net profit a system is capable of in a one-year span. What's great about this tool is that it doesn't matter what kind of system a trader is running. Expectunity exploits profit from the rate of all trades, no matter the asset. This makes comparison amongst other systems simple and easy. This calculation takes into account every cost factor that is faced during investing. Expectunity is given by

$$E' = (E - C)T$$

where E is the previously calculated expectancy, C being the total costs (subscription, fees, commission, etc.), and T being the estimated number of trades per year (Radzicki, 2016). Even though expectunity is calculated on a yearly basis, it does not imply that it needs to be. For instance, if a trader wanted to know their monthly net profit, the simple switch of making "T" the number of trades per month is plausible.

7.2.3 System Quality

How does one know if their system has an edge? A quick answer would be to ascertain the system's quality. Dr. Van Tharp, a prominent investor and educationalist, developed the System Quality Number (SQN) after numerous years researching position sizing (Tharp, 1996). This number measures the relationship between expectancy and standard deviation of R-multiples (i.e. risk/reward ratios). In addition, Dr. Tharp also stresses that position sizing strategies are easier to manipulate when one has a higher SQN. Given the expectunity, the system quality is given by

$$Q = \frac{E'}{\sigma(c)}$$

where (c) is the standard deviation of the R-multiples for every trade in the system. Below is a guide a trader can use to grade their SQN. The data is only held reliable for systems with 30 trades or more. *(Contributors of Trading Journal Spreadsheets)*

Score: 1.6 – 1.9	*Below Average*
Score: 2.0 – 2.4	*Average*
Score: 2.5 – 2.9	*Good*
Score: 3.0 – 5.0	*Excellent*
Score: 5.1 – 6.9	*Outstanding*
Score: 7.0+	*Holy Grail*

7.3 Modern Portfolio Theory

Harry Markovitz created the Modern Portfolio Theory in an effort to help investors choose stocks and create portfolios that can generate returns optimized for the market risk at the time. The main tenant of Modern Portfolio is the belief that there is a certain frontier or collection of portfolios that can be optimized to give best return for a given risk level. In addition to optimizing the portfolio for a certain risk level the theory also allows for the benefits of diversification to be quantified.

The MPT considers the main risk to most investors as the spread between the return on a certain stock versus the average return of that stock during a defined time period. The theory behind this methodology is that one can reduce the riskiness of the portfolio as a whole by combining many risky stocks together to reduce the deviation from the mean. In order to fully quantify the benefit of diversifying one's assets, five main statistical

measures are used. The five measures, also called risk-ratios, used by the Modern Portfolio Theory to quantify risk and diversification are listed as below:

- Alpha
- Beta
- Standard Deviation
- R-Squared
- Sharpe Ratio

(Investopedia Staff, "Modern Portfolio Theory")

7.3.1 Alpha

Alpha is simply the difference between the performance of a single stock or a mixed portfolio of many stocks against a certain benchmark target. In some cases the alpha of a portfolio can also be defined as the extra return beyond the benchmark return of the portfolio. The main goal of alpha is find the risk and return factor of a mutual fund when used alongside with Modern Portfolio Theory.

Alpha is a metric that is used mostly in active funds, as it is an easy way to quantify the performance of the fund manager. For example, if a certain fund has an alpha of zero then that fund manager is adding no significant value since the fund is simply returning the same as an index fund. In contrast, if the alpha of a fund is above zero then the manager is adding value to the fund as the fund has returns that exceed the market. In most cases, an actively managed fund needs to have a relatively high alpha in order to sustain investment as these funds charge high fees in exchange for high rates of return.

Although alpha is considered a key metric in Modern Portfolio Theory it cannot be used to measure performance across portfolios with different allocations of financial assets as the alpha of each class of asset varies significantly. In addition, the proper calculation of alpha requires the use of the current benchmark for that unique portfolio and thus the incorrect selection of a benchmark index can lead to wide disparities in alpha values.

7.3.2 Beta

The beta of a security or portfolio is typically determined via regression analysis and is indicative of the volatility of the investment in comparison to the general market. The main reason for the beta value is to measure a specific security or portfolio's tendency to change prices in tandem with the changes in the market.

In order to properly use the beta value when investing it is important to consider the R-Squared value of the security to be analyzed. The R-Squared value is needed to calculate the beta due to the fact that this value is used to measure the number of times that a change in price of a security is correlated to changes in a benchmark index. Thus, the R-Squared value is extremely important to the accuracy of the beta value. After finding the R-Squared value, one can then calculate the beta value by dividing the covariance of the selected security's returns and then divide this value by the variance of the returns of the benchmark over a certain period of time.

After calculated it is important to understand what the value means and how it affects the security being analyzed. For example, if a security has a beta of less than one then, that security is considered to be less volatile than the market and has fewer price changes than the market. In contrast, if a stock or security has a beta value above one, then that stock is more volatile than the market benchmark. Beta values in the equity market

vary based on stock type and sector as utilities usually have betas close to one, while newer sectors such as technology stocks have beta values significantly above one. When the beta value is above one, an investor can expect the stock to be riskier than the benchmark index but can also expect increased returns when compared to simply investing in an index fund.

7.3.3 Standard Deviation

The main purpose of Standard Deviation is to measure the distance of a data set from the mean. Standard deviation is calculated by obtaining the square root of the variance of each data point to the mean. When used in financial terms the standard deviation is used to measure the volatility of a certain security. The volatility of a security is calculated by finding the deviation of its returns with that of a benchmark mean during a certain time period.

7.3.4 Sharpe Ratio

The Sharpe Ratio is a risk measure created by William F. Sharpe and is a method used by the financial industry to calculate a portfolio or security's return adjusted return. The Sharpe ratio functions by subtracting a risk-free unit of measure from the average return of a security or portfolio. By subtracting the risk-free return factor, the return based on risk can be isolated from the portfolio or security being analyzed. The benchmark security used to determine the risk-free rate is the US Treasury Bill which is considered to have a Sharpe ratio of zero, thus having essentially zero risk. US Treasury bills have a Sharpe ratio of zero due to the fact that the chance of the American government defaulting on Treasuries is extremely rare.

After understanding the basics behind the Sharpe ratio, it is important to understand the uses of the ratio and situations when it is most accurate. It is important to understand that the Sharpe ratio does not function accurately when the risk of a security is not linear such as options. The Sharpe ratio is inherently connected to the Modern Portfolio theory because the Sharpe ratio is known to increase as the diversification of a portfolio increases. The formula required to calculate the ratio is extremely simple and is simply the mean return of the portfolio minus the risk-free rate, divided by the standard deviation of the portfolio return.

There are two main reasons to use the Sharpe ratio and both are essential to the financial services industry. The Sharpe ratio is used by investment managers and financial advisors to determine the changes in the risk based return of a portfolio. This is done when different financial assets are considered and added to the portfolio. If the investment manager determines that the additional assets increases the overall Sharpe ratio of the portfolio, then the asset should be included in the portfolio. However, if the asset under consideration is determined to lower the Sharpe ratio, then the asset or asset mix should not be added to the portfolio.

In addition to determining assets to add to a portfolio, the Sharpe ratio can also be used to evaluate the performance of an investor or a portfolio manager. More specifically, the Sharpe ratio is used to determine whether the returns of a given portfolio are based on sound investments or as a result of risky assets performing well in a certain time period. Many hedge funds and investment managers have a range of promised returns, but it is essential to determine that the increased returns are not a result of a riskier investment strategy.

Although the Sharpe ratio is used by many members of the finance and banking community to determine true risk-factored return of a portfolio, there are some disadvantages in using this somewhat time-worn measure of financial performance. The Sharpe ratio utilizes the standard deviation of the portfolio returns, which means that it cannot be used in scenarios or assets that do not have returns that are distributed normally. In addition to relying on the standard deviation of returns, another issue with the Sharpe ratio is that portfolio and fund managers can manipulate the Sharpe ratio in order to show that their returns are favorable. Simple ways of manipulating the Sharpe ratio include changing the time period for the standard deviation calculations as well as using non-compounding returns for calculating the standard deviation. Besides basic manipulation of the returns and time period, managers can also use measures such as eliminating extreme return values, smoothing the returns via unconventional pricing models, and using various option techniques to offload excess risk to a time period not considered when calculating the ratio.

Due to the fact that the Sharpe ratio includes both positive and negative variability, a better solution called the Sortino ratio was created. The Sortino ratio was produced by Frank A. Sortino. It is an adaptation of the Sharpe ratio as it separates the negative variability of an asset from the positive by finding the standard deviation of only negative asset returns which is also called the downside deviation. The main reason for the use of the Sortino ratio is to counteract the fact that the Sharpe ratio can misrepresent actual risk in an investment by including the positive variability of the asset.

(Investopedia Staff, “Sharp Ratio”)

8: Dereck Pacheco's System

8.1 Overview

This portion of the project will discuss our system in the foreign exchange market. Both manual and automated trading were implemented because of doubt the other would be successful. Each style was given their own set of entry and exit rules that was profitable, but to an extent. At first there wasn't much success with net profit, but towards the end strategy flaws were critiqued creating a reliable system. When reading about the automated system one will see a difference in returns when trading under daily bars, or during a specific time of day. When reading about the manual system one will be given some feedback that may influence their decision on what currencies to invest in. Also, there is evidence to suggest that there may be a difference in returns when either buying or shorting a currency.

Reasons for choosing foreign exchange

- Cheap

For someone new to the market, we wanted to find ways of trading as cheap as possible. Unlike your average assets, brokerage firms do not require any commission when trading currency. Also, one can open an account for as little as fifty dollars.

- Level Playing Field

With stocks and other assets, there will always be "insider traders" and news released late. Both of which can kill someone's hopes of succeeding in the market. On the other hand, since forex currencies are strictly related to their country's economy, no party can have an

advantage over another. This is because economy updates are released at the same time for everyone.

- Stable

Forex is probably the most stable asset in the market, so there is no worry of drastic downfalls. While other assets experience large price fluctuations on a daily basis, it is rare to see currencies change by more than one percent.

- Availability

Unlike sessions in stocks, currencies can be traded twenty-four hours a day around the word. This is important to us because it presents the opportunity to handle one's profession, and be able to make trades on the side afterwards.

Currency Pairs Traded

- Automated System
    - EUR/USD
- Manual System
    - EUR/USD
    - GBP/USD
    - USD/JPY
    - AUD/USD
    - EUR/GBP
    - USD/CAD

8.2 Literature Review

"Understanding and using basic principles provides an anchor of sanity when trading in a crazy world" (Wright, 1998). Charlie Wright believed that trading wasn't just a hobby, but more so a business that encouraged the use of essential rules and regulations. In his book, *Trading as a Business*, he went over certain concepts that can guide one's ability to create a successful trading system. Wright wrote that a systems profit doesn't come from good market predictions. Instead, it comes from having a well-structured strategy with entry rules, exit rules, stop rules, and principles surrounding money management. His ideas on testing these strategies were implemented in this system by means of optimizing. Wright suggested the best way to begin designing a strategy is to review just one indicator at a time. Beginning with the automated trading system, one will see only one indicator was used. Optimizing one indicator was helpful because the software moved faster and gained more trades, which offered more accurate results.

Moving over to the manual trading system, one will notice that three indicators were used, MACD, RSI, and SMA. Each of these indicators was resourced through *babypips.com*, a beginner's guide to forex trading. The MACD indicator was developed by Gerald Appel and publicized in his book, *The Moving Average Convergence Divergence Trading Method*, in the late 1970s. He wanted to create a tool that revealed changes in strength, direction, momentum, and duration of a stock price trends. A man named Thomas Aspray added to this discovery later on down the road in 1986. He introduced the divergence bar graph to the MACD that also assisted with means of anticipating crossovers. In 1978, J. Welles Wilder developed the RSI indicator and recorded it in his book *New Concepts in Technical Trading Systems*. Wilder based this

idea off of the stochastic tool created by George C. Lane in the 1950s. Wilder emphasized how systems using trend-following methods are the most profitable in trending markets. However, one needed to understand that profit regularly decreases when the market moves non-directionally (sideways). Wilder wanted to come up with a tool that portrayed directional movement and volatility while considering rates on commission. He realized that commission takes over systems that trade in sideways markets due to the fact that more frequent trades are processed and smaller profits are obtained. Wilder communicates that entering the market only in times where assets are overbought and oversold not only foresees trend shifts, but also cuts down on less profitable trades. Lastly, the SMA is the basis for all technical analysis techniques. Dating back to 1901, a statistician named Reginald Hawthorn Hooker developed what we now know as a "moving average". It was developed to smoothen out data over time while forecasting trends. Not only was Hooker's discovery used for mathematical purposes, but it also led to tracking system designs for the government. Regardless, simple moving averages have been used for decades by many traders to predict trends in the market.

8.3 Methodology

Automated

- Moving Average 2 Lines Crossover

o Prof. Radzicki's *mjr_In_Class_5*

The objective for this strategy was to experiment with double moving average indicators and see if it is a reliable strategy. Only one indicator of strategy was used

because over the course of this IQP, we learned that some of the most profitable automated trading systems were the simplest. Overall, the experiments went well and revealed useful information about optimization, a phenomenon that was previously discussed in Chapter 4. Creating automated code that's already invented, or otherwise "re-inventing the wheel", is useless. So with the help of Professor Radzicki's EasyLanguage scripts, a simple moving average crossover code was found to carry out the process. After gathering Radzicki's code, "mjr_In_Class_5", it was later put to the test with TradeStation's optimization tool. All trades were performed under hour and daily bars, while being traded from 7am to 1pm and all day respectively. Hour bars were given the 7am-1pm time restrictions so that 10'Oclock bulls could be accounted for. Both approaches were applied to see if the time of day, as well as bar intervals affected the outcome of returns under the same strategy. Also, no position sizing rules were implemented so each trade was either buying or selling one hundred shares. Optimizing with these parameters was key when comparing the two approaches.

Manual

- Combination of Indicators
  - MACD
  - RSI
  - SMAs

In this manual trading strategy, a great deal of trial and error went into effect when trying to find the best possible indicators. Due the success rate of the automated system, more than one indicator was implanted to see if it had effect on profitability. Optimization could not be used in this case since the strategy wasn't code based; so all feedback was

processed through excel calculations (see findings in Results). The leading indicator used is this strategy was the MACD (14, 28, 9) because it is known to be good a foundation for trend shifts in the market. The input variables were used by default. If there were any discrepancies with this process, then the next two sub-indicators would clear most of them up. For example, RSI (14) and SMA's (14), (28), (50), and (100) would be examined if the MACD and signal line continued to cross with little separation between them. If this event occurred when RSI data was above 70, then a trend shift was about to materialize. The same result is considered if the data was below 30. SMA indicators would then be used to back up this information by also confirming swings in the market. When operating the 4 moving average lines, long to short term trending was presented providing a broader view of market tendencies. Hour bars, four-hour bars, and daily bars were also used to advocate decision-making by reinforcing past market trends. No position sizing rules were implemented and trades were executed at random times throughout the day. The amount of shares bought or sold was strictly based off confidence.

8.4 Entry Rules

Automated (Refer to Appendix for full EasyLanguage script)

- If linear, exponential, or weighted averages = 1, then buy long if the fast average line crossed above the slow average line
- If linear, exponential, or weighted averages = 1, then sell short if the fast average line crossed below the slow average line
- If HOURS bars, code would begin when time was ≥ 0700

- If DAILY bars, code would begin at any time specified by the trader

Manual

- Currency shares would be bought if all comply…
  - MACD line crosses over the average line
  - RSI data is under bought (under the 30 signal line)
  - SMAs begin to belly up bullishly
- Currency shares would be sold if all comply…
  - MACD line crosses under the average line
  - RSI data is over bought (over the 70 signal line)
  - SMAs begin to belly down bearishly
- For further reference, the previously specified time slots would be cycled through before performing a trade. This offered reinforcement on market trend predictions as well by smoothing out the indicator lines

8.5 Exit Rules

Automated (Refer to Appendix for full EasyLanguage script)

- Long position closes when it's time to sell short
- Short position closes when it's time to buy long
- If HOURS bars, code would stop when time was ≤ 1300
- If DAILY bars, code would stop at any time specified by the trader

Manual

- Long position closes when MACD crosses under average line

- Short position closes when MACD crosses over average line
- Avoiding the market altogether is a result from tightly intertwined crossovers from the MACD and average line

8.6 Results (Refer to Appendix for full Optimization and/or Trade data)

Automated

All in all, the system proved to be profitable. The feedback was quite unusual because out of the twenty-one recorded trades, just four accounted for 96% of the total profit. These four trades were under daily bars, which is odd because there were only five total trades under that parameter. This aspect from the results concludes that daily bars appear to be more profitable than hour bars. The system quality stood at an outrageous 17.86 because of it. See below for recorded results.

	All Trades	Daily	Hourly
Total Net Profit	$4.90	$4.73	$0.17
Total Loss	-$4.09	-$0.19	-$3.90
Total Profit	$8.99	$4.92	$4.07
Total Number of Trades	21	5	16
Total Winning Trades	13	4	9
Total Losing Trades	8	1	7
Win Ratio	61.90%	80.00%	56.25%
Loss Ratio	38.10%	20.00%	43.75%
Avg. Trade Net Profit	$0.23	$0.95	$0.01
Avg. Trade Net Loss	-$0.19	-$0.04	-$0.24
Reward/Risk Ratio	1.20	24.87	0.04
Expectancy	0.2190	0.8891	0.0096
Expectunity (63 trades/yr)	13.80	13.34	0.46
System Quality	17.86	17.27	0.59

Table 8.6A

For further review, our team utilized Market System Analyzer software to measure position sizing. Our best result gave a total net profit of $244.50, with a fixed fraction of

5.050 and a max drawdown of .139. For further review of results, please refer to Figure 8.6A and 8.6B in Appendix B

Manual

Overall, manual trading provided us with a system quality of 3.6, a more realistic quality that was calculated with only 45 trades per year. After comparing long and short trade returns the total profit was much higher going long, but the system quality was just the opposite. One should also take into consideration of the main outlier in the traded currency pairs, the *Great Britain Pound* (GBP). The GBP pairs had the worst success rate out of all the currencies with 0% profitability and a total expectancy of -20.74 (see Figure 1). Only 15 trades were executed so there is still some discrepancy if the data holds true over time. However, with a 73.33% win ratio there's also reason to believe it's reliable. See below for recorded results.

	All Trades	Long Trades	Short Trades
Overall Investment	$196,265.40	$171,702.09	$24,563.31
Total Profit	$19.00	$14.40	$4.60
Total Loss	$8.91	$6.28	$2.64
Total (Profit-Loss)	$10.09	$8.13	$1.96
Total Number of Trades	15	8	7
Total Winning Trades	11	6	5
Total Losing Trades	4	2	2
Win Ratio	73.33%	75.00%	71.43%
Loss Ratio	26.67%	25.00%	28.57%
Avg. Trade Net Profit	$1.27	$1.80	$0.66
Avg. Trade Net Loss	$0.59	$0.78	$0.38
Reward/Risk Ratio	2.13	2.29	1.74
Expectancy	0.1407	0.0340	0.2628
Expectunity (45 trades/yr)	6.33	0.82	5.52
System Quality	3.60	0.46	3.14

Table 8.6B

In addition, the manual system was also run through Market System Analyzer software to measure position sizing. Our best result gave a total net profit of $190.46, with a fixed fraction of 10.000 and a max drawdown of .057. For further review of results, please refer to Figure 8.6C and 8.6D in Appendix B.

8.7 Conclusion

Even though both systems turned out to be profitable, the manual system gave a higher profit factor according to Market System Analyzer. The automated system developed a profit factor of 2.193, while the manual system gave a 4.048. These profit factors are good, but after comparing them to the net profit not much money was made, thus other areas of strategy should be looked into if one wanted to make this system more profitable. Specifically, testing out higher developed strategies like the *Ichimoku Kinko Hyo* (IKH). This strategy is known to produce great performance. The Ichimoku Kinko Hyo is a very interesting strategy that is known to be very reliable in the forex market. At first, the strategy appeared to be too complicated to try and understand. However, gaining more knowledge of the forex market opened up many doors for system innovation. So with long hours of research and testing, the IKH strategy will soon be utilized.

In addition, when trading currencies manually it's easier to recognize their stability and how it can affect your system. For instance, all trades performed with GBP as one of the currency pairs gave back negative returns. Even though this currency was only involved with three trades, it's safe to say that GBP is too volatile for this system and that it should not be used for further trading. Refer to Figure 8.7A to see the manual comparison of currency pairs.

9: Sanjay Batchu's System

9.1: Overview

The goal of any investor or trader is to generate profits on a consistent basis that exceed what the market can provide. In order to accomplish this goal, one can choose to create a trading system where one enters and exits the market on a routine basis based on certain rules determined by the trader. However, one can also create an investment system, which calls for an investor to buy and hold stocks over long periods of time. Similar to traders, investors also have entry rules, which determine when an investor buys a stock. In contrast to traders, an investor does not trade stocks on a frequent basis which causes differences in the ability for a system to be evaluated scientifically.

Trading systems can be evaluated by using back-testing and walk-forward analysis which can both be used to optimize the system for maximum profit or minimum risk. In contrast, investing systems cannot be evaluated this manner due to the fact that they do not produce physical trades that can be back-tested or be used in a walk-forward analysis. However, investing systems can be scientifically evaluated via the Modern Portfolio Theory which was created by Harry Markowitz.

9.1.1 Problem Statement

Investing systems are primarily utilized my investors to generate profit that exceeds what the market can provide. Most investors create systems that prioritize two main things: profit and risk reduction. Value investing is a method derived primarily from Benjamin Graham, and generates profit by finding stocks that the market deems

undervalued. Risk can be reduced in a value investing system via diversification of the equities chosen. By diversifying the equities within a portfolio, one reduces the correlation between the returns which reduces the overall risk of the portfolio.

In order for any system to be successful in the market, there must be an aspect that is unique to an individual investor. This unique aspect of a system is called the edge and it is what allows the system to generate returns that exceed the market. In this iteration of the value investing method, the edge is derived from a combination of the unique method used to value the stocks chosen, and the unique selection of sectors used in this system. Specifically, the sectors chosen for this system are as follows: healthcare, technology, and industrials.

The sectors chosen and the valuation methods used are unique to this specific system due to the fact that they differ greatly from the sectors and methods used by Benjamin Graham when he created the value investing method.

9.2 Literature Review

Since value investing is not a new concept it is important for investors and traders who intend to use this method analyze past works of Benjamin Graham and David Dodd in addition to the works of current analysts in order to obtain a better understanding of the value investing methods. During the construction of this trading system the article titled *Value Investing: A Look at the Benjamin Graham Approach* by Maria Crawford Scott was used to understand the concepts behind value investing. This article provides a modern interpretation of the value investing method outlined in Graham's book *The Intelligent Investor* which was written in 1949 and is thought to be the premier resource on value

investing. Although from different periods of time, both of the works detailed above demonstrate that the value investing method continues to progress along with time while still retaining the essential features of its founder Benjamin Graham.

Both of the publications noted above are excellent resources in understanding the fundamentals of the value investing theory created by Benjamin Graham. Both publications present the essential components of a proper system utilizing the value investing strategy. The article by Scott for the AAII or the American Association of Individual Investors goes into incredible detail on key aspects of value investing such as the method's driving philosophy, , stock selection process, evaluation process, and the method's rules on entering and exiting a stock position.

In order to better analyze Graham and Dodd's intentions when they coined the value investing method it is important to analyze its underlying structural philosophy. According to Scott, the two purpose of the value investing method as coined by Ben Graham is to find the intrinsic value of a specific financial asset using various indicators. According to Scott, Graham believes that by focusing on the intrinsic value of an asset the investor is less inclined to be "misled by the misjudgments often made by the market during periods of deep pessimism or euphoria" (Scott 12). In addition to allowing for a more rational investing strategy, value investing also values diversification in assets in order to avoid the excess risk that is often present when investing in high growth stocks. Along with the basic philosophy of value investing, the AAII article also describes the criteria used by Ben Graham himself on picking the appropriate stock for use while utilizing the value investing method.

After analyzing the fundamental philosophy behind value investing, the AAII article also attempts to demonstrate how Graham's value investment method can adapt to different types of investors, which symbolizes the method's versatility. According to the author, Graham categorizes investors into two main categories: defensive and aggressive. In value investing, investors are not categorized by their appetite for risk. Instead, they utilize the energy and effort outlined by Graham to follow the process. Value investing believes that defensive investors should focus on big companies that are leaders in their respective area while enterprising or aggressive investors should venture to lesser-known companies if they still fall under the criteria determined by the investor.

In addition to categorizing the different categories of investors Graham and the AAII, also outline how to properly screen stocks to find suitable options for future investment. After selecting stocks based on criteria such as sales, financial statement health, dividend analysis, growth in earnings, and ratio analysis, investors also need to decide when to enter and exit the investment position. Graham also believes it is important to consider subjective or secondary factors such as management, cash levels, bond ratings, and market sentiment when considering positions. By outlining Benjamin Graham's positions on these key criteria the article outlays the baseline characteristics of a proper value investing system and establishes a good platform on which a unique trading system based on value investing can be constructed upon.

9.3: Equities Selection Methodology

A vital component of the value investment trading strategy is the selection of various financial assets chosen by the investor or trader. This particular iteration of the value investing strategy utilizes the original selection criteria coined by Benjamin Graham adapted to modern day price levels and concentrated on three main sectors within the equity markets. In particular, this system balances high growth sectors such as healthcare and tech with the stalwart energy sector. The rationale behind choosing the healthcare and technologies lies in secondary factors such as market sentiment, strong earning potentials, as well as their relative lack of age. In contrast, the energy sector was chosen as a counterbalance in order to buffer the other two sectors which have increased price volatility. The energy sector is an excellent safe choice due to its relative price stability over the last few yearsas well as ease of predictability. This system is designed to be used by enterprising investors and thus contains companies that are less known than the blue chips featured in the media yet contain the same fundamentals that fulfill the criteria outlined by Benjamin Graham.

Entry Rules

The goal of value investing is too determining the “intrinsic value” of a financial asset and investing when this value is less than the market value. When creating the rules for a trading system based on value investing, one needs to create rules for choosing stocks for your “stock universe” (Stock Screening) as well as rules for actual investment.

When choosing stocks for use in this system, the criteria for stock screening is extremely similar to the criteria chosen by the creator of value investing Benjamin Graham. The screening process for the stocks in the sectors chosen via categories such as

a given company's size, financial condition, stability of earnings, dividend record, earnings growth, P/E ratio, and price to book ratio.

Screening Criteria

The size of a company is an important indicator for potential investment because a company that is too small can be seen as too unstable and risky, while a company that is excessively large is usually too overpriced for an investor using the value investing strategy. During the design of this system the size criteria for potential investment targets is a valuation of approximately $340 million dollars for industrial companies as of 1996. This figure was constructed using a model that assumed a five percent overall growth rate from 1972, which is when Graham conceived his original figures of a $100 million-dollar valuation. It is important to note that Graham believed these valuation figures are to be used as a minimum and that prospective companies should have valuations above the values defined here to be suitable investment targets.

After considering the size of a company's valuation size it is also important to consider the financial condition of the prospective investment target. The value investing method defines a prospective investment target as having the value of current assets be double that of current liabilities. In addition, a potential investor should look for targets to have long term debt liabilities values be less than net current liabilities. By using these simple financial strength criteria an investor can be confident that they are following the ideal definition of value investing as determined by Benjamin Graham.

In addition to the overall stability of a company's financials, it is also essential to understand the target company's earnings stability and growth potential. Graham believes that a good value investment strategy screens stocks for companies that have maintained

positive earnings for at least five years. In addition, the EPS or Earning Per Share of a company needs to grow by three percent over a period of ten years for a company to be a good investment opportunity.

After analyzing the company's earnings reports and valuation, it is also essential to perform basic ratio-analysis in order to better understand the investment potential of an asset. One of the key ratios used to screen stocks for value investing is the P/E ratio or price to earnings ratio. Graham believes that the P/E ratio for a company needs to be less than fifteen in order to be a proper investment under the value investment strategy. Which means that when proper financial analysis is performed, the price of the asset should be less than fifteen times the average earnings of that asset. Another notable ratio that needs to be analyzed is the price to book value ratio. The price to book value is simply the stock price of the company divided by the difference between its total assets and its intangible assets and liabilities. Graham believes that a good investment target under the value investment strategy should have price to book ratio of less than 1.5. Having this ratio below 1.5 demonstrates that the stock may be undervalued and thus makes it a suitable ratio to analyze for this method of investing.

Choosing Equities within a Defined Universe

These fundamental criteria were chosen to create a collection of stocks ranging from blue chips to lesser-known stocks across three key sectors of the market. After screening for stocks, it is important to generate rules to determine which stocks to choose.

The truly unique aspects of value investing are presented when the investor is required to select stocks that are truly undervalued in the market. The selection of these stocks can be done via both qualitative and quantitative methods. This iteration of the

system utilizes Benjamin Graham's model of valuation to find the approximate intrinsic value in addition to the star index based on Morningstar analysis to find the quantitative definition of the intrinsic value. Morningstar reports are used in this strategy as they consider a stock's financials before creating a star system that evaluates the stock price to determine whether a particular equity is undervalued, at par, or overvalued.

In addition to utilizing Graham's model and Morningstar star evaluation model, the system also factors in intangible assets also listed as "goodwill capital" within a company's financial statements. The qualitative aspects of a company vary by sector but can include the patent portfolio, governmental relations, and market sentiment/news. Each sector has different secondary factors to be considered. For example, in the healthcare industry, a majority of the value of an equity is defined by the drug pipeline which is heavily influenced by the government. In addition, companies in the healthcare sector are valued heavily on their ability to spend on research and development for the creation of new remedies. Since these companies focus on drugs and products heavily regulated by the government, any news on drug approvals or regulatory issues have a long-term effect on the valuation of a given company. With regards to companies in the energy industry, their value can also be influenced by government policy in addition to global energy markets. Similarly, to the healthcare sector, the technology sector contains secondary factors such as patent portfolios and research and development funding that can influence the value of that equity.

Stocks Selected for Investment

The following stocks were selected from the stock universe remaining after running a screener on a Bloomberg terminal using the criteria defined above. These

particular stocks were chosen based on secondary factors and the intrinsic value generated via the Graham valuation model as the base financials for each of these stocks are extremely similar. It is important to note that these stocks were chosen under Graham's notion of an enterprising investor with the time and effort required to carefully maintain this particular portfolio.

The stocks chosen from the screened universe are listed below and all have similar fundamental financials and were determined to contain some of the secondary factors defined above in addition to an intrinsic value that is less than the market price and/or a Morningstar rating of more than three stars.

9.4: Calculating Intrinsic Value

Graham Valuation Model

The Graham model is a good approximation of the intrinsic value and is the primary method used to determine the equities chosen to be added to this portfolio. The formula that this model is based on is listed below:

$$Intrinsic\ Value\ Approximation\ = [EPS(8.5 + 2g)] * \frac{4.4}{AAA}$$

Equation 9.4.1: The Graham Valuation Model Equation

In order to better understand the formula, it is important to clarify the terms of the formula. "AAA" is representative of the prevailing interesting rate of a AAA corporate bond. The variable "g" represents the growth of earnings and this value depends on each specific equity. "EPS" is an acronym for earnings per share and it depends on each specific security being rated.

The main problem with this model is that it is suited for a period of time before increased valuations and the creation of new economic sectors. In order to correct for

modern market conditions the original model uses the average five-year diluted value for EPS in order to provide a stronger baseline EPS data point. Due to the fact that companies have conservative growth percentages than during the time of Graham, the growth number is decreased from 8.5 to 7.5 in concurrence with a reduction in the earnings growth multiplier from two to one-point-five. By modifying these values one can modify the Graham formula to be more in line with current valuation methods and increase the margin of safety when constructing intrinsic valuations.

Morning Star Rating System

The Morning Star system is a system designed to determine the "fair value" of an equity using Morningstar analysts and relies on a proprietary analysis of a company's financial statements and estimates. This method of valuation is used in this system as it serves as a simple way to see if a stock is at par value or undervalued. However, this type of analysis cannot be used in isolation to make a decision on the valuation of a specific equity, as it is too basic of a calculation without the rationale being available.

DCF Analysis (Discount Cash Flow Analysis)

Although the Graham valuation model can be useful in approximating a value of a company, it is not very precise as the formula is dated and does not account for companies in new sectors such as healthcare and technology which have different financial fundamentals than companies from Graham's era. As with the Graham model of valuation the DCF method of valuation is not completely accurate and one needs to implement a margin of safety component to account for one-time changes in the market.

The main goal of DCF analysis is to synthesize the actual current value of an asset or company based on how much capital the equity or asset will generate in a time period in the future. In order to perform a DCF an analyst needs to make numerous assumptions such as the amount of FCF, growth rate, discount rate, etc. These assumptions can change the final answer by significant amounts and thus most analysts perform a DCF for different scenarios and create a range of potential values.

Revenue Growth Rate

In order to start a DCF valuation, the revenue growth rate of the asset or company is estimated. The revenue growth can vary based on industry, market sentiment, market share, product creation, and price variation. Since these assumptions are extremely fluid, most analysts create various scenarios of growth ranging from bull markets to depressions.

FCF: Free Cash Flows

After calculating the revenue growth rate, it is important to measure the asset or company's FCF or free cash flow. The Free Cash Flow of a given company is simply the amount of capital it has available to finance various opportunities that can positively improve shareholder value for investors. The equation used to determine FCF can be found below:

$$FCF = Sales\ Revenue - Operating\ Costs - Taxes - Net\ Investment - Change\ in\ Working\ Capital$$

Equation 9.4.2: Equation for Free Cash Flows

This approach requires some assumptions regarding the growth of operating expenses within a company as well as some research into the firms reported financial statements. The guideline for most investors is that the operating costs can be found via

deducting the EBIT from net revenues. When predicting future operational expenses during the forecasting period usually the operating margin is also considered and can be found via the following equation:

Operating Margin = Operating Income / Net Sales
Equation 9.4.3: Equation used to calculate the operating margin.

When calculating the tax component of the FCF equation it is important to note that most companies do not pay the corporate tax rate of 35% if incorporated in the United States. Thus, simple division discovers the actual tax rate of the company. Dividing the taxes paid for each year and then dividing by the pre-tax profits of the company will get you that rate.

In addition to finding the tax liabilities of a firm, a potential investor is wise to also find the net investment and change in working capital of a company. Net investment consists of the amount of money spent by a company on PPE or Plants, Property, and Equipment. These purchases are considered capital expenditures and the value can be found by deducting the non-cash depreciation from the capital expenditures of a company. The change in working capital, is simply the amount of liquid cash a firm needs to maintain daily operations. The working capital is the simple subtraction of current liabilities from current assets and grows alongside revenues. These are all essential components that are needed to discover the FCF of a company during the process of conducting a DCF analysis to find the intrinsic value of a company.

Discount Rate

The discount rate is an essential assumption that needs to be calculated as part of any DCF analysis and is found using the WACC or Weighted Average Cost of Capital. The discount rate is used to determine the current values of the FCF over the determined

forecasting period. In order to calculate this value one uses the WACC which is shown below.

$$WACC = \frac{E}{V} * R_E + \frac{D}{V} * R_D * (1 - T_C)$$

Equation 9.4.4: WACC Equation

WACC in in its simplest form is simply the cost a company incurs when additional capital is needed to increase cash flows. Companies can either use debt or equity to raise capital and these factors are represented in the WACC equation above via the "E/V" and the "D/V" values respectively. These values are then multiplied by the firm's cost of equity and debt, R_E and R_D respectively. Since debt is taxed the tax rate or T_C is also factored into the calculations. From this equation one can discover the discount rate for future cash flows, which then allows for the calculation of the NPV or Net Present Value of future cash flows.

Calculating the Fair Value

Now that one has calculate the growth rate, FCF, and discount rate it is possible to calculate the fair value of a specific firm or asset. In order to calculate the final fair value of an asset one needs to find the Terminal Value, and Total Enterprise Value which then can be used to calculate the final Fair Value of Equity.

The terminal value is the value of the cash flows after the forecasted period expires. If this terminal value is not properly calculated, it would assume that the company stops grows after the end of the forecasting period. One method used to calculate the TV is to use the Gordon Growth Model. This model uses the formula below to estimate the terminal value of free cash flows after the forecasting period.

$$TV\ (Terminal\ Value) = \frac{Final\ YR\ Cashflows * (1 + Long\ Term\ Cash\ Flow\ Growth\ Rate)}{Discount\ Rate - Long\ Term\ Cash\ Flow\ Growth\ Rate}$$

Equation 9.4.5: Terminal Value Equation

Total Enterprise Value

Finding the total enterprise value is an extremely simple task and it is simply the present value of cash flows and divide them by the discount rate. These values are then added up to create the value that is called the EV or Enterprise Value as shown in the table below.

Forecast Period	Y1	Y2	Y3	Y4	Y5	TV (Terminal Value)
FCF (Free Cash Flow)	1M	2M	3M	4M	5M	10M
TEV						**15.6M**

Table 9.4.1: The table above displays sample calculations that can be used to find the Terminal Enterprise Value using an assumed discount rate of 12%.

Calculations: $TEV = \left(\frac{1M}{1.12}\right) + \left(\frac{2M}{(1.12)^2}\right) + \frac{3M}{(1.12)^3} + \frac{4M}{(1.12)^4} + \frac{5M}{(1.12)^5} + \frac{10M}{(1.12)^5}$

Fair Value of Equity

After calculating the EV or enterprise value of a firm it is necessary to exclude the net debt value in order to arrive at the fair value for a company. The fair value can then be divided by the number of shares disbursed by the company to arrive at the fair value per share. This value can then be used to make a decision on whether one should enter the position or stay patient and wait until the price declines further. Essentially if the fair value per share of the company is higher than the market price it is prudent to enter the position as soon as possible and wait for the market price to match the fair value price.

Morningstar Valuations

In addition to the DCF method and the Graham valuation model, one can also use third party firms to value prospective investment opportunities. Morningstar is a firm that utilizes proprietary models to analyze financial statements of numerous companies to generate a fair value that is displayed via a star system. A three-star rating from Morningstar signifies that the firm or asset is at par with its market value. If the potential position is only a three-star value it is advantageous to wait until the price changes in order to generate more value. However, a four or five-star equity is a ripe entry opportunity as it signifies that the true intrinsic price of the asset or firm is above that of market value.

9.5: Exit Rules

Although entering positions in value investing takes some time and commitment from an investor deciding when to exit is somewhat simpler. This system follows the original approach derived by Benjamin Graham and is simply to hold the position until the intrinsic value increases above the actual value of the asset. Most active investors will review their portfolios of securities on a fixed time frame and reevaluate what decisions need to be made regarding individual equities.

9.6: Overview of Results

Stocks Chosen

Healthcare	Technology	Industrials
CERN	CA	ARW
CNC	AMZN	OC
ALXN	MSFT	XRX
AMGN	USAT	KFY

Table 9.6.1: Lists all the stocks present in the portfolio.

Graham Model Equity Evaluation Table

Equity Ticker	Name	EPS (5Yr Diluted Average)	"g" Earnings Growth (%)	AAA Corp. Bond Rate (%)	Intrinsic Valuation (Modified Model)
Healthcare					
ALXN	Alexion	2.1	15.61	4.1	69.67185366
AMGN	Amgen	7.632	15.75	4.1	254.9274146
CELG	Celgene	2.032	19.26	4.1	79.35505171
CNC	Centene	2.01	33.37	4.1	124.1503463
Technology					
AMZN	Amazon	1.226	33.4	4.1	75.78474146
CA	CA Technologies	1.898	5.63	4.1	32.47802049
USAT	USA Technologies	0.07	5.01	4.1	1.127956098
MSFT	Microsoft	2.158	9.19	4.1	49.29398341
Industrials					
ARW	Arrow Electronics	6.3	7	4.1	121.697561
OC	Owens Corning	3.81	20	4.1	153.3292683
XRX	Xerox	0.94	5	4.1	15.13170732
KFY	Korn/Ferry Internationa	2.5	15	4.1	80.48780488

Table 9.6.1: Describes the Graham Model when applied to all the stocks in the Portfolio

Sample DCF Valuations by Sector

The following section demonstrates the use of Bloomberg DCF templates to illustrate the use of a DCF analysis on the decision to enter an equity position in the market. One can view all the DCF analyses conducted in the appendix section if desired.

Healthcare DCF (Representative Sample)

Bloomberg **Discounted Cash Flow**

Ticker	CNC	Currency	Trading
Name	Centene Corp	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Dec 11 A	Dec 12 A	Dec 13 A	Dec 14 A	Dec 15 A	Dec 16 A	Dec 17 E	Dec 18 E	Dec 19 E	Dec 20 E	Dec 21 E	Dec 22 E	Trend
Revenue (Estimate Comparable)	5,341	8,668	10,863	16,560	22,760	40,607	46,772	51,663	56,251	60,722	60,552	66,257	
% YoY Growth		62%	25%	52%	37%	78%	15%	10%	9%	8%	0%	9%	
EBITDA	249	202	352	564	772	1,572	1,768	2,293	2,503	2,702	2,694	2,948	
% Margin	5%	2%	3%	3%	3%	4%	4%	4%	4%	4%	4%	4%	
Free Cash Flow	141	274	265	1,093	518	3,338	2,325	2,810	3,417	3,493	3,875	3,944	
% Margin	3%	3%	2%	7%	2%	8%	5%	5%	6%	6%	6%	6%	

Perpetuity Growth Method	
Current Price (USD)	75.79
Consensus Price Target	82.88
DCF Estimated Value per Share (USD)	428.41
DCF Estimated Upside	465%

		Perpetuity Growth				
		1.0%	1.5%	2.0%	2.5%	3.0%
Discount Rate (WACC)	5.8%	443.67	488.39	545.02	619.05	719.96
	6.3%	400.42	435.95	479.84	535.41	608.06
	6.8%	364.72	393.54	**428.41**	471.48	526.01
	7.3%	334.77	358.53	386.81	421.03	463.30
	7.8%	309.28	329.15	352.47	380.23	413.82
		1.0%	1.5%	2.0%	2.5%	3.0%
	5.8%	485%	544%	619%	717%	850%
	6.3%	428%	475%	533%	606%	702%
	6.8%	381%	419%	**465%**	522%	594%
	7.3%	342%	373%	410%	456%	511%
	7.8%	308%	334%	365%	402%	446%

EBITDA Multiple Method	
Current Price (USD)	75.79
Consensus Price Target	82.88
DCF Estimated Value per Share (USD)	152.40
DCF Estimated Upside	101%

		Terminal EBITDA Multiple				
		3.4x	4.9x	6.4x	7.9x	9.4x
Discount Rate (WACC)	5.8%	121.32	139.64	157.96	176.28	194.61
	6.3%	119.36	137.25	155.15	173.04	190.93
	6.8%	117.44	134.92	**152.40**	169.88	187.35
	7.3%	115.57	132.64	149.72	166.79	183.87
	7.8%	113.74	130.42	147.10	163.79	180.47
		3.4x	4.9x	6.4x	7.9x	9.4x
	5.8%	60%	84%	108%	133%	157%
	6.3%	57%	81%	105%	128%	152%
	6.8%	55%	78%	**101%**	124%	147%
	7.3%	52%	75%	98%	120%	143%
	7.8%	50%	72%	94%	116%	138%

Figure 9.6.1: A typical DCF analysis performed on a firm in the healthcare sector.

Technology DCF (Representative Sample)

Bloomberg **Discounted Cash Flow**

Ticker	AMZN	Currency	Trading
Name	Amazon.com Inc	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Dec 11 A	Dec 12 A	Dec 13 A	Dec 14 A	Dec 15 A	Dec 16 A	Dec 17 E	Dec 18 E	Dec 19 E	Dec 20 E	Dec 21 E	Dec 22 E	Trend
Revenue (Estimate Comparable)	48,077	61,093	74,452	88,988	107,006	135,987	165,924	200,338	238,310	278,834	319,640	365,664	
% YoY Growth		27%	22%	20%	20%	27%	22%	21%	19%	17%	15%	14%	
EBITDA	1,945	2,910	4,010	5,094	8,514	12,302	19,361	25,387	32,627	39,505	47,968	56,837	
% Margin	4%	5%	5%	6%	8%	9%	12%	13%	14%	14%	15%	16%	
Free Cash Flow	1,155	157	1,528	1,370	6,008	8,210	9,623	10,238	7,414	14,459	12,968	4,900	
% Margin	2%	0%	2%	2%	6%	6%	6%	5%	3%	5%	4%	1%	

Perpetuity Growth Method	
Current Price (USD)	949.04
Consensus Price Target	1099.26
DCF Estimated Value per Share (USD)	266.91
DCF Estimated Upside	-72%

		Perpetuity Growth				
		1.0%	1.5%	2.0%	2.5%	3.0%
Discount Rate (WACC)	9.0%	274.98	287.49	301.78	318.27	337.51
	9.5%	260.07	270.90	283.18	297.22	313.41
	10.0%	246.81	256.27	**266.91**	278.97	292.75
	10.5%	234.95	243.27	252.55	263.00	274.85
	11.0%	224.29	231.63	239.80	248.92	259.18
		1.0%	1.5%	2.0%	2.5%	3.0%
	9.0%	-71%	-70%	-68%	-66%	-64%
	9.5%	-73%	-71%	-70%	-69%	-67%
	10.0%	-74%	-73%	**-72%**	-71%	-69%
	10.5%	-75%	-74%	-73%	-72%	-71%
	11.0%	-76%	-76%	-75%	-74%	-73%

EBITDA Multiple Method	
Current Price (USD)	949.04
Consensus Price Target	1099.26
DCF Estimated Value per Share (USD)	2288.11
DCF Estimated Upside	141%

		Terminal EBITDA Multiple				
		30.0x	31.5x	33.0x	34.5x	36.0x
Discount Rate (WACC)	9.0%	2184.01	2288.17	2392.33	2496.49	2600.65
	9.5%	2135.90	2237.71	2339.51	2441.32	2543.12
	10.0%	2089.08	2188.60	**2288.11**	2387.62	2487.13
	10.5%	2043.52	2140.80	2238.08	2335.37	2432.65
	11.0%	1999.17	2094.28	2189.39	2284.50	2379.61
		30.0x	31.5x	33.0x	34.5x	36.0x
	9.0%	130%	141%	152%	163%	174%
	9.5%	125%	136%	147%	157%	168%
	10.0%	120%	131%	**141%**	152%	162%
	10.5%	115%	126%	136%	146%	156%
	11.0%	111%	121%	131%	141%	151%

Figure 9.6.2: A typical DCF analysis performed on a company in the technology sector.

Industrials DCF (Representative Sample)

Bloomberg — Discounted Cash Flow

Ticker	ARW
Name	Arrow Electronics Inc
Currency	Trading
Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Dec 11 A	Dec 12 A	Dec 13 A	Dec 14 A	Dec 15 A	Dec 16 A	Dec 17 E	Dec 18 E	Dec 19 E	Dec 20 E	Dec 21 E	Dec 22 E	Trend
Revenue (Estimate Comparable)	21,390	20,405	21,357	22,769	23,282	23,825	24,999	25,895	26,001	26,848	27,650	28,403	
% YoY Growth		-5%	5%	7%	2%	2%	5%	4%	0%	3%	3%	3%	
EBITDA	1,095	922	954	1,036	1,049	1,091	1,143	1,207	1,204	1,243	1,280	1,315	
% Margin	5%	5%	4%	5%	5%	5%	5%	5%	5%	5%	5%	5%	
Free Cash Flow	(113)	537	454	779	554	388	593	625	630	603	616	671	
% Margin	-1%	3%	2%	3%	2%	2%	2%	2%	2%	2%	2%	2%	

Perpetuity Growth Method

Current Price (USD)	77.63
Consensus Price Target	80.57
DCF Estimated Value per Share (USD)	114.63
DCF Estimated Upside	48%

		Perpetuity Growth				
		2.8%	3.3%	3.8%	4.3%	4.8%
Discount Rate (WACC)	7.2%	119.45	134.73	154.41	180.74	217.75
	7.7%	105.04	117.01	132.01	151.33	177.17
	8.2%	93.27	102.87	**114.63**	129.35	148.31
	8.7%	83.48	91.33	100.76	112.29	126.74
	9.2%	75.21	81.72	89.43	98.68	110.01

		2.8%	3.3%	3.8%	4.3%	4.8%
	7.2%	54%	74%	99%	133%	180%
	7.7%	35%	51%	70%	95%	128%
	8.2%	20%	33%	**48%**	67%	91%
	8.7%	8%	18%	30%	45%	63%
	9.2%	-3%	5%	15%	27%	42%

EBITDA Multiple Method

Current Price (USD)	77.63
Consensus Price Target	80.57
DCF Estimated Value per Share (USD)	88.61
DCF Estimated Upside	14%

		Terminal EBITDA Multiple				
		5.8x	7.3x	8.8x	10.3x	11.8x
Discount Rate (WACC)	7.2%	62.54	77.93	93.32	108.72	124.11
	7.7%	60.85	75.89	90.93	105.97	121.01
	8.2%	59.21	73.91	**88.61**	103.30	118.00
	8.7%	57.62	71.98	86.34	100.70	115.06
	9.2%	56.06	70.10	84.13	98.17	112.20

		5.8x	7.3x	8.8x	10.3x	11.8x
	7.2%	-19%	0%	20%	40%	60%
	7.7%	-22%	-2%	17%	37%	56%
	8.2%	-24%	-5%	**14%**	33%	52%
	8.7%	-26%	-7%	11%	30%	48%
	9.2%	-28%	-10%	8%	26%	45%

Figure 9.6.3: A typical DCF analysis performed on a company from the industrials sector.

Modern Portfolio Theory

1) Enter Tickers / 2) Enter Asset Class

Tickers	ALXN US Equity	CERN US Equity	CNC US Equity	MGN US Equit	CA US Equity	AMZN US Equit	MSFT US Equity	USAT US Equity	ARW US Equity	OC US Equity	XRX US Equity	KFY US Equity
Asset Class	Healthcare	Healthcare	Healthcare	Healthcare	Technology	Technology	Technology	Technology	Industrials	Industrials	Industrials	Industrials

	ALEXION PHARMAC	CERNER CORP	CENTENE CORP	AMGEN INC	CA INC	AMAZON. COM INC	MICROSO FT CORP	USA TECHNOL	ARROW ELECTRO	OWENS CORNING	XEROX CORP	KORN/FER RY
Return *	24.90%	16.79%	30.88%	18.09%	8.23%	31.60%	15.22%	27.80%	12.38%	8.36%	1.71%	10.71%
Standard Dev	33.99%	24.96%	36.33%	22.42%	21.35%	30.50%	22.42%	65.97%	29.36%	33.09%	28.34%	37.77%

* All returns and standard deviations are annualized. Forecasted returns are for demonstration only, not recommendations; please review your inputs carefully.

3) Choose Return Type: (•) Historical Return ( ) Forecasted Return

* You have chosen historical rates. Please review the start and end dates below to determine return range.

4) Enter Dates Below: Start Date ###### / End Date ######

* Historical returns, correlations and standard deviations will update according to the chosen dates.

	ALEXION PHARMAC	CERNER CORP	CENTENE CORP	AMGEN INC	CA INC	AMAZON. COM INC	MICROSO FT CORP	USA TECHNOL	ARROW ELECTRO	OWENS CORNING	XEROX CORP	KORN/FER RY
ALEXION	1.000											
CERNER	0.348	1.000										
CENTENE	0.205	0.226	1.000									
AMGEN INC	0.366	0.357	0.229	1.000								
CA INC	0.272	0.398	0.203	0.352	1.000							
AMAZON.CO	0.278	0.348	0.207	0.313	0.444	1.000						
MICROSOFT	0.238	0.346	0.212	0.298	0.497	0.383	1.000					
USA	0.097	0.067	0.138	0.123	0.149	0.127	0.133	1.000				
ARROW	0.239	0.338	0.296	0.377	0.555	0.396	0.443	0.149	1.000			
OWENS	0.243	0.336	0.290	0.202	0.467	0.372	0.347	0.086	0.521	1.000		
XEROX	0.280	0.296	0.291	0.335	0.510	0.332	0.405	0.169	0.587	0.444	1.000	
KORN/FERR	0.188	0.310	0.235	0.265	0.429	0.336	0.341	0.102	0.482	0.489	0.445	1.000

5) Review Constraints: [x] Use Constraints

Min Weight	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Max Weight	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%

6) Launch Optimization: Optimize Weights

Objective 1: Portfolio that minimizes risk	Free Return:	2.80%		Return:	16.35%	ndard Dev:	16.3%	arpe Ratio:	0.83			
Weights	4.2%	17.6%	7.4%	20.0%	20.0%	3.3%	20.0%	1.9%	0.0%	1.0%	4.5%	0.0%
Objective 2: Portfolio that maximizes return	Free Return:	2.80%		Return:	26.65%	ndard Dev:	22.9%	arpe Ratio:	1.04			
Weights	20.0%	0.0%	20.0%	20.0%	0.0%	20.0%	0.0%	20.0%	0.0%	0.0%	0.0%	0.0%
Objective 3: Portfolio that maximizes Sharpe Ratio	Free Return:	2.80%		Return:	24.33%	ndard Dev:	18.5%	arpe Ratio:	1.16			
Weights	14.2%	8.2%	20.0%	20.0%	0.0%	20.0%	12.7%	4.9%	0.0%	0.0%	0.0%	0.0%
Objective 4: Portfolio that maximizes return (*give	Free Return:	2.80%		Return:	17.13%	ndard Dev:	16.3%	arpe Ratio:	0.88			
Weights	4.8%	17.1%	8.5%	20.0%	20.0%	4.6%	20.0%	2.1%	0.0%	0.5%	2.3%	0.0%
Objective 5: Portfolio that minimizes risk (*given a	Free Return:	2.80%		Return:	16.54%	ndard Dev:	22.9%	arpe Ratio:	0.60			
Weights	20.0%	0.0%	20.0%	20.0%	0.0%	20.0%	0.0%	20.0%	0.0%	0.0%	0.0%	0.0%

Figure 9.6.4: The data gathered from all the stocks combined in a MPT format.

Efficient Frontier

Figure 9.6.5: The Efficient Frontier of the Portfolio.

Correlation Matrix

Bloomberg

Correlation Spreadsheet

GO | Settings | Import Sec. | Show / Hide Ref. Data

Correlation | Field = Last Price, Data Type = Pct Chg (1D), Log Type = Exponential, Periodicity = 1D, Currency = Dflt, Start Date = 2/3/2017, End Date = 5/3/2017

Tickers	ALXN US Eq	CERN US Equity	CNC US Equity	AMGN US Equity	CA US Equity	AMZN US Equity	MSFT US Equity	USAT US Equity	ARW US Equity	OC US Equity	XRX US Equity	KFY US Equity
ALXN US Equity	1.000	0.229	0.295	0.126	0.337	0.303	0.329	0.224	0.314	0.211	0.068	0.411
CERN US Equity	0.229	1.000	0.167	0.035	0.048	0.002	0.166	0.243	0.056	0.092	0.031	0.070
CNC US Equity	0.295	0.167	1.000	0.128	0.102	0.254	0.223	0.264	0.074	0.144	0.143	0.139
AMGN US Equity	0.126	0.035	0.128	1.000	0.262	0.124	0.110	0.077	0.241	0.246	0.234	0.177
CA US Equity	0.337	0.048	0.102	0.262	1.000	0.205	0.429	0.260	0.478	0.400	0.142	0.112
AMZN US Equity	0.303	0.002	0.254	0.124	0.205	1.000	0.454	0.171	0.183	0.219	0.126	0.192
MSFT US Equity	0.329	0.166	0.223	0.110	0.429	0.454	1.000	0.527	0.394	0.406	0.126	0.225
USAT US Equity	0.224	0.243	0.264	0.077	0.260	0.171	0.527	1.000	0.222	0.591	-0.069	0.244
ARW US Equity	0.314	0.056	0.074	0.241	0.478	0.183	0.394	0.222	1.000	0.372	0.241	0.498
OC US Equity	0.211	0.092	0.144	0.246	0.400	0.219	0.406	0.591	0.372	1.000	-0.098	0.325
XRX US Equity	0.068	0.031	0.143	0.234	0.142	0.126	0.126	-0.069	0.241	-0.098	1.000	0.290
KFY US Equity	0.411	0.070	0.139	0.177	0.112	0.192	0.225	0.244	0.498	0.325	0.290	1.000

Figure 9.6.6: Portfolio Correlation Matrix

9.7: Evaluating System Performance

Overall, the value investing method worked as desired as it was able to generate excellent returns for a majority of stocks chosen. However, as expected there were some stocks chosen that did not perform as expected due to a variety of factors such as market sentiment, or unpredictable market behavior. During the design of the system m, a major difficulty was choosing the correct stocks to invest in Due to the buy and based on Benjamin Graham's model. hold strategy used in a value investing strategy, the system must be evaluated in a manner that does not require trades to be present. The Modern Portfolio theory created by Harry Markowitz allows one to properly assess an investing

system as it does not require trades to me made and can demonstrate which assets are riskier than others.

Throughout the course of this study we invested in a total of 12 stocks over three major sectors of the market. The three sectors choses were Healthcare, Technology, and Industrials. These sectors were chosen as they were a diverse group and allowed for limited correlation amongst the equities chosen as shown by the correlation matrix which is shown in figure 9.6.6. The decision to invest in only 12 stocks was taken because if too many stocks are chosen then the portfolio becomes an index fund as it begins to mirror market behavior. After applying the Modern Portfolio Theory to my portfolio of 12 stocks as shown in the figure 9.6.4 a GMV or global minimum variance portfolio was created to show that the portfolio could earn 16.35% on an annual basis with a standard deviation or risk of 16.3%. A GMV portfolio is one that generates the most return with the least amount of risk. In today's market 16.35% is an extremely significant return figure as the average index fund is approximately 10%. Thus, when the Modern Portfolio Theory is applied to this system, one can say that it can generate better returns than what the market can provide.

In addition to providing predictions of the return possible from a given portfolio, the MPT can also provide the exact asset allocations needed to achieve a given rate of return. For the GMV portfolio the allocations are given below:

· Alexion Pharmaceuticals (ALXN) – 4.2%

· Cerner Corp (CERN) – 17.6%

· Centene Corp (CNC) – 7.4%

· Amgen Inc. (AMGN) – 20.0%

· CA Inc. – 20%

· Amazon Inc. (AMZN) – 3.3%

· Microsoft (MSFT) – 20.0%

· USA Technologies (USAT) – 1.9%

· Arrow Electronics (ARW) – 0.0%

· Owens Corning (OC) – 1.0%

· Xerox Corp (XRX) – 4.5%

· Korn Ferry (KFY) – 0.0%

These allocations are extremely useful to investors as it allows them to create a portfolio that is scientifically sound and can still provide returns above what the market can provide. For example, in a given portfolio valued at $1,000, $176 would be invested in Cerner Corp due to the fact that the MPT allocated 17.6% of the portfolio to that particular equity. All other investments would similarly follow and combine to form the full $1,000 USD portfolio. As demonstrated by the process described above, applying the MPT to a given portfolio not only gives an investor an avenue to measure the risk of a portfolio but can also provide the optimal position sizing as well. Position sizing is an important aspect of a trading or investment system as it allows for an investor to maximize profits and minimize losses.

Another aspect of the Modern Portfolio theory is the efficient frontier which is a chart that displays a set of portfolios and the level of returns that may provide and the level of risk of each. Figure 9.6.5 shows the possible efficient frontier for this given portfolio and one can see that as one moves towards the possibility of higher risk the returns also increase as well. For example, at the very right of the efficient frontier chart, a

portfolio data point shows that it is possible to obtain a 28% percent return with a standard deviation of 24%. In addition, one can create a line that is tangential to the efficient frontier called the utility factor, which is variable depending on one's appetite for risk. In essence, the MPT is essential to the evaluation of the value investing system as it allows for position sizing as well as the reduction of risk within a given portfolio.

9.8: Conclusions

In conclusion, the performance of my system is excellent as it allows for almost the possibility for a 27% return which is significantly higher than the average return obtainable from the market. However, it is a known fact that value investing does not work well in the current market as it is a bull market. In addition, there are numerous methods to value a company and this company used a multitude of valuation strategies in order to obtain the best companies for potential investment. As one can see above, the Graham valuation model is outdated when compared to the DCF model as it has not adjusted to new market norms. In essence, the system performs well as it maximizes return while minimizing risk using the principles of the Modern Portfolio Theory.

10: Michael Bahnan's System

10.1 Overview & Literature Review

In the world of trading, there are numerous methods and systems that are the conventional standard to use for the stock exchange. In addition to these systems, individuals modify these current systems or create their own in the hopes that they have constructed the next innovative, revolution system on the market.

William J. O'Neil, the founder of Investor's Business Daily (IBD) and author of the book title, "How to Make Money in Stocks" is the founding father of the growth

investment strategy known as CAN SLIM. The philosophy behind the CAN SLIM strategy is centered on the seven part criteria that states when a company hits these criteria, it is projected for substantial and rapid growth. The seven criteria are represented in each letter of the acronym CAN SLIM, which are quantitated in next following sections.

The first letter in CAN SLIM, C, stands for current earnings growth, which states that the stocks must have a significant increase in their earnings in this quarter as compared to the same quarter in the prior year. The goal is to have the highest EPS growth possible, but the stock must have at least a 25% increase to fit the criteria of a CAN SLIM stock. The second letter, A, stands for annual earnings growth, which states that in addition to the quarterly increase, it must also have a 25% increase in annual earnings per share in each of the past five years with a return on equity higher than 17% making it an even better stock to choose. With the third letter of the acronym, N, the method states that new products, new management and new price highs are quality measurements and criteria. O'Neil has stated that when the price reaches new highs, its quality increases as well as its potential to continue reaching new heights. (Staff, Investopedia. "Stock-Picking Strategies: CAN SLIM.")

The second word, SLIM, begins with the letter, S, which states that when there is a large demand and a small supply this creates an increase in demand, which in turn drives the price in a rapid fashion. In addition, volume change is a significant factor with this criterion because investors must watch the stock and seek out a 50% increase in the past 50 days in comparison to the average trading volume. (O'Neil, William J. *How to make money in stocks: a winning system in good times or bad*.)

For the letter, L, it is all about the leaders instead of the laggards in the industry or sector the stock resides in. Using a relative strength index is a great way to depict, which stocks are excelling, in their respected industry. IBD, Investor's Business Daily, complies all stocks and gives them an RS rating, which basically complies the stock's performance in the past 12 months and assigns a percentile number ranging from 1 to 99, with 99 being the best and 1 being the worst. Investors should focus on a rating of 80 or better to see find the stocks performing the best in their respected industries. In another sense, a stock having a rising relative strength line that is near its new 52-week high is another way an individual can find how well a respected stock is performing. (Daily, Investor's Business. "Leader or Laggard.")

I, the sixth letter in CAN SLIM, stands for institutional sponsorship, or an ownership of a stock by multiple intuitions ranging from mutual funds to banks and other large, solidified institutions. This is crucial because if a stock receives backing from large institutions, which analyze thousands of stocks daily, then an investor receives closure in their researching into a stock. Also, increasing trading volume quarterly and even daily leads to a larger demand for the stock and when one large institution invests into a particular stock, it leads to other institutions to research and even allocate their investment to the same stock. (Staff, Investopedia. "Stock-Picking Strategies: CAN SLIM.")

The last letter, M, which stands for Market direction, is wildly considered the toughest and most crucial indicator of the entire system. Even if an investor researches and analyzes stocks that fit the six criteria above, the investor runs the risk of losing it all if they neglect the current state of the market. Reviewing market averages daily and projected trends in the market for the coming days and weeks should be any trader's

upmost priority, especially if they are a CAN SLIM investor. According to IBD, approximately 75% of all stocks in the market move in correlation with the direction of the market whether it is rising or falling. Naturally with the 25% in play, there is always the possibility that an investor's stock could continuously rise, but that is at the judgment of the investor and whether they choose to run that risk. Following major market indexes as stated in Chapter 2 in the DJIA and S&P 500 for instance, are great indictors of the overall trend of the current market. (Daily, Investor's Business. "Market Direction.")

One may say that these criterions are extremely specific and make it quite difficult to find these stocks if they even exist, but due to modern innovation finding these stocks is simple. Every investor that has use, tried to use or consistently uses this investment strategy relies on one tool: a screener. With a click on a button, a screener simply generates the stocks based on the criteria the investor selects and the investor is given a list of potential stocks to invest in. Most investors then dig even deeper into the company's background, the correlation between the stocks generated and the sectors each stock resides in.

10.2 Methodology

The research and assessment of CAN SLIM sparked the team's interest in the investment strategy due to its potential to generate large increases in stock value and in turn earn substantial profits. After becoming familiar with the system, we assessed the constraints and made slight changes to CAN SLIM strategy in the hopes that it may lead to larger results. Using the Zack's screener, the parameters were the following:

- 5 year Historical EPS growth > = 25%
- Last Year's Growth (F [0] / F [-1])
- Shares Outstanding < = 25 million
- Price as a % of 52 Week H-L Range >= 80
- Current ROE >= 17%
- Exchange: NASDAQ
- % Change EPS (F (-1)/F (-2)) >= 25%

Based on my criteria, it is clear that it is very similar to the CAN SLIM method, but it also has the team's own adjustments. Instead of using the parameter that there has to be a 25% increase in EPS growth each year for 5 years, we only did the last 2 years. In addition, the team added a parameter that stated that the stock must have an overall increase in EPS growth of at least 25% over that 5-year period. The parameter we added, which does not affect CAN SLIM, is that we told the screener to only apply these criteria on the NASDAQ stock exchange.

Overall, the only major change in my modified CAN SLIM method was in the 5-year historical EPS growth, which we believed was the key to success in the current market. The reasoning behind thought process was due to the current state of the market and the direction in which it is traveling. The stock market now has changed dramatically from the post-recession market that was once at large. The method, which fundamentally is revolutionary, does not take into account recession or the aftermath that they create in the market. With that being said, our team believed that adjusting the parameter to the past 2 years, but still considering relative growth for 5 years, was a better indicator of future success.

10.3 Entry Rules

The entry rules for my system are unique in the sense that they follow the conventional William O'Neil CAN SLIM method for entering the market, while also incorporating a moving average. Once a stock has met the criteria to be considered for my system, the entry into the market is another important aspect to any success. The stock must produce the ever-sought out cup and handle image with its 60-minute bars, shown below, in order it to be acceptable to enter. On the off chance that this image is not created, which with some CAN SLIM stocks does occur, then implementing a moving average indicator becomes crucial and allows for more entry into the market.

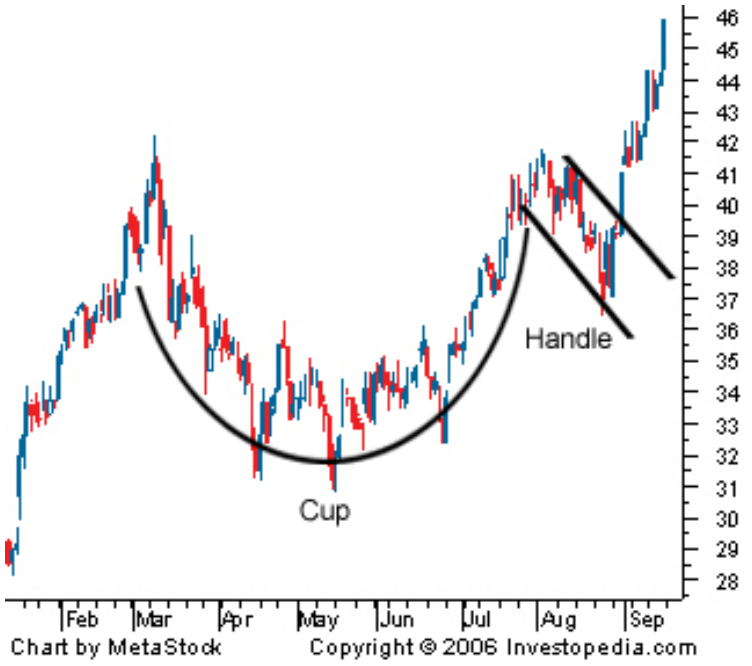

Figure 10.3A Cup and Handle Example

Although the tea cup image is the most desired indicator, at times it may never appear and can leave a CAN SLIM trader frustrated because they have this amazing system, but can never use it but the tea cup image limits the trader to a few trades. Due to this, our group added a moving average indicator, in order to open up my system to more trades and lead to more opportunities to make larger profits.

Figure 10.3B Moving Average Example

10.4 Exit Rules

William O'Neil often stated that when using the CAN SLIM method, it is best to sell once profits reach 20-25% on a stock. On the other hand, when exiting with a loss, it is best to exit when 3 losing 60-minute bars occur in a row or 8% of the original value of the stocks is loss. The 8% rule, is one that William O'Neil elaborates on in his book, "How to Make Money in Stocks," but he came to the conclusion of this very number through his own design of the method. For the system, the stocks were manually traded so the team used a trailing stop in Trade Station to let the program know that we wished to exit under these parameters. ("The CAN SLIM Investing Framework." *Stock Rover.*)

10.5 Overview of Results

As a trader, one often experiences their relative ups and downs and through the system we were fortunate enough to see that relative success across numerous stocks. At first, the team ran into a bit of an issue with my CAN SLIM method due to the lack of

entry into the market because the stocks never produced the iconic cup and handle image that the team desired to achieve. After entering the market once using just this method, the team decided that it was time to modify the entry procedure for my system. Implementing the moving average was a great indicator for the system because it allowed more opportunity to enter the market and from that the team was able to see the success I desired.

Over the course of this scientific study, the team was able to complete 18 trades across 8 of my 12 CAN SLIM eligible stocks. The results due to the limited time and restrictions were tough to assess based on the limited number of trades and time to let the stocks prosper over time. With that being said, from the limited number of trades the team was able to see some positive results through my trades and Modern Portfolio Theory. After using the Modern Portfolio Theory, found in the Appendix of this document, to assess the stocks, the program concluded that the stocks using the system had a 31.51% return on investment with an 8.7% standard deviation or risk for my investment. This is an extremely positive assessment of the system's efficiency using these CAN SLIM stocks under normal circumstances. In addition, the theory generated the proper allocation of money to each stock based on the statistics the program assessed for the past five years. These allocations are shown below:

- Advanced Energy Industries, Inc. (AEIS): 20%
- BioTelemetry, Inc.(BEAT): 20%
- Builders FirstSource, Inc. (BLDR): 20%
- NutriSystem Inc. (NTRI): 20%
- Euronet Worldwide, Inc.: 10.7%
- Facebook, Inc. (FB): 4.8%
- Tucows, Inc. (TCX) : 4.5%

These results basically state, for example, if we were to invest $100,000 using this set of stocks, 20% or $20,000 will be allocated to Advanced Energy Industries, Inc. (AEIS) and the rest of the investment will be allocated to the rest of the stocks based on their percentage. This would be benefit for position sizing as well because for the system, the team used the default 100 stocks to allocate my investment, but through this method, the position size would depend on the money invested versus the default 100 stocks.

In addition to the Modern Portfolio Theory, the limited number of stocks that were actually traded supported the theory's calculations, which was impressive. Based on the trades, Tucows, Inc. (TCX) and Facebook, Inc.(FB) generated the largest rise in stock value and therefore the largest profit for the system. Tucows, Inc. (TCX) provided the ever-sought out cup (shown below) and handle indicator and supported the strong CAN SLIM indicator with a rise of stock value from 50.7 to 58.65 from March 23 to April 28.

Figure 10.5A Facebook, Inc. Cup and Handle Indicator

This stock was impressive to watch because as the team was watching the stock generate larger stock values, we realized the phenomenon of this CAN SLIM method right before my very eyes. The curve for this particular stock was practically perfect due to its rapid growth once the stock produced a floor at the top of the cup before taking off.

Figure 10.5B Tucows, Inc. Stock Chart

In addition to the growth shown by Tucows, Inc. (TCX), Facebook, Inc. (FB) showed similar results, but using the moving average indicator that the team touched on in the Entry strategies above. This indicator allowed Facebook, Inc. to rise from 143.19 to 150.11 from March 20 to March 28! The indicator is shown on the figure below and it is truly impressive due to the fact that it produced similar results to Tucows, Inc. in eight days instead of 37 days.

Figure 10.5C Facebook, Inc. Moving Average Indicator

Again, this was yet another stock that produced and verified the CAN SLIM method for stocks, which are on the verge of rapid and significant growth. Using the 60-minute bars, the rapid stock growth over the eight-day period is shown below.

Figure 10.5C Facebook, Inc. Stock Chart

10.6 Conclusion

Overall, the team was extremely pleased by the verification of the CAN SLIM method and the relative success it has experienced. With that being said, there is always room for improvement from an efficiency standpoint and thanks to the analysis done by the Modern Portfolio Theory, that improvement can be achieved almost instantly. With the analysis, the biggest change and improvement would be allocating the investment according to the analysis generated by the program. This allocation is deemed the most efficient and will lead to more profits and less risk, which is what every trader yearns for. The system as a whole was successful in the team's eyes and in the future using the information acquired from this analysis, it will be even more prosperous.

11: Compilation of Systems

A key aspect of this trading and investing project is the simulation of a hedge fund environment. In order to do simulate this environment, it is necessary to combine different trading systems in order to maximize the potential for return. In this project the CANSLIM method and the value investing method of trading were combined and the results were examined.

Initially a correlation matrix of all the stocks used by both systems was created and demonstrated that the stocks were not correlated in a significant manner. This is essential to a compilation of systems because it allows for the risk of the portfolio to become balanced across both systems. In addition, this method of combining systems allows for the returns of the portfolio to become independent of the business cycle. For example, the CANSLIM model can be used very effectively in a bull market cycle as growth is a priority in that type of market. In contrast, the value investing strategy performs the best when in a bear market since value investing relies on buying equities at low prices and waiting for the values too rise.

Bloomberg

Correlation Spreadsheet

/ Hide Ref. Data ings | Show / Hide Ref. Data Sec.

Correlation | Field = Last Price, Data Type = Pct Chg (1D), Log Type = None, Periodicity = 1D, Currency = Dflt, Start Date = 5/5/2016, End Date = 5/5/2017

	AEIS US Equity	APOG US Equity	BEAT US Equity	BLDR US Equity	BOFI US Equity	EEFT US Equity	FB US Equity	ISLE US Equity	NTRI US Equity	TCX US Equity	ULTA US Equity	WLDN US Equity
CNC US Equity	0.195	0.082	0.090	0.217	0.078	0.130	0.251	0.052	0.056	0.098	0.084	0.082
AMGN US Equity	0.243	0.232	0.272	0.302	0.330	0.222	0.289	0.088	0.139	0.062	0.174	0.150
CA US Equity	0.449	0.249	0.172	0.342	0.254	0.375	0.381	0.096	0.177	0.182	0.218	0.136
AMZN US Equity	0.304	0.173	0.107	0.274	0.181	0.389	0.575	0.039	0.117	0.151	0.145	0.127
MSFT US Equity	0.408	0.245	0.243	0.297	0.269	0.435	0.488	0.068	0.140	0.188	0.229	0.093
USAT US Equity	0.269	0.185	0.135	0.281	0.255	0.263	0.252	0.039	0.085	0.105	0.132	0.131
ARW US Equity	0.537	0.394	0.267	0.507	0.395	0.483	0.295	0.361	0.238	0.190	0.290	0.258
OC US Equity	0.339	0.380	0.151	0.506	0.272	0.325	0.277	0.189	0.228	0.256	0.194	0.227
XRX US Equity	0.279	0.273	0.175	0.332	0.220	0.331	0.289	0.121	0.156	0.090	0.162	0.126
KFY US Equity	0.344	0.348	0.282	0.429	0.404	0.339	0.132	0.093	0.210	0.179	0.214	0.182

Figure 11 Correlation Matrix

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13: Appendix A *Tables & Figures*

Table 5.3.3A: Major Currency Pairs

Currency Pair	Countries Involved
EUR/USD	Eurozone Nations and United States
USD/JPY	United States and Japan
GBP/USD	United Kingdom and United States
USD/CHF	United States and Switzerland
USD/CAD	United States and Canada
AUD/USD	Australia and the United States

Figure 5.4A (Source: Slide 29, Inter-market analysis & sector rotation, rad guy)

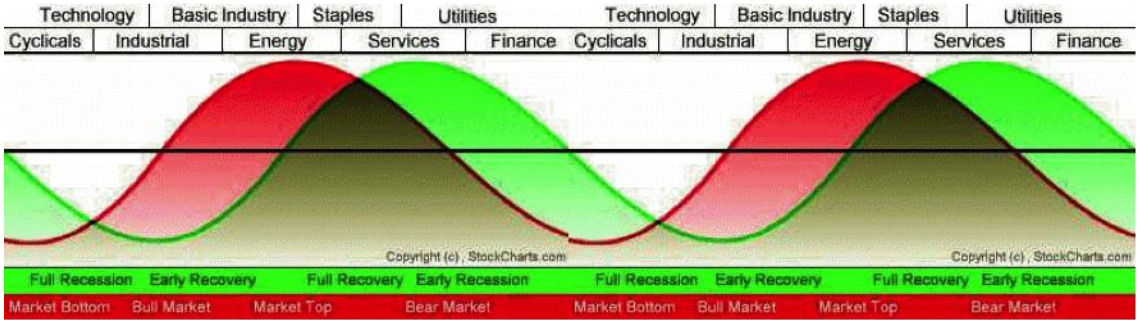


Figure 5.4B (Source: Slide 28, Inter-market analysis & sector rotation, rad guy)

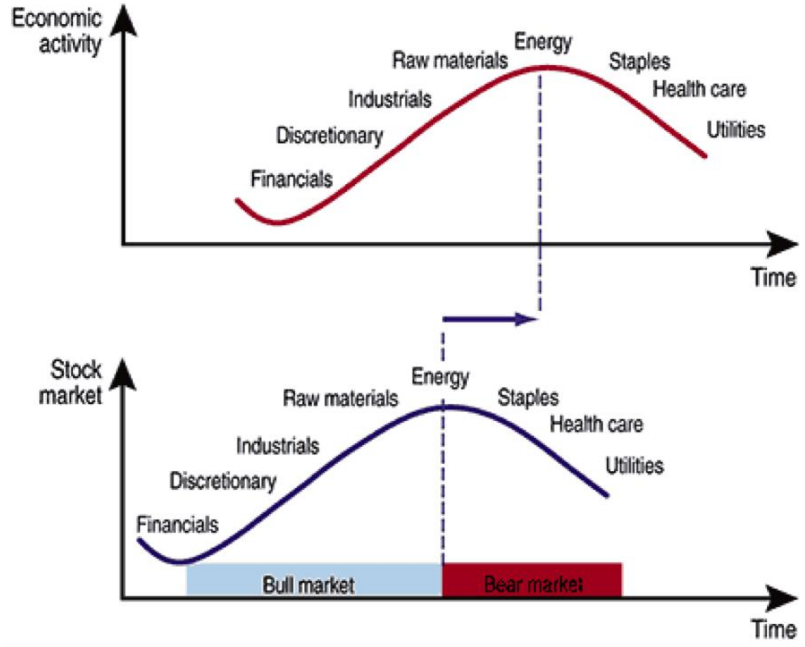


Table 5.4A (Source: https://www.fidelity.com/learning-center/trading-investing/markets-sectors/intro-sector-rotation-strats)

Sector	Early	Mid	Late	Recession
Financials	+			
Real Estate*	++			– –
Consumer Discretionary	++		– –	
Info Technology	++	+	– –	– –
Industrials	++	+		– –
Materials		– –	++	–
Consumer Staples	–		+	++
Health Care	–		++	++
Energy	– –		++	
Telecom	– –			++
Utilities	– –	–	+	++

Table 6.3.1

The 4 Asset Classes	Common Exchanges to Use
Equities	*New York Stock Exchange (NYSE) *National Association of Securities Dealers Automated Quotation System (NASDAQ)
Bonds	*Citigroup BIG *Barclays Capital Aggregate Bond Index *Merrill Lynch Domestic Master
Commodities	*New York Mercantile Exchg. (NYMEX) *New York Board of Trade (NYBOT) *Chicago Board of Trade (CBOT) *Chicago Mercantile Exchg. (CME)
Currencies	*Oanda Fx *Thinkorswim (TD Ameritrade) *Forex.com *MB Trading (MetaTrader)

Figure 6.4.3A
(Source: http://www.investopedia.com/university/stockpicking/stockpicking5.asp#ixzz4f1TDpeEl)

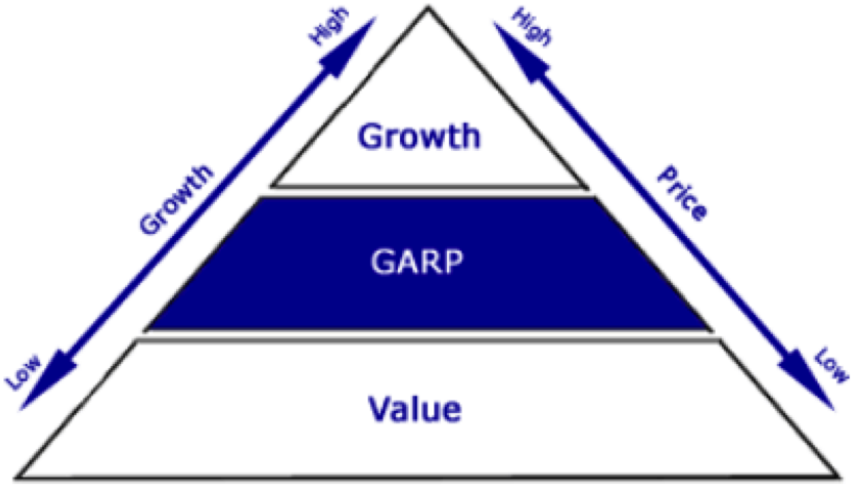


Figure 6.5.1A (Source: *MetaStock.com*)

Figure 6.5.4A *(*Source: *StockCharts.com)*

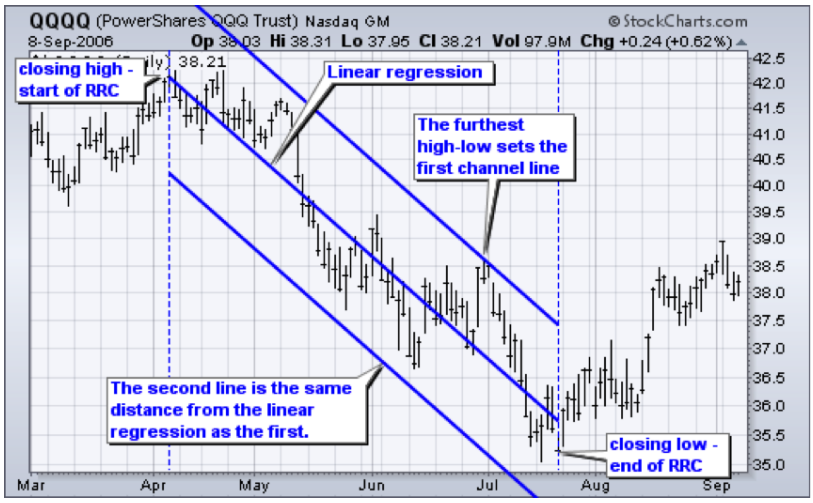


Figure 6.5.5A *(Source: Investopedia.com)*

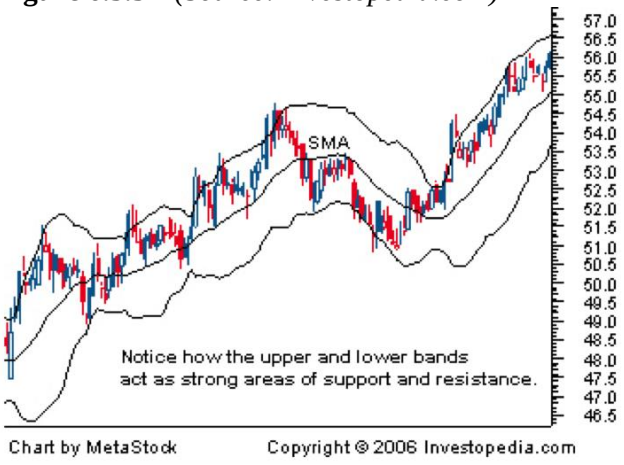


Figure 6.5.9A *(Source: Investopedia.com)*

Figure 6.5.12 (Source: *babypips.com*)

Strategy	Number of Trades	P/L in Pips	P/L in %	Max Drawdown
Buy And Hold	1	-3,416.66	-3.42	25.44
Bollinger Bands	20	-19,535.97	-19.54	37.99
MACD	110	3,937.67	3.94	27.55
Parabolic SAR	128	-9,746.29	-9.75	21.96
Stochastic	74	-20,716.40	-20.72	30.64
RSI	8	-18,716.69	-18.72	34.57
Ichimoku Kinko Hyo	53	30,341.22	30.34	19.51

Table 6.6A *(Source: Wright, 2009)*

Table 1	Trend	S /R	Volatility
Time in the market	Always in the market	Not always in the market	A substantial amount of time out of the market
Winning trades	Small percentage of winning trades	Higher percentage of winning trades	High percentage of winning trades
Where is money made	Money is made on big moves	Money is made in sideways markets	Money is made in market explosions
Where is money not made	Money is lost in choppy periods	Money lost in trending periods	Money is not made in quiet markets
Biggest con	Many false signals, long drawdown periods	Difficult to sustain profit over the long term	Never get the big move
Biggest pro	Possibility of high profits	Higher percentage of profitable trades	High percentage of profitable trades
Profit	Average profit per trade high over long term, unlimited	Limited average profit per trade	Small profit per trade, limited
Philosophy	Buy high and exit higher, sell low and exit lower	Buy low and sell high	Very quick and short term trades
Emotional	Long sustained drawdown periods can be difficult	Easier to trade because you are buying low and selling high	Exciting to trade - trades are short-term
Type of Indicators used	Moving Average, ADX, price bands and channels	RSI, %R, Stochastics, Support/Resistance lines	Purely based on price

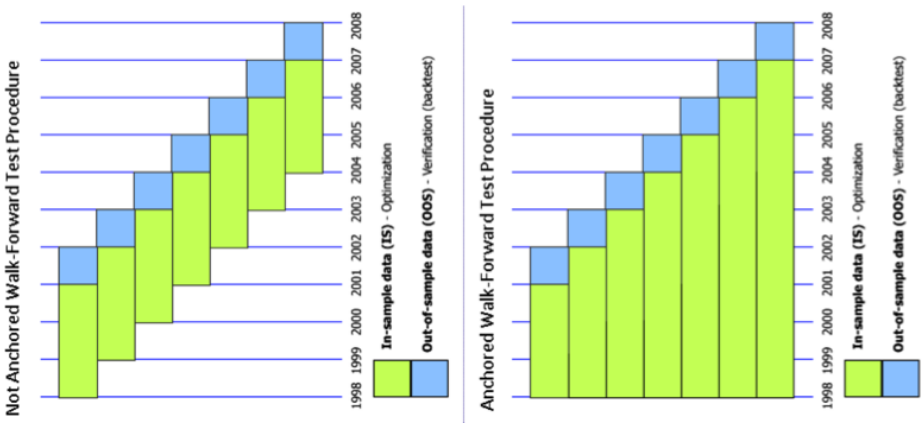


Figure 7.2A *(*Source: *MultiCharts.com)*

Figure 8.7A (Dereck's Manual System Comparison)

Currency Pair	Total # of Trades	Total Profit	Percent Profitable Trades	Expectancy	Expectunity (45 trades/year)	System Quality
EUR/USD	6	$6.70	83.33%	1.0404	18.73	16.52
USD/JPY	3	$9.54	100.00%	0.0283	0.25	7.86
USD/CAD	1	$1.12	100.00%	0.8327	2.50	not enough data
GBP/USD	2	-$8.62	0.00%	-3.4181	-20.51	-10.34
AUD/USD	2	$1.41	100.00%	1.8639	11.18	11.77
EUR/GBP	1	-$0.06	0.00%	-0.0762	-0.23	not enough data

14: Appendix B *Trades & Codes*

14.1 Dereck's Data

Optimization Performance Summary

Automated 60 min

	All Trades	Long Trades	Short Trades
Total Net Profit	$105.54	$57.52	$48.02
Gross Profit	$596.18	$311.30	$284.88
Gross Loss	($490.64)	($253.78)	($236.86)
Profit Factor	1.22	1.23	1.2
Roll Over Credit	($8.39)	($5.22)	($3.17)
Open Position P/L	($0.32)	($0.32)	$0.00
Select Total Net Profit	$65.39	$50.30	$15.10
Select Gross Profit	$514.57	$284.97	$229.60
Select Gross Loss	($449.18)	($234.67)	($214.51)
Select Profit Factor	1.15	1.21	1.07
Adjusted Total Net Profit	$62.04	$25.54	$18.48
Adjusted Gross Profit	$573.44	$294.49	$269.52
Adjusted Gross Loss	($511.39)	($268.95)	($251.04)
Adjusted Profit Factor	1.12	1.09	1.07
Total Number of Trades	1248	624	624
Percent Profitable	55.05%	54.97%	55.13%
Winning Trades	687	343	344
Losing Trades	559	280	279
Even Trades	2	1	1
Avg. Trade Net Profit	$0.08	$0.09	$0.08
Avg. Winning Trade	$0.87	$0.91	$0.83
Avg. Losing Trade	($0.88)	($0.91)	($0.85)
Ratio Avg. Win:Avg. Loss	0.99	1	0.98

Largest Winning Trade		$8.73	$6.72	$8.73
Largest Losing Trade		($9.98)	($9.98)	($6.08)
Largest Winner as % of Gross Profit		1.46%	2.16%	3.06%
Largest Loser as % of Gross Loss		2.03%	3.93%	2.57%
Net Profit as % of Largest Loss		1057.40%	576.26%	790.10%
Select Net Profit as % of Largest Loss		655.18%	503.94%	248.36%
Adjusted Net Profit as % of Largest Loss		621.59%	255.90%	304.08%
Max. Consecutive Winning Trades		10	10	10
Max. Consecutive Losing Trades		8	8	8
Avg. Bars in Total Trades		73.17	78.05	68.3
Avg. Bars in Winning Trades		71.7	77.32	66.1
Avg. Bars in Losing Trades		75.24	79.22	71.24
Avg. Bars in Even Trades		2.5	2	3
Max. Shares/Contracts Held		100	100	100
Total Shares/Contracts Held		124900	62500	62400
Account Size Required		$29.65	$17.25	$24.41
Total Slippage		$0.00	$0.00	$0.00
Total Commission		$0.00	$0.00	$0.00
Return on Initial Capital		0.11%		
Annual Rate of Return		0.01%		
Buy & Hold Return		11.50%		
Return on Account		355.96%		
Avg. Monthly Return		$1.50		
Std. Deviation of Monthly Return		$2.69		
Return Retracement Ratio		0.09		
RINA Index		26.77		
Sharpe Ratio		-46.57		
K-Ratio	n/a			
Trading Period	14 Yrs, 6 Mths, 9 Dys, 17 Hrs			
Percent of Time in the Market	100.00%			
Time in the Market	14 Yrs, 6 Mths, 9 Dys, 14 Hrs			
Longest Flat Period	n/a			

Max. Equity Run-up	$109.03		
Date of Max. Equity Run-up	4/28/17 11:00		
Max. Equity Run-up as % of Initial Capital	0.11%		
Max. Drawdown (Intra-day Peak to Valley)			
Value	($33.60)	($19.50)	($27.86)
Date	5/12/09 6:00		
as % of Initial Capital	0.03%	0.02%	0.03%
Net Profit as % of Drawdown	314.10%	294.94%	172.38%
Select Net Profit as % of Drawdown	194.62%	257.93%	54.19%
Adjusted Net Profit as % of Drawdown	184.65%	130.98%	66.34%
Max. Drawdown (Trade Close to Trade Close)			
Value	($29.65)	($17.25)	($24.41)
Date	5/12/09 8:00		
as % of Initial Capital	0.03%	0.02%	0.02%
Net Profit as % of Drawdown	355.96%	333.41%	196.75%
Select Net Profit as % of Drawdown	220.56%	291.57%	61.85%
Adjusted Net Profit as % of Drawdown	209.25%	148.06%	75.72%
Max. Trade Drawdown	($13.78)	($10.59)	($13.78)

All Trades

Total Net Profit	$105.54	Profit Factor	1.22
Gross Profit	$596.18	Gross Loss	($490.64)
Roll Over Credit	($8.39)		
Open Position Profit/Loss	($0.32)		
Select Total Net Profit	$65.39	Select Profit Factor	1.15
Select Gross Profit	$514.57	Select Gross Loss	($449.18)
Adjusted Total Net Profit	$62.04	Adjusted Profit Factor	1.12
Adjusted Gross Profit	$573.44	Adjusted Gross Loss	($511.39)

Total Number of Trades	1248	Percent Profitable	55.05%
Winning Trades	687	Losing Trades	559
Even Trades	2		
Avg. Trade Net Profit	$0.08	Ratio Avg. Win:Avg. Loss	0.99
Avg. Winning Trade	$0.87	Avg. Losing Trade	($0.88)
Largest Winning Trade	$8.73	Largest Losing Trade	($9.98)
Largest Winner as % of Gross Profit	1.46%	Largest Loser as % of Gross Loss	2.03%
Net Profit as % of Largest Loss	1057.40%		
Slct. Net Profit as % of Largest Loss	655.18%	Adj. Net Profit as % of Largest Loss	621.59%
Max. Consecutive Winning Trades	10	Max. Consecutive Losing Trades	8
		Avg. Bars in Losing	
Avg. Bars in Winning Trades	71.7	Trades	75.24
Avg. Bars in Total Trades	73.17		
Max. Shares/Contracts Held	100	Account Size Required	$29.65
Total Commission	$0.00	Total Slippage	$0.00
Return on Initial Capital	0.11%	Annual Rate of Return	0.01%
Buy and Hold Return	11.50%	Return on Account	355.96%
		Std. Deviation of	
Avg. Monthly Return	$1.50	Monthly Return	$2.69
Return Retracement Ratio	0.09	RINA Index	26.77
Sharpe Ratio	-46.57	K-Ratio	n/a
	14 Yrs, 6 Mths, 9	Percent of Time in the	
Trading Period	Dys, 17 Hrs	Market	100.00%
	14 Yrs, 6 Mths, 9		
Time in the Market	Dys, 14 Hrs	Longest Flat Period	n/a
Max. Equity Run-up	$109.03		
		Max. E. Run-up as % of	
Date of Max. E. Run-up	4/28/17 11:00	Initial Capital	0.11%
Max. Drawdown (Intra-day Peak to Valley)	Max. Drawdown (Trade Close to Trade Close)		
Value	($33.60)	Value	($29.65)
			5/12/09
Date	5/12/09 6:00	Date	8:00
as % of Initial Capital	0.03%	as % of Initial Capital	0.03%

Net Profit as % of Drawdown	314.10%	Net Profit as % of Drawdown	355.96%
Slct. Net Profit as % of Drawdown	194.62%	Slct. Net Profit as % of Drawdown	220.56%
Adj. Net Prof as % of Drawdown	184.65%	Adj. Net Profit as % of Drawdown	209.25%
Max. Trade Drawdown	($13.78)		
Long Trades			
Total Net Profit	$57.52	Profit Factor	1.23
Gross Profit	$311.30	Gross Loss	($253.78)
Roll Over Credit	($5.22)		
Open Position Profit/Loss	($0.32)		
Select Total Net Profit	$50.30	Select Profit Factor	1.21
Select Gross Profit	$284.97	Select Gross Loss	($234.67)
Adjusted Total Net Profit	$25.54	Adjusted Profit Factor	1.09
Adjusted Gross Profit	$294.49	Adjusted Gross Loss	($268.95)
Total Number of Trades	624	Percent Profitable	54.97%
Winning Trades	343	Losing Trades	280
Even Trades	1		
Avg. Trade Net Profit	$0.09	Ratio Avg. Win:Avg. Loss	1
Avg. Winning Trade	$0.91	Avg. Losing Trade	($0.91)
Largest Winning Trade	$6.72	Largest Losing Trade	($9.98)
Largest Winner as % of Gross Profit	2.16%	Largest Loser as % of Gross Loss	3.93%
Max. Consecutive Winning Trades	10	Max. Consecutive Losing Trades	8
Avg. Bars in Winning Trades	77.32	Avg. Bars in Losing Trades	79.22
Avg. Bars in Total Trades	78.05		
Max. Shares/Contracts Held	100	Account Size Required	$17.25
Total Commission	$0.00	Total Slippage	$0.00
Net Profit as % of Largest Loss	576.26%		

Slct. Net Profit as % of Largest Loss	503.94%	Adj. Net Profit as % of Largest Loss	255.90%
Max. Drawdown (Intra-day Peak to Valley)		Max. Drawdown (Trade Close to Trade Close)	
Value	($19.50)	Value	($17.25)
as % of Initial Capital	0.02%	as % of Initial Capital	0.02%
Net Profit as % of Drawdown	294.94%	Net Profit as % of Drawdown	333.41%
Slct. Net Profit as % of Drawdown	257.93%	Slct. Net Profit as % of Drawdown	291.57%
Adj. Net Prof as % of Drawdown	130.98%	Adj. Net Profit as % of Drawdown	291.57%
Max. Trade Drawdown	($10.59)		
Short Trades			
Total Net Profit	$48.02	Profit Factor	1.2
Gross Profit	$284.88	Gross Loss	($236.86)
Roll Over Credit	($3.17)		
Open Position Profit/Loss	$0.00		
Select Total Net Profit	$15.10	Select Profit Factor	1.07
Select Gross Profit	$229.60	Select Gross Loss	($214.51)
Adjusted Total Net Profit	$18.48	Adjusted Profit Factor	1.07
Adjusted Gross Profit	$269.52	Adjusted Gross Loss	($251.04)
Total Number of Trades	624	Percent Profitable	55.13%
Winning Trades	344	Losing Trades	279
Even Trades	1		
Avg. Trade Net Proft	$0.08	Ratio Avg. Win:Avg. Loss	0.98
Avg. Winning Trade	$0.83	Avg. Losing Trade	($0.85)
Largest Winning Trade	$8.73	Largest Losing Trade	($6.08)
Largest Winner as % of Gross Profit	3.06%	Largest Loser as % of Gross Loss	3.93%
Max. Consecutive Winning Trades	10	Max. Consecutive Losing Trades	8
Avg. Bars in Winning Trades	66.1	Avg. Bars in Losing Trades	71.24

Avg. Bars in Total Trades	68.3		
Max. Shares/Contracts Held	100	Account Size Required	$24.41
Total Slippage	$0.00	Total Commission	$0.00
Net Profit as % of Largest Loss	790.10%		
Slct. Net Profit as % of Largest Loss	248.36%	Adj. Net Profit as % of Largest Loss	304.08%
Max. Drawdown (Intra-day Peak to Valley)	Max. Drawdown (Trade Close to Trade Close)		
Value	($27.86)	Value	($24.41)
as % of Initial Capital	0.03%	as % of Initial Capital	0.02%
Net Profit as % of Drawdown	172.38%	Net Profit as % of Drawdown	196.75%
Slct. Net Profit as % of Drawdown	54.19%	Slct. Net Profit as % of Drawdown	61.85%
Adj. Net Prof as % of Drawdown	66.34%	Adj. Net Prof as % of Drawdown	75.72%
Max. Trade Drawdown	($13.78)		

Automated Daily

	All Trades	Long Trades	Short Trades
Total Net Profit	$40.52	$19.42	$21.10
Gross Profit	$54.57	$27.34	$27.23
Gross Loss	($14.04)	($7.92)	($6.12)
Profit Factor	3.89	3.45	4.45
Roll Over Credit	$0.04	($0.36)	$0.40
Open Position P/L	$0.40	$0.00	$0.40
Select Total Net Profit	$40.52	$19.42	$21.10
Select Gross Profit	$54.57	$27.34	$27.23
Select Gross Loss	($14.04)	($7.92)	($6.12)
Select Profit Factor	3.89	3.45	4.45
Adjusted Total Net Profit	$28.12	$10.34	$12.64
Adjusted Gross Profit	$45.47	$20.90	$20.81
Adjusted Gross Loss	($17.35)	($10.56)	($8.17)
Adjusted Profit Factor	2.62	1.98	2.55

Total Number of Trades	54	27	27
Percent Profitable	66.67%	66.67%	66.67%
Winning Trades	36	18	18
Losing Trades	18	9	9
Even Trades	0	0	0
Avg. Trade Net Profit	$0.75	$0.72	$0.78
Avg. Winning Trade	$1.52	$1.52	$1.51
Avg. Losing Trade	($0.78)	($0.88)	($0.68)
Ratio Avg. Win:Avg. Loss	1.94	1.73	2.22
Largest Winning Trade	$4.97	$4.33	$4.97
Largest Losing Trade	($1.72)	($1.72)	($1.67)
Largest Winner as % of Gross Profit	9.11%	15.83%	18.26%
Largest Loser as % of Gross Loss	12.25%	21.73%	27.19%
Net Profit as % of Largest Loss	2354.67%	1128.51%	1267.40%
Select Net Profit as % of Largest Loss	2354.67%	1128.51%	1267.40%
Adjusted Net Profit as % of Largest Loss	1633.87%	600.67%	759.35%
Max. Consecutive Winning Trades	8	6	5
Max. Consecutive Losing Trades	6	3	3
Avg. Bars in Total Trades	9.19	9.11	9.26
Avg. Bars in Winning Trades	9.53	10.44	8.61
Avg. Bars in Losing Trades	8.5	6.44	10.56
Avg. Bars in Even Trades	0	0	0
Max. Shares/Contracts Held	100	100	100
Total Shares/Contracts Held	5500	2700	2800
Account Size Required	$7.03	$4.96	$3.21
Total Slippage	$0.00	$0.00	$0.00
Total Commission	$0.00	$0.00	$0.00
Return on Initial Capital	0.04%		
Annual Rate of Return	0.02%		
Buy & Hold Return	-1.20%		
Return on Account	576.69%		
Avg. Monthly Return	$1.86		
Std. Deviation of Monthly Return	$2.98		
Return Retracement Ratio	0.74		
RINA Index	48.55		
Sharpe Ratio	n/a		

K-Ratio	3		
Trading Period	1 Yr, 9 Mths, 21 Dys		
Percent of Time in the Market	95.61%		
Time in the Market	1 Yr, 8 Mths, 22 Dys		
Longest Flat Period	n/a		
Max. Equity Run-up	$43.22		
Date of Max. Equity Run-up	4/27/17 16:59		
Max. Equity Run-up as % of Initial Capital	0.04%		
Max. Drawdown (Intra-day Peak to Valley)			
Value	($8.43)	($6.43)	($5.41)
Date	11/9/16 16:59		
as % of Initial Capital	0.01%	0.01%	0.01%
Net Profit as % of Drawdown	480.54%	301.91%	390.20%
Select Net Profit as % of Drawdown	480.54%	301.91%	390.20%
Adjusted Net Profit as % of Drawdown	333.44%	160.70%	233.79%
Max. Drawdown (Trade Close to Trade Close)			
Value	($7.03)	($4.96)	($3.21)
Date	10/12/16 16:59		
as % of Initial Capital	0.01%	0.00%	0.00%
Net Profit as % of Drawdown	576.69%	391.80%	656.78%
Select Net Profit as % of Drawdown	576.69%	391.80%	656.78%
Adjusted Net Profit as % of Drawdown	400.16%	208.54%	393.50%
Max. Trade Drawdown	($4.44)	($4.44)	($3.35)

All Trades

Total Net Profit	$40.52	Profit Factor	3.89
Gross Profit	$54.57	Gross Loss	($14.04)
Roll Over Credit	$0.04		

Open Position Profit/Loss	$0.40		
Select Total Net Profit	$40.52	Select Profit Factor	3.89
Select Gross Profit	$54.57	Select Gross Loss	($14.04)
Adjusted Total Net Profit	$28.12	Adjusted Profit Factor	2.62
Adjusted Gross Profit	$45.47	Adjusted Gross Loss	($17.35)
Total Number of Trades	54	Percent Profitable	66.67%
Winning Trades	36	Losing Trades	18
Even Trades	0		
Avg. Trade Net Profit	$0.75	Ratio Avg. Win:Avg. Loss	1.94
Avg. Winning Trade	$1.52	Avg. Losing Trade	($0.78)
Largest Winning Trade	$4.97	Largest Losing Trade	($1.72)
Largest Winner as % of Gross Profit	9.11%	Largest Loser as % of Gross Loss	12.25%
Net Profit as % of Largest Loss	2354.67%		
Slct. Net Profit as % of Largest Loss	2354.67%	Adj. Net Profit as % of Largest Loss	1633.87%
Max. Consecutive Winning Trades	8	Max. Consecutive Losing Trades	6
Avg. Bars in Winning Trades	9.53	Avg. Bars in Losing Trades	8.5
Avg. Bars in Total Trades	9.19		
Max. Shares/Contracts Held	100	Account Size Required	$7.03
Total Commission	$0.00	Total Slippage	$0.00
Return on Initial Capital	0.04%	Annual Rate of Return	0.02%
Buy and Hold Return	-1.20%	Return on Account	576.69%
Avg. Monthly Return	$1.86	Std. Deviation of Monthly Return	$2.98
Return Retracement Ratio	0.74	RINA Index	48.55
Sharpe Ratio	n/a	K-Ratio	3
Trading Period	1 Yr, 9 Mths, 21 Dys	Percent of Time in the Market	95.61%
Time in the Market	1 Yr, 8 Mths, 22 Dys	Longest Flat Period	n/a
Max. Equity Run-up	$43.22		
Date of Max. E. Run-up	4/27/17 16:59	Max. E. Run-up as % of Initial Capital	0.04%

Max. Drawdown (Intra-day Peak to Valley)		Max. Drawdown (Trade Close to Trade Close)	
Value	($8.43)	Value	($7.03)
Date	11/9/16 16:59	Date	10/12/16 16:59
as % of Initial Capital	0.01%	as % of Initial Capital	0.01%
Net Profit as % of Drawdown	480.54%	Net Profit as % of Drawdown	576.69%
Slct. Net Profit as % of Drawdown	480.54%	Slct. Net Profit as % of Drawdown	576.69%
Adj. Net Prof as % of Drawdown	333.44%	Adj. Net Profit as % of Drawdown	400.16%
Max. Trade Drawdown	($4.44)		

Long Trades

Total Net Profit	$19.42	Profit Factor	3.45
Gross Profit	$27.34	Gross Loss	($7.92)
Roll Over Credit	($0.36)		
Open Position Profit/Loss	$0.00		
Select Total Net Profit	$19.42	Select Profit Factor	3.45
Select Gross Profit	$27.34	Select Gross Loss	($7.92)
Adjusted Total Net Profit	$10.34	Adjusted Profit Factor	1.98
Adjusted Gross Profit	$20.90	Adjusted Gross Loss	($10.56)
Total Number of Trades	27	Percent Profitable	66.67%
Winning Trades	18	Losing Trades	9
Even Trades	0		
Avg. Trade Net Profit	$0.72	Ratio Avg. Win:Avg. Loss	1.73
Avg. Winning Trade	$1.52	Avg. Losing Trade	($0.88)
Largest Winning Trade	$4.33	Largest Losing Trade	($1.72)
Largest Winner as % of Gross Profit	15.83%	Largest Loser as % of Gross Loss	21.73%
Max. Consecutive Winning Trades	6	Max. Consecutive Losing Trades	3
Avg. Bars in Winning Trades	10.44	Avg. Bars in Losing Trades	6.44
Avg. Bars in Total Trades	9.11		
Max. Shares/Contracts Held	100	Account Size Required	$4.96

Total Commission	$0.00	Total Slippage	$0.00
Net Profit as % of Largest Loss	1128.51%		
Slct. Net Profit as % of Largest Loss	1128.51%	Adj. Net Profit as % of Largest Loss	600.67%
Max. Drawdown (Intra-day Peak to Valley)		Max. Drawdown (Trade Close to Trade Close)	
Value	($6.43)	Value	($4.96)
as % of Initial Capital	0.01%	as % of Initial Capital	0.00%
Net Profit as % of Drawdown	301.91%	Net Profit as % of Drawdown	391.80%
Slct. Net Profit as % of Drawdown	301.91%	Slct. Net Profit as % of Drawdown	391.80%
Adj. Net Prof as % of Drawdown	160.70%	Adj. Net Profit as % of Drawdown	391.80%
Max. Trade Drawdown	($4.44)		
Short Trades			
Total Net Profit	$21.10	Profit Factor	4.45
Gross Profit	$27.23	Gross Loss	($6.12)
Roll Over Credit	$0.40		
Open Position Profit/Loss	$0.40		
Select Total Net Profit	$21.10	Select Profit Factor	4.45
Select Gross Profit	$27.23	Select Gross Loss	($6.12)
Adjusted Total Net Profit	$12.64	Adjusted Profit Factor	2.55
Adjusted Gross Profit	$20.81	Adjusted Gross Loss	($8.17)
Total Number of Trades	27	Percent Profitable	66.67%
Winning Trades	18	Losing Trades	9
Even Trades	0		
Avg. Trade Net Proft	$0.78	Ratio Avg. Win:Avg. Loss	2.22
Avg. Winning Trade	$1.51	Avg. Losing Trade	($0.68)
Largest Winning Trade	$4.97	Largest Losing Trade	($1.67)
Largest Winner as % of Gross Profit	18.26%	Largest Loser as % of Gross Loss	21.73%
Max. Consecutive Winning Trades	5	Max. Consecutive Losing Trades	3
Avg. Bars in Winning Trades	8.61	Avg. Bars in Losing Trades	10.56

Avg. Bars in Total Trades	9.26		
Max. Shares/Contracts Held	100	Account Size Required	$3.21
Total Slippage	$0.00	Total Commission	$0.00
Net Profit as % of Largest Loss	1267.40%		
Slct. Net Profit as % of Largest Loss	1267.40%	Adj. Net Profit as % of Largest Loss	759.35%
Max. Drawdown (Intra-day Peak to Valley)		Max. Drawdown (Trade Close to Trade Close)	
Value	($5.41)	Value	($3.21)
as % of Initial Capital	0.01%	as % of Initial Capital	0.00%
Net Profit as % of Drawdown	390.20%	Net Profit as % of Drawdown	656.78%
Slct. Net Profit as % of Drawdown	390.20%	Slct. Net Profit as % of Drawdown	656.78%
Adj. Net Prof as % of Drawdown	233.79%	Adj. Net Prof as % of Drawdown	393.50%

Automated Trades (see Table 8.6A for performance)

Dereck Pacheco's Automated Currency Trading Results										
Trade #	Time Interval	Currency Pair	Buy/ Sell	Entry Date	Entry Price	Shares	Exit Date	Exit Price	Profit/Loss (USD)	R-Multiples
1	Hour	EUR/USD	Sell	1/9/17 13:00	1.05750	100	1/18/17 8:00	1.06864	-$1.11	-1.050
2	Daily	EUR/USD	Sell	1/12/17	1.05790	100	2/16/17	1.05984	-$0.19	-0.180
3	Hour	EUR/USD	Buy	1/18/17 8:00	1.06864	100	1/25/17 13:00	1.07425	$0.56	0.524
4	Hour	EUR/USD	Sell	1/25/17 13:00	1.07425	100	1/26/17 12:00	1.06710	$0.71	0.666
5	Hour	EUR/USD	Buy	1/26/17 12:00	1.06710	100	1/27/17 8:00	1.06928	$0.22	0.204
6	Hour	EUR/USD	Sell	1/27/17 8:00	1.06928	100	1/27/17 11:00	1.07013	-$0.09	-0.079
7	Hour	EUR/USD	Buy	1/27/17 11:00	1.07013	100	2/14/17 9:00	1.06214	-$0.80	-0.747
8	Hour	EUR/USD	Sell	2/14/17 9:00	1.06214	100	2/15/17 11:00	1.05605	$0.61	0.573
9	Hour	EUR/USD	Buy	2/15/17 11:00	1.05605	100	2/20/17 11:00	1.06216	$0.61	0.579
10	Daily	EUR/USD	Buy	2/16/17	1.05984	100	2/21/17	1.06084	$0.10	0.094
11	Hour	EUR/USD	Sell	2/20/17 11:00	1.06216	100	3/2/17 8:00	1.05222	$0.99	0.936
12	Daily	EUR/USD	Sell	2/21/17	1.06084	100	2/22/17	1.05345	$0.74	0.697
13	Daily	EUR/USD	Buy	2/22/17	1.05345	100	3/17/17	1.07636	$2.29	2.175
14	Hour	EUR/USD	Buy	3/2/17 8:00	1.05222	100	3/3/17 8:00	1.05381	$0.16	0.151
15	Hour	EUR/USD	Sell	3/3/17 8:00	1.05381	100	3/6/17 13:00	1.05840	-$0.46	-0.436
16	Hour	EUR/USD	Buy	3/6/17 13:00	1.05840	100	3/9/17 11:00	1.05927	$0.09	0.082
17	Hour	EUR/USD	Sell	3/9/17 11:00	1.05927	100	3/13/17 13:00	1.06682	-$0.76	-0.713
18	Hour	EUR/USD	Buy	3/13/17 13:00	1.06682	100	3/15/17 12:00	1.06250	-$0.43	-0.405
19	Hour	EUR/USD	Sell	3/15/17 12:00	1.06250	100	4/4/17 11:00	1.06511	-$0.26	-0.246
20	Daily	EUR/USD	Sell	3/17/17	1.07636	100	4/10/17	1.05850	$1.79	1.659
21	Hour	EUR/USD	Buy	4/4/17 11:00	1.06511	100	4/6/17 8:00	1.06631	$0.12	0.113

Manual Trades (see Table 8.6B for performance)

Dereck Pacheco's Manual Currency Trading Results									
Trade #	Currency Pair	Buy/Sell	Entry Date	Entry Price	Shares	Exit Date	Exit Price	Profit/Loss (USD)	R-Multiples
1	EUR/USD	Sell	1/31/17 13:30	1.07864	200	2/1/17 16:07	1.07706	0.316	0.293
2	EUR/USD	Buy	2/1/17 16:07	1.07706	200	2/2/17 19:26	1.07588	-0.236	-0.219
3	EUR/USD	Buy	2/2/17 19:27	1.07584	200	2/2/17 20:23	1.07669	0.17	0.158
4	GBP/USD	Buy	2/13/17 18:16	1.25283	1000	2/14/17 21:17	1.24479	-6.04	-4.821
5	EUR/USD	Sell	2/13/17 18:46	1.05966	1000	2/14/17 22:34	1.05779	1.87	1.765
6	USD/JPY	Buy	2/13/17 18:54	113.702	1000	2/14/17 21:15	114.417	6.2498	0.055
7	USD/JPY	Sell	4/12/17 12:33	109.641	200	4/12/17 16:21	109.092	1.0065	0.009
8	AUD/USD	Sell	4/18/17 14:15	0.75579	200	4/19/17 12:17	0.74973	1.212	1.604
9	EUR/GBP	Sell	4/19/17 12:22	0.83804	500	4/19/17 21:17	0.83814	-0.0639	-0.076
10	EUR/USD	Buy	4/19/17 12:22	1.07094	200	4/23/17 21:18	1.08532	2.876	2.685
11	USD/CAD	Buy	4/21/17 9:39	1.35097	200	4/25/17 8:33	1.35861	1.1249	0.833
12	GBP/USD	Sell	4/24/17 21:06	1.27787	500	4/25/17 8:33	1.28302	-2.575	-2.015
13	EUR/USD	Buy	4/25/17 8:34	1.08959	500	4/25/17 17:09	1.09299	1.7	1.560
14	USD/JPY	Buy	4/25/17 8:35	110.575	500	4/25/17 16:07	111.082	2.2819	0.021
15	AUD/USD	Sell	4/25/17 8:42	0.75305	200	4/26/17 0:39	0.75207	0.196	0.260

Figure 8.6A: Automated MSA Graph

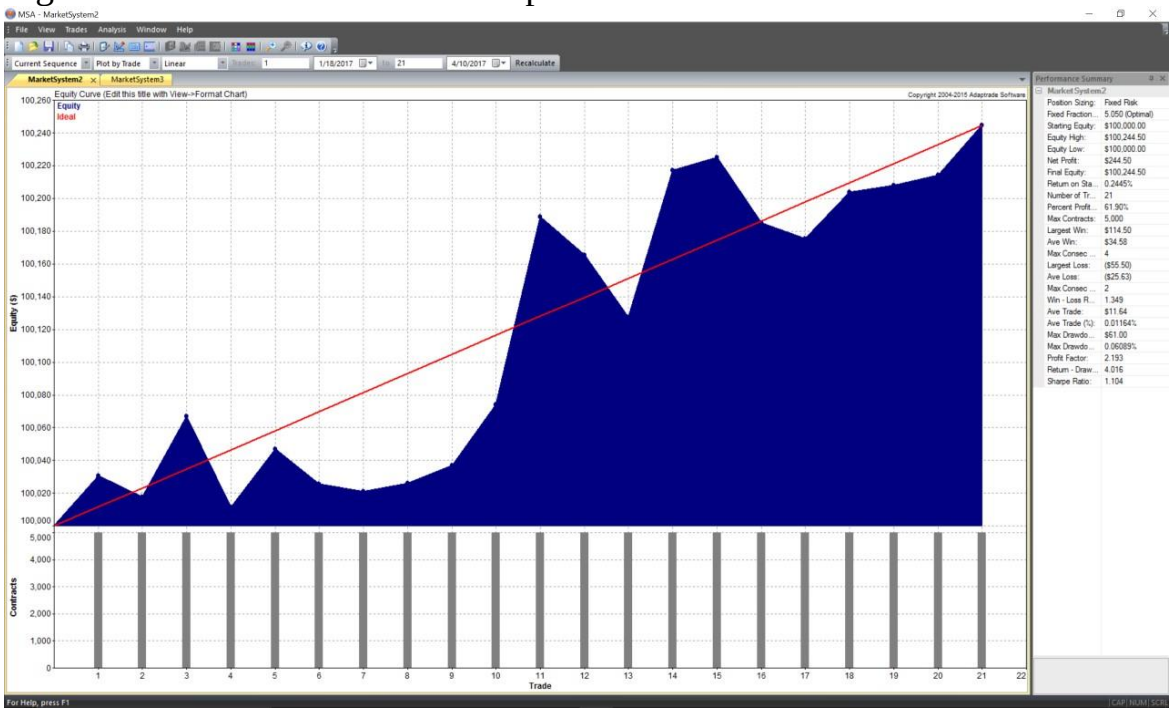


Figure 8.6B: Automated MSA Data

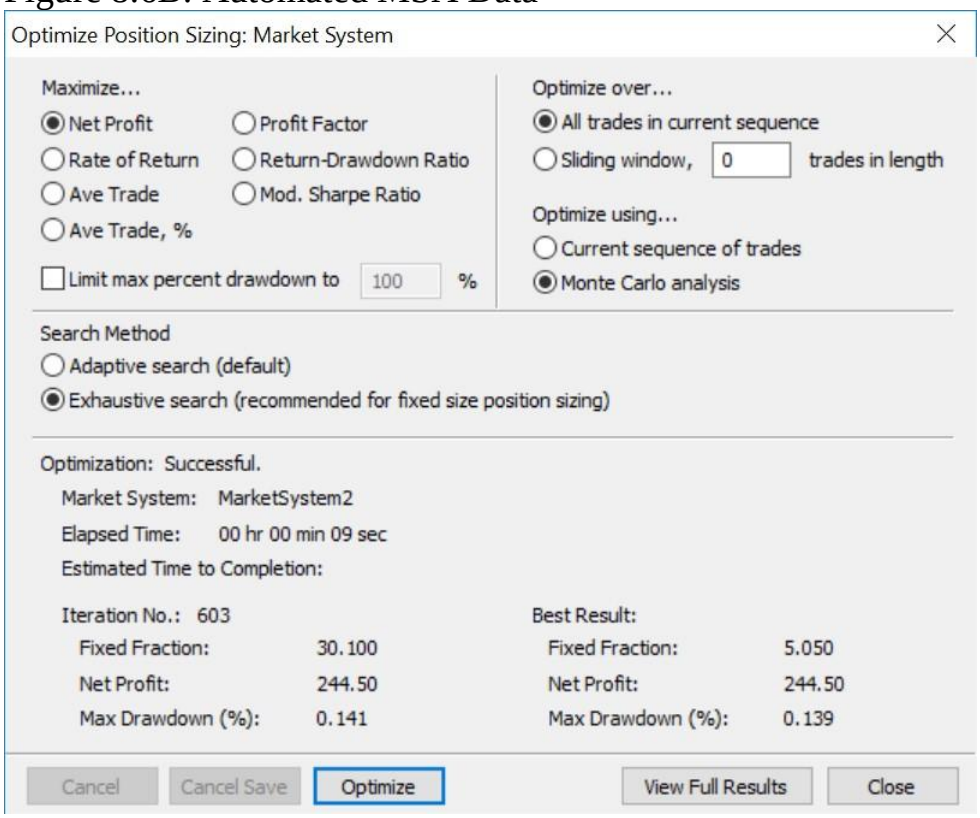


Figure 8.6C: Manual MSA Graph

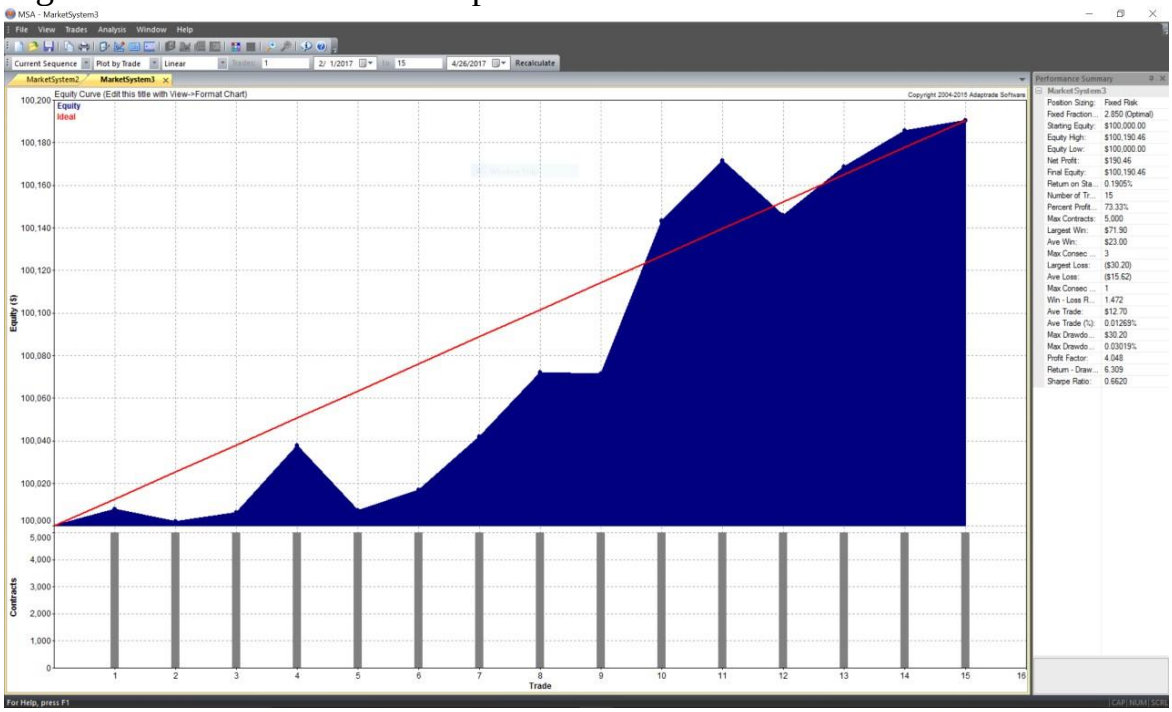
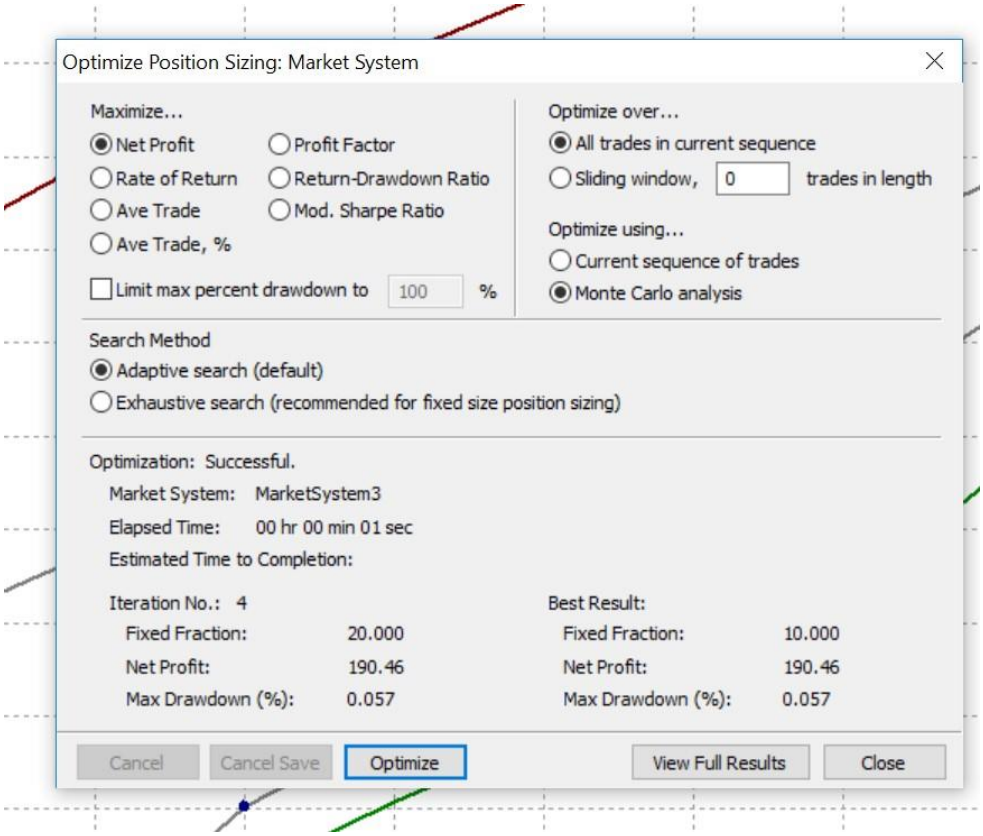


Figure 8.6D: Manual MSA Data



EasyLanguage Code for Automated System

```
Inputs:
        Fast_Length ( 5 ) ,
        Slow_Length ( 15 ) ,
        Linear_Ave ( 1 ) ,
        Exponential_Ave ( 0 ) ,
        Weighted_Ave ( 0 ) ;
Variables:
        Fast_Average ( 0 ) ,
        Slow_Average ( 0 ) ;
If Linear_Ave = 1 Then

Begin
                Fast_Average = Average ( Close , Fast_Length ) ;
                Slow_Average = Average ( Close , Slow_Length ) ;
        End

        Else
```

```
        Begin
                If Exponential_Ave = 1 Then
                        Begin
                                Fast_Average = XAverage ( Close , Fast_Length ) ;
                                Slow_Average = XAverage ( Close , Slow_Length ) ;
                        End
                        Else
                        Begin

                                If Weighted_Ave = 1 Then
                                        Begin
                                                Fast_Average = WAverage ( Close ,
Fast_Length ) ;
                                                Slow_Average = WAverage ( Close ,
Slow_Length ) ;
                                        End ;
                        End ;
        End ;

If Time >= 0700 and time <=1300 then begin;

If Fast_Average Crosses Above Slow_Average Then
        Buy 100 Shares Next Bar at Market ;

If Fast_Average Crosses Below Slow_Average Then
        Sell Short 100 Shares Next Bar at market ;

End;
```

14.2 Sanjay's Data

DCF Diagrams

Ticker	ALXN	Currency	Trading
Name	Alexion Pharmaceuticals Inc	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Dec 11 A	Dec 12 A	Dec 13 A	Dec 14 A	Dec 15 A	Dec 16 A	Dec 17 E	Dec 18 E	Dec 19 E	Dec 20 E	Dec 21 E	Dec 22 E	Trend
Revenue (Estimate Comparable)	783	1,134	1,551	2,234	2,604	3,084	3,478	4,033	4,823	5,628	6,371	6,141	
% YoY Growth		45%	37%	44%	17%	18%	13%	16%	20%	17%	13%	-4%	
EBITDA	262	446	604	963	979	1,199	1,746	2,091	2,509	3,459	3,927	4,315	
% Margin	33%	39%	39%	43%	38%	39%	50%	52%	52%	61%	62%	70%	
Free Cash Flow	211	367	449	348	896	332	1,140	1,382	1,629	2,557	2,676	3,064	
% Margin	27%	32%	29%	16%	34%	11%	33%	34%	34%	45%	42%	50%	

Perpetuity Growth Method

Current Price (USD)	124.48
Consensus Price Target	159.89
DCF Estimated Value per Share (USD)	**239.01**
DCF Estimated Upside	92%

Discount Rate (WACC)	Perpetuity Growth 4.1%	4.6%	5.1%	5.6%	6.1%
8.1%	247.83	280.59	324.26	385.40	477.09
8.6%	218.35	243.37	275.53	318.40	378.42
9.1%	194.80	214.45	**239.01**	270.58	312.67
9.6%	175.55	191.33	210.63	234.74	265.74
10.1%	159.53	172.44	187.95	206.89	230.57

Discount Rate (WACC)	Perpetuity Growth 4.1%	4.6%	5.1%	5.6%	6.1%
8.1%	99%	125%	160%	210%	283%
8.6%	75%	96%	121%	156%	204%
9.1%	56%	72%	**92%**	117%	151%
9.6%	41%	54%	69%	89%	113%
10.1%	28%	39%	51%	66%	85%

EBITDA Multiple Method

Current Price (USD)	124.48
Consensus Price Target	159.89
DCF Estimated Value per Share (USD)	**331.56**
DCF Estimated Upside	166%

Discount Rate (WACC)	Terminal EBITDA Multiple 23.1x	24.6x	26.1x	27.6x	29.1x
8.1%	310.07	328.47	346.87	365.28	383.68
8.6%	303.15	321.13	339.11	357.10	375.08
9.1%	296.41	313.99	**331.56**	349.14	366.71
9.6%	289.86	307.04	324.21	341.39	358.57
10.1%	283.48	300.27	317.06	333.85	350.64

Discount Rate (WACC)	Terminal EBITDA Multiple 23.1x	24.6x	26.1x	27.6x	29.1x
8.1%	149%	164%	179%	193%	208%
8.6%	144%	158%	172%	187%	201%
9.1%	138%	152%	**166%**	180%	195%
9.6%	133%	147%	160%	174%	188%
10.1%	128%	141%	155%	168%	182%

Bloomberg

Discounted Cash Flow

Ticker	AMGN	Currency	Trading
Name	Amgen Inc	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Dec 11 A	Dec 12 A	Dec 13 A	Dec 14 A	Dec 15 A	Dec 16 A	Dec 17 E	Dec 18 E	Dec 19 E	Dec 20 E	Dec 21 E	Dec 22 E	Trend
Revenue (Estimate Comparable)	15,582	17,265	18,676	20,063	21,662	22,991	22,710	22,823	23,311	23,865	24,295	24,929	
% YoY Growth		11%	8%	7%	8%	6%	-1%	0%	2%	2%	2%	3%	
EBITDA	6,280	7,132	7,387	8,960	10,799	13,551	13,004	12,894	12,872	9,717	9,203	9,927	
% Margin	40%	41%	40%	45%	50%	59%	57%	56%	55%	41%	38%	40%	
Free Cash Flow	5,472	5,389	5,298	12,320	8,187	10,397	11,362	11,426	11,625	7,394	7,083	8,022	
% Margin	35%	31%	28%	61%	38%	45%	50%	50%	50%	31%	29%	32%	

Perpetuity Growth Method

Current Price (USD)	163.03
Consensus Price Target	184.71
DCF Estimated Value per Share (USD)	**208.63**
DCF Estimated Upside	28%

Discount Rate (WACC)	Perpetuity Growth 3.9%	4.4%	4.9%	5.4%	5.9%
8.4%	215.23	235.59	261.78	296.71	345.65
8.9%	195.91	211.90	231.89	257.60	291.89
9.4%	180.10	192.94	**208.63**	228.26	253.50
9.9%	166.92	177.42	190.03	205.44	224.71
10.4%	155.76	164.49	174.80	187.18	202.32

Discount Rate (WACC)	Perpetuity Growth 3.9%	4.4%	4.9%	5.4%	5.9%
8.4%	32%	45%	61%	82%	112%
8.9%	20%	30%	42%	58%	79%
9.4%	10%	18%	**28%**	40%	55%
9.9%	2%	9%	17%	26%	38%
10.4%	-4%	1%	7%	15%	24%

EBITDA Multiple Method

Current Price (USD)	163.03
Consensus Price Target	184.71
DCF Estimated Value per Share (USD)	**137.48**
DCF Estimated Upside	-16%

Discount Rate (WACC)	Terminal EBITDA Multiple 6.6x	8.1x	9.6x	11.1x	12.6x
8.4%	116.40	129.32	142.23	155.15	168.06
8.9%	114.58	127.21	139.83	152.45	165.07
9.4%	112.81	125.14	**137.48**	149.81	162.15
9.9%	111.08	123.13	135.19	147.25	159.30
10.4%	109.39	121.17	132.96	144.75	156.53

Discount Rate (WACC)	Terminal EBITDA Multiple 6.6x	8.1x	9.6x	11.1x	12.6x
8.4%	-29%	-21%	-13%	-5%	3%
8.9%	-30%	-22%	-14%	-6%	1%
9.4%	-31%	-23%	**-16%**	-8%	-1%
9.9%	-32%	-24%	-17%	-10%	-2%
10.4%	-33%	-26%	-18%	-11%	-4%

Bloomberg

Discounted Cash Flow

Ticker	AMZN	Currency	Trading
Name	Amazon.com Inc	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Dec 11 A	Dec 12 A	Dec 13 A	Dec 14 A	Dec 15 A	Dec 16 A	Dec 17 E	Dec 18 E	Dec 19 E	Dec 20 E	Dec 21 E	Dec 22 E	Trend
Revenue (Estimate Comparable)	48,077	61,093	74,452	88,988	107,006	135,987	165,924	200,338	238,310	278,834	319,640	365,664	
% YoY Growth		27%	22%	20%	20%	27%	22%	21%	19%	17%	15%	14%	
EBITDA	1,945	2,910	4,010	5,094	8,514	12,302	19,361	25,387	32,627	39,505	47,968	56,837	
% Margin	4%	5%	5%	6%	8%	9%	12%	13%	14%	14%	15%	16%	
Free Cash Flow	1,155	157	1,528	1,370	6,008	8,210	9,623	10,238	7,414	14,459	12,968	4,900	
% Margin	2%	0%	2%	2%	6%	6%	6%	5%	3%	5%	4%	1%	

Perpetuity Growth Method

Current Price (USD)	949.04
Consensus Price Target	1099.26
DCF Estimated Value per Share (USD)	266.91
DCF Estimated Upside	-72%

Perpetuity Growth

Discount Rate (WACC)	1.0%	1.5%	2.0%	2.5%	3.0%
9.0%	274.98	287.49	301.78	318.27	337.51
9.5%	260.07	270.90	283.18	297.22	313.41
10.0%	246.81	256.27	**266.91**	278.97	292.75
10.5%	234.95	243.27	252.55	263.00	274.85
11.0%	224.29	231.63	239.80	248.92	259.18

Discount Rate (WACC)	1.0%	1.5%	2.0%	2.5%	3.0%
9.0%	-71%	-70%	-68%	-66%	-64%
9.5%	-73%	-71%	-70%	-69%	-67%
10.0%	-74%	-73%	**-72%**	-71%	-69%
10.5%	-75%	-74%	-73%	-72%	-71%
11.0%	-76%	-76%	-75%	-74%	-73%

EBITDA Multiple Method

Current Price (USD)	949.04
Consensus Price Target	1099.26
DCF Estimated Value per Share (USD)	2288.11
DCF Estimated Upside	141%

Terminal EBITDA Multiple

Discount Rate (WACC)	30.0x	31.5x	33.0x	34.5x	36.0x
9.0%	2184.01	2288.17	2392.33	2496.49	2600.65
9.5%	2135.90	2237.71	2339.51	2441.32	2543.12
10.0%	2089.08	2188.60	**2288.11**	2387.62	2487.13
10.5%	2043.52	2140.80	2238.08	2335.37	2432.65
11.0%	1999.17	2094.28	2189.39	2284.50	2379.61

Discount Rate (WACC)	30.0x	31.5x	33.0x	34.5x	36.0x
9.0%	130%	141%	152%	163%	174%
9.5%	125%	136%	147%	157%	168%
10.0%	120%	131%	**141%**	152%	162%
10.5%	115%	126%	136%	146%	156%
11.0%	111%	121%	131%	141%	151%

Bloomberg

Discounted Cash Flow

Ticker	ARW	Currency	Trading
Name	Arrow Electronics Inc	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Dec 11 A	Dec 12 A	Dec 13 A	Dec 14 A	Dec 15 A	Dec 16 A	Dec 17 E	Dec 18 E	Dec 19 E	Dec 20 E	Dec 21 E	Dec 22 E	Trend
Revenue (Estimate Comparable)	21,390	20,405	21,357	22,769	23,282	23,825	24,999	25,895	26,001	26,848	27,650	28,403	
% YoY Growth		-5%	5%	7%	2%	2%	5%	4%	0%	3%	3%	3%	
EBITDA	1,095	922	954	1,036	1,049	1,091	1,143	1,207	1,204	1,243	1,280	1,315	
% Margin	5%	5%	4%	5%	5%	5%	5%	5%	5%	5%	5%	5%	
Free Cash Flow	(113)	537	454	779	554	388	593	625	630	603	616	671	
% Margin	-1%	3%	2%	3%	2%	2%	2%	2%	2%	2%	2%	2%	

Perpetuity Growth Method

Current Price (USD)	77.63
Consensus Price Target	80.57
DCF Estimated Value per Share (USD)	114.63
DCF Estimated Upside	48%

Perpetuity Growth

Discount Rate (WACC)	2.8%	3.3%	3.8%	4.3%	4.8%
7.2%	119.45	134.73	154.41	180.74	217.75
7.7%	105.04	117.01	132.01	151.33	177.17
8.2%	93.27	102.87	**114.63**	129.35	148.31
8.7%	83.48	91.33	100.76	112.29	126.74
9.2%	75.21	81.72	89.43	98.68	110.01

Discount Rate (WACC)	2.8%	3.3%	3.8%	4.3%	4.8%
7.2%	54%	74%	99%	133%	180%
7.7%	35%	51%	70%	95%	128%
8.2%	20%	33%	**48%**	67%	91%
8.7%	8%	18%	30%	45%	63%
9.2%	-3%	5%	15%	27%	42%

EBITDA Multiple Method

Current Price (USD)	77.63
Consensus Price Target	80.57
DCF Estimated Value per Share (USD)	88.61
DCF Estimated Upside	14%

Terminal EBITDA Multiple

Discount Rate (WACC)	5.8x	7.3x	8.8x	10.3x	11.8x
7.2%	62.54	77.93	93.32	108.72	124.11
7.7%	60.85	75.89	90.93	105.97	121.01
8.2%	59.21	73.91	**88.61**	103.30	118.00
8.7%	57.62	71.98	86.34	100.70	115.06
9.2%	56.06	70.10	84.13	98.17	112.20

Discount Rate (WACC)	5.8x	7.3x	8.8x	10.3x	11.8x
7.2%	-19%	0%	20%	40%	60%
7.7%	-22%	-2%	17%	37%	56%
8.2%	-24%	-5%	**14%**	33%	52%
8.7%	-26%	-7%	11%	30%	48%
9.2%	-28%	-10%	8%	26%	45%

Bloomberg

Discounted Cash Flow

Ticker	CA	Currency	Trading
Name	CA Inc	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Mar 11 A	Mar 12 A	Mar 13 A	Mar 14 A	Mar 15 A	Mar 16 A	Mar 17 E	Mar 18 E	Mar 19 E	Mar 20 E	Mar 21 E	Mar 22 E	Trend
Revenue (Estimate Comparable)	4,429	4,814	4,643	4,515	4,262	4,025	3,971	3,989	4,073	4,161	4,119	4,157	
% YoY Growth		9%	-4%	-3%	-6%	-6%	-1%	0%	2%	2%	-1%	1%	
EBITDA	1,623	1,850	1,900	1,662	1,565	1,489	1,551	1,576	1,569	1,596	1,580	1,595	
% Margin	37%	38%	41%	37%	37%	37%	39%	40%	39%	38%	38%	38%	
Free Cash Flow	1,372	1,488	1,331	1,284	847	1,142	1,050	1,036	1,006	987	1,034	1,028	
% Margin	31%	31%	29%	28%	20%	28%	26%	26%	25%	24%	25%	25%	

Perpetuity Growth Method	
Current Price (USD)	32.32
Consensus Price Target	32.67
DCF Estimated Value per Share (USD)	36.88
DCF Estimated Upside	14%

		Perpetuity Growth				
		1.0%	1.5%	2.0%	2.5%	3.0%
Discount Rate (WACC)	7.7%	38.02	40.25	42.87	46.00	49.80
	8.2%	35.56	37.44	39.63	42.20	45.28
	8.7%	33.42	35.03	**36.88**	39.03	41.55
	9.2%	31.55	32.93	34.51	36.33	38.44
	9.7%	29.89	31.10	32.46	34.00	35.79
		1.0%	1.5%	2.0%	2.5%	3.0%
	7.7%	18%	25%	33%	42%	54%
	8.2%	10%	16%	23%	31%	40%
	8.7%	3%	8%	**14%**	21%	29%
	9.2%	-2%	2%	7%	12%	19%
	9.7%	-8%	-4%	0%	5%	11%

EBITDA Multiple Method	
Current Price (USD)	32.32
Consensus Price Target	32.67
DCF Estimated Value per Share (USD)	32.27
DCF Estimated Upside	0%

		Terminal EBITDA Multiple				
		5.0x	6.5x	8.0x	9.5x	11.0x
Discount Rate (WACC)	7.7%	25.53	29.48	33.44	37.40	41.35
	8.2%	25.11	28.98	32.85	36.71	40.58
	8.7%	24.71	28.49	**32.27**	36.04	39.82
	9.2%	24.32	28.01	31.70	35.39	39.08
	9.7%	23.93	27.54	31.15	34.76	38.37
		5.0x	6.5x	8.0x	9.5x	11.0x
	7.7%	-21%	-9%	3%	16%	28%
	8.2%	-22%	-10%	2%	14%	26%
	8.7%	-24%	-12%	**0%**	12%	23%
	9.2%	-25%	-13%	-2%	10%	21%
	9.7%	-26%	-15%	-4%	8%	19%

Ticker	CERN	Currency	Trading
Name	Cerner Corp	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Dec 11 A	Dec 12 A	Dec 13 A	Dec 14 A	Dec 15 A	Dec 16 A	Dec 17 E	Dec 18 E	Dec 19 E	Dec 20 E	Dec 21 E	Dec 22 E	Trend
Revenue (Estimate Comparable)	2,203	2,665	2,911	3,403	4,425	4,796	5,201	5,617	6,104	6,674	7,236	7,742	
% YoY Growth		21%	9%	17%	30%	8%	8%	8%	9%	9%	8%	7%	
EBITDA	672	794	946	1,081	1,374	1,476	1,715	1,871	2,068	2,317	2,538	2,716	
% Margin	31%	30%	32%	32%	31%	31%	33%	33%	34%	35%	35%	35%	
Free Cash Flow	397	514	333	581	575	832	866	940	976	1,105	1,264	1,314	
% Margin	18%	19%	11%	17%	13%	17%	17%	17%	16%	17%	17%	17%	

Perpetuity Growth Method	
Current Price (USD)	64.61
Consensus Price Target	63.95
DCF Estimated Value per Share (USD)	55.11
DCF Estimated Upside	-15%

		Perpetuity Growth				
		1.6%	2.1%	2.6%	3.1%	3.6%
Discount Rate (WACC)	7.7%	57.01	61.20	66.21	72.30	79.88
	8.2%	52.56	56.05	60.17	65.08	71.06
	8.7%	48.74	51.69	**55.11**	59.15	63.98
	9.2%	45.43	47.94	50.83	54.20	58.16
	9.7%	42.53	44.69	47.16	50.00	53.30
		1.6%	2.1%	2.6%	3.1%	3.6%
	7.7%	-12%	-5%	2%	12%	24%
	8.2%	-19%	-13%	-7%	1%	10%
	8.7%	-25%	-20%	**-15%**	-8%	-1%
	9.2%	-30%	-26%	-21%	-16%	-10%
	9.7%	-34%	-31%	-27%	-23%	-18%

EBITDA Multiple Method	
Current Price (USD)	64.61
Consensus Price Target	63.95
DCF Estimated Value per Share (USD)	81.37
DCF Estimated Upside	26%

		Terminal EBITDA Multiple				
		10.3x	11.8x	13.3x	14.8x	16.3x
Discount Rate (WACC)	7.7%	68.66	76.80	84.94	93.08	101.22
	8.2%	67.22	75.18	83.13	91.08	99.04
	8.7%	65.82	73.60	**81.37**	89.14	96.91
	9.2%	64.46	72.06	79.65	87.25	94.85
	9.7%	63.13	70.56	77.98	85.41	92.83
		10.3x	11.8x	13.3x	14.8x	16.3x
	7.7%	6%	19%	31%	44%	57%
	8.2%	4%	16%	29%	41%	53%
	8.7%	2%	14%	**26%**	38%	50%
	9.2%	0%	12%	23%	35%	47%
	9.7%	-2%	9%	21%	32%	44%

Bloomberg

Discounted Cash Flow

Ticker	CNC	Currency	Trading
Name	Centene Corp	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Dec 11 A	Dec 12 A	Dec 13 A	Dec 14 A	Dec 15 A	Dec 16 A	Dec 17 E	Dec 18 E	Dec 19 E	Dec 20 E	Dec 21 E	Dec 22 E	Trend
Revenue (Estimate Comparable)	5,341	8,668	10,863	16,560	22,760	40,607	46,772	51,663	56,251	60,722	60,552	66,257	
% YoY Growth		62%	25%	52%	37%	78%	15%	10%	9%	8%	0%	9%	
EBITDA	249	202	352	564	772	1,572	1,768	2,293	2,503	2,702	2,694	2,948	
% Margin	5%	2%	3%	3%	3%	4%	4%	4%	4%	4%	4%	4%	
Free Cash Flow	141	274	265	1,093	518	3,338	2,325	2,810	3,417	3,493	3,875	3,944	
% Margin	3%	3%	2%	7%	2%	8%	5%	5%	6%	6%	6%	6%	

Perpetuity Growth Method	
Current Price (USD)	75.79
Consensus Price Target	82.88
DCF Estimated Value per Share (USD)	428.41
DCF Estimated Upside	465%

EBITDA Multiple Method	
Current Price (USD)	75.79
Consensus Price Target	82.88
DCF Estimated Value per Share (USD)	152.40
DCF Estimated Upside	101%

Perpetuity Growth

Discount Rate (WACC)	1.0%	1.5%	2.0%	2.5%	3.0%
5.8%	443.67	488.39	545.02	619.05	719.96
6.3%	400.42	435.95	479.84	535.41	608.06
6.8%	364.72	393.54	**428.41**	471.48	526.01
7.3%	334.77	358.53	386.81	421.03	463.30
7.8%	309.28	329.15	352.47	380.23	413.82

Discount Rate (WACC)	1.0%	1.5%	2.0%	2.5%	3.0%
5.8%	485%	544%	619%	717%	850%
6.3%	428%	475%	533%	606%	702%
6.8%	381%	419%	**465%**	522%	594%
7.3%	342%	373%	410%	456%	511%
7.8%	308%	334%	365%	402%	446%

Terminal EBITDA Multiple

Discount Rate (WACC)	3.4x	4.9x	6.4x	7.9x	9.4x
5.8%	121.32	139.64	157.96	176.28	194.61
6.3%	119.36	137.25	155.15	173.04	190.93
6.8%	117.44	134.92	**152.40**	169.88	187.35
7.3%	115.57	132.64	149.72	166.79	183.87
7.8%	113.74	130.42	147.10	163.79	180.47

Discount Rate (WACC)	3.4x	4.9x	6.4x	7.9x	9.4x
5.8%	60%	84%	108%	133%	157%
6.3%	57%	81%	105%	128%	152%
6.8%	55%	78%	**101%**	124%	147%
7.3%	52%	75%	98%	120%	143%
7.8%	50%	72%	94%	116%	138%

Bloomberg

Discounted Cash Flow

Ticker	KFY	Currency	Trading
Name	Korn/Ferry International	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Apr 11 A	Apr 12 A	Apr 13 A	Apr 14 A	Apr 15 A	Apr 16 A	Apr 17 E	Apr 18 E	Apr 19 E	Apr 20 E	Apr 21 E	Apr 22 E	Trend
Revenue (Estimate Comparable)	744	791	813	960	1,028	1,303	1,567	1,639	1,735	1,974	2,198	2,389	
% YoY Growth		6%	3%	18%	7%	27%	20%	5%	6%	14%	11%	9%	
EBITDA	101	100	89	126	152	193	235	249	269	306	341	371	
% Margin	14%	13%	11%	13%	15%	15%	15%	15%	16%	16%	16%	16%	
Free Cash Flow	54	43	68	79	97	139	144	177	189	221	250	270	
% Margin	7%	5%	8%	8%	9%	11%	9%	11%	11%	11%	11%	11%	

Perpetuity Growth Method	
Current Price (USD)	32.40
Consensus Price Target	34.67
DCF Estimated Value per Share (USD)	64.57
DCF Estimated Upside	99%

EBITDA Multiple Method	
Current Price (USD)	32.40
Consensus Price Target	34.67
DCF Estimated Value per Share (USD)	62.77
DCF Estimated Upside	94%

Perpetuity Growth

Discount Rate (WACC)	3.0%	3.5%	4.0%	4.5%	5.0%
9.6%	66.55	70.60	75.39	81.10	88.06
10.1%	62.12	65.55	69.53	74.22	79.84
10.6%	58.28	61.20	**64.57**	68.48	73.09
11.1%	54.92	57.44	60.30	63.61	67.45
11.6%	51.96	54.14	56.61	59.42	62.67

Discount Rate (WACC)	3.0%	3.5%	4.0%	4.5%	5.0%
9.6%	105%	118%	133%	150%	172%
10.1%	92%	102%	115%	129%	146%
10.6%	80%	89%	**99%**	111%	126%
11.1%	70%	77%	86%	96%	108%
11.6%	60%	67%	75%	83%	93%

Terminal EBITDA Multiple

Discount Rate (WACC)	8.0x	9.5x	11.0x	12.5x	14.0x
9.6%	52.82	58.97	65.12	71.26	77.41
10.1%	51.91	57.92	63.93	69.94	75.94
10.6%	51.02	56.89	**62.77**	68.64	74.52
11.1%	50.15	55.90	61.64	67.38	73.12
11.6%	49.31	54.92	60.54	66.15	71.77

Discount Rate (WACC)	8.0x	9.5x	11.0x	12.5x	14.0x
9.6%	63%	82%	101%	120%	139%
10.1%	60%	79%	97%	116%	134%
10.6%	57%	76%	**94%**	112%	130%
11.1%	55%	73%	90%	108%	126%
11.6%	52%	70%	87%	104%	122%

Bloomberg

Discounted Cash Flow

Ticker	MSFT	Currency	Trading
Name	Microsoft Corp	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Jun 11 A	Jun 12 A	Jun 13 A	Jun 14 A	Jun 15 A	Jun 16 A	Jun 17 E	Jun 18 E	Jun 19 E	Jun 20 E	Jun 21 E	Jun 22 E	Trend
Revenue (Estimate Comparable)	69,943	73,723	77,849	86,833	93,580	91,963	96,355	103,602	111,415	123,039	129,785	131,647	
% YoY Growth		5%	6%	12%	8%	-2%	5%	8%	8%	10%	5%	1%	
EBITDA	29,927	30,923	31,252	32,716	34,118	27,914	37,234	40,622	45,805	44,566	47,115	48,454	
% Margin	43%	42%	40%	38%	36%	30%	39%	39%	41%	36%	36%	37%	
Free Cash Flow	24,016	26,737	22,001	28,117	19,566	20,625	25,780	27,667	32,665	30,654	31,957	31,743	
% Margin	34%	36%	28%	32%	21%	22%	27%	27%	29%	25%	25%	24%	

Perpetuity Growth Method

Current Price (USD)	68.94
Consensus Price Target	73.28
DCF Estimated Value per Share (USD)	**62.92**
DCF Estimated Upside	-9%

		Perpetuity Growth				
		1.0%	1.5%	2.0%	2.5%	3.0%
Discount Rate (WACC)	8.0%	64.72	68.06	71.96	76.58	82.11
	8.5%	60.96	63.81	67.09	70.92	75.45
	9.0%	57.68	60.12	**62.92**	66.14	69.90
	9.5%	54.79	56.91	59.30	62.04	65.21
	10.0%	52.22	54.07	56.14	58.50	61.19

	1.0%	1.5%	2.0%	2.5%	3.0%
8.0%	-6%	-1%	4%	11%	19%
8.5%	-12%	-7%	-3%	3%	9%
9.0%	-16%	-13%	**-9%**	-4%	1%
9.5%	-21%	-17%	-14%	-10%	-5%
10.0%	-24%	-22%	-19%	-15%	-11%

EBITDA Multiple Method

Current Price (USD)	68.94
Consensus Price Target	73.28
DCF Estimated Value per Share (USD)	**90.57**
DCF Estimated Upside	31%

		Terminal EBITDA Multiple				
		13.4x	14.9x	16.4x	17.9x	19.4x
Discount Rate (WACC)	8.0%	81.31	87.69	94.08	100.46	106.85
	8.5%	79.82	86.06	92.30	98.54	104.78
	9.0%	78.37	84.47	**90.57**	96.67	102.77
	9.5%	76.96	82.92	88.88	94.84	100.80
	10.0%	75.59	81.42	87.24	93.07	98.90

	13.4x	14.9x	16.4x	17.9x	19.4x
8.0%	18%	27%	36%	46%	55%
8.5%	16%	25%	34%	43%	52%
9.0%	14%	23%	**31%**	40%	49%
9.5%	12%	20%	29%	38%	46%
10.0%	10%	18%	27%	35%	43%

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Discounted Cash Flow

Ticker	OC	Currency	Trading
Name	Owens Corning	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Dec 11 A	Dec 12 A	Dec 13 A	Dec 14 A	Dec 15 A	Dec 16 A	Dec 17 E	Dec 18 E	Dec 19 E	Dec 20 E	Dec 21 E	Dec 22 E	Trend
Revenue (Estimate Comparable)	5,335	5,172	5,295	5,276	5,350	5,677	5,899	6,156	6,415	6,842	7,119	7,145	
% YoY Growth		-3%	2%	0%	1%	6%	4%	4%	4%	7%	4%	0%	
EBITDA	763	584	728	717	850	1,070	1,132	1,211	1,307	1,220	1,265	1,270	
% Margin	14%	11%	14%	14%	16%	19%	19%	20%	20%	18%	18%	18%	
Free Cash Flow	(103)	171	280	221	505	565	613	705	839	754	767	782	
% Margin	-2%	3%	5%	4%	9%	10%	10%	11%	13%	11%	11%	11%	

Perpetuity Growth Method

Current Price (USD)	61.65
Consensus Price Target	66.32
DCF Estimated Value per Share (USD)	**90.58**
DCF Estimated Upside	47%

		Perpetuity Growth				
		1.0%	1.5%	2.0%	2.5%	3.0%
Discount Rate (WACC)	6.9%	94.25	102.46	112.35	124.46	139.67
	7.4%	85.59	92.40	100.46	110.16	122.05
	7.9%	78.18	83.90	**90.58**	98.50	108.02
	8.4%	71.78	76.64	82.25	88.81	96.58
	8.9%	66.19	70.36	75.13	80.64	87.08

	1.0%	1.5%	2.0%	2.5%	3.0%
6.9%	53%	66%	82%	102%	127%
7.4%	39%	50%	63%	79%	98%
7.9%	27%	36%	**47%**	60%	75%
8.4%	16%	24%	33%	44%	57%
8.9%	7%	14%	22%	31%	41%

EBITDA Multiple Method

Current Price (USD)	61.65
Consensus Price Target	66.32
DCF Estimated Value per Share (USD)	**73.02**
DCF Estimated Upside	18%

		Terminal EBITDA Multiple				
		5.2x	6.7x	8.2x	9.7x	11.2x
Discount Rate (WACC)	6.9%	52.39	64.54	76.68	88.83	100.98
	7.4%	51.09	62.96	74.83	86.70	98.57
	7.9%	49.83	61.43	**73.02**	84.62	96.22
	8.4%	48.60	59.93	71.26	82.59	93.93
	8.9%	47.40	58.47	69.55	80.62	91.70

	5.2x	6.7x	8.2x	9.7x	11.2x
6.9%	-15%	5%	24%	44%	64%
7.4%	-17%	2%	21%	41%	60%
7.9%	-19%	0%	**18%**	37%	56%
8.4%	-21%	-3%	16%	34%	52%
8.9%	-23%	-5%	13%	31%	49%

Bloomberg

Discounted Cash Flow

Ticker	USAT	Currency	Trading
Name	USA Technologies Inc	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Jun 11 A	Jun 12 A	Jun 13 A	Jun 14 A	Jun 15 A	Jun 16 A	Jun 17 E	Jun 18 E	Jun 19 E	Jun 20 E	Jun 21 E	Jun 22 E	Trend
Revenue (Estimate Comparable)	23	29	36	42	58	77	96	114	139	168	198	232	
% YoY Growth		27%	24%	18%	37%	33%	24%	19%	22%	21%	18%	17%	
EBITDA	(3)	(4)	5	6	5	5	7	12	15	18	21	25	
% Margin	-11%	-12%	15%	14%	9%	6%	7%	11%	11%	11%	11%	11%	
Free Cash Flow	(6)	(7)	(4)	(5)	(26)	11	(5)	(4)	(6)	(9)	4	(2)	
% Margin	-28%	-25%	-10%	-11%	-45%	14%	-6%	-4%	-4%	-6%	2%	-1%	

Perpetuity Growth Method	
Current Price (USD)	4.90
Consensus Price Target	6.33
DCF Estimated Value per Share (USD)	-0.94
DCF Estimated Upside	-119%

EBITDA Multiple Method	
Current Price (USD)	4.90
Consensus Price Target	6.33
DCF Estimated Value per Share (USD)	16.47
DCF Estimated Upside	236%

Perpetuity Growth

Discount Rate (WACC)	1.0%	1.5%	2.0%	2.5%	3.0%
8.4%	-0.96	-0.99	-1.02	-1.06	-1.10
8.9%	-0.93	-0.95	-0.98	-1.01	-1.05
9.4%	-0.90	-0.92	**-0.94**	-0.97	-1.00
9.9%	-0.87	-0.89	-0.91	-0.93	-0.96
10.4%	-0.85	-0.87	-0.88	-0.90	-0.92

Discount Rate (WACC)	1.0%	1.5%	2.0%	2.5%	3.0%
8.4%	-120%	-120%	-121%	-122%	-122%
8.9%	-119%	-119%	-120%	-121%	-121%
9.4%	-118%	-119%	**-119%**	-120%	-120%
9.9%	-118%	-118%	-119%	-119%	-120%
10.4%	-117%	-118%	-118%	-118%	-119%

Terminal EBITDA Multiple

Discount Rate (WACC)	41.5x	43.0x	44.5x	46.0x	47.5x
8.4%	16.06	16.66	17.27	17.87	18.47
8.9%	15.69	16.27	16.86	17.45	18.04
9.4%	15.32	15.90	**16.47**	17.05	17.62
9.9%	14.96	15.53	16.09	16.65	17.21
10.4%	14.62	15.17	15.72	16.27	16.82

Discount Rate (WACC)	41.5x	43.0x	44.5x	46.0x	47.5x
8.4%	228%	240%	252%	265%	277%
8.9%	220%	232%	244%	256%	268%
9.4%	213%	224%	**236%**	248%	260%
9.9%	205%	217%	228%	240%	251%
10.4%	198%	210%	221%	232%	243%

Bloomberg

Discounted Cash Flow

Ticker	XRX	Currency	Trading
Name	Xerox Corp	Data	Adjusted (If available)

Summary Analysis | Input Calculation | Output Analysis

Summary Analysis

In Millions of USD	Dec 11 A	Dec 12 A	Dec 13 A	Dec 14 A	Dec 15 A	Dec 16 A	Dec 17 E	Dec 18 E	Dec 19 E	Dec 20 E	Dec 21 E	Dec 22 E	Trend
Revenue (Estimate Comparable)	22,626	22,390	21,435	19,540	18,161	10,771	10,170	9,860	9,559	7,549	6,307	5,815	
% YoY Growth		-1%	-4%	-9%	-7%	-41%	-6%	-3%	-3%	-21%	-16%	-8%	
EBITDA	3,085	3,049	2,773	3,016	2,009	1,707	1,809	1,788	1,849	1,460	1,220	1,125	
% Margin	14%	14%	13%	15%	11%	16%	18%	18%	19%	19%	19%	19%	
Free Cash Flow	2,370	2,201	2,511	2,073	3,234	1,427	1,610	1,597	1,677	1,362	1,039	957	
% Margin	10%	10%	12%	11%	18%	13%	16%	16%	18%	18%	16%	16%	

Perpetuity Growth Method	
Current Price (USD)	7.11
Consensus Price Target	8.29
DCF Estimated Value per Share (USD)	12.72
DCF Estimated Upside	79%

EBITDA Multiple Method	
Current Price (USD)	7.11
Consensus Price Target	8.29
DCF Estimated Value per Share (USD)	7.63
DCF Estimated Upside	7%

Perpetuity Growth

Discount Rate (WACC)	1.0%	1.5%	2.0%	2.5%	3.0%
7.1%	13.25	14.35	15.67	17.27	19.26
7.6%	12.06	12.98	14.06	15.35	16.92
8.1%	11.04	11.82	**12.72**	13.77	15.04
8.6%	10.15	10.81	11.57	12.46	13.50
9.1%	9.37	9.94	10.59	11.33	12.20

Discount Rate (WACC)	1.0%	1.5%	2.0%	2.5%	3.0%
7.1%	86%	102%	120%	143%	171%
7.6%	70%	83%	98%	116%	138%
8.1%	55%	66%	**79%**	94%	112%
8.6%	43%	52%	63%	75%	90%
9.1%	32%	40%	49%	59%	72%

Terminal EBITDA Multiple

Discount Rate (WACC)	4.8x	6.3x	7.8x	9.3x	10.8x
7.1%	5.55	6.79	8.03	9.28	10.52
7.6%	5.40	6.61	7.83	9.04	10.25
8.1%	5.25	6.44	**7.63**	8.81	10.00
8.6%	5.11	6.27	7.43	8.59	9.74
9.1%	4.97	6.10	7.24	8.37	9.50

Discount Rate (WACC)	4.8x	6.3x	7.8x	9.3x	10.8x
7.1%	-22%	-4%	13%	30%	48%
7.6%	-24%	-7%	10%	27%	44%
8.1%	-26%	-9%	**7%**	24%	41%
8.6%	-28%	-12%	4%	21%	37%
9.1%	-30%	-14%	2%	18%	34%

14.3 Michael's Data

System Stock Screener

Company Name	Ticker	5 Yr. Hist. EPS Growth	Last Yrs Growth (F[0] / F [-1])	Shares Outstanding	Price as a % of 52 Wk H-L Range	Current ROE (TTM)	Exchange	% Change EPS (F(-1)/F(-2))
Advanced Energy Industries, Inc.	AEIS	40.51	43.84	39.73	100	34.94	NSDQ	180.42
Apogee Enterprises, Inc.	APOG	58	48	28.65	91.48	19.12	NSDQ	39.32
BioTelemetry, Inc.	BEAT	215.01	73.91	28.37	100	23.76	NSDQ	611.55
Builders FirstSource, Inc.	BLDR	123.44	418.75	112.04	100	48.7	NSDQ	731.61
BofI Holding, Inc.	BOFI	33.37	36.04	63.36	82.05	18.15	NSDQ	27.93
Euronet Worldwide, Inc.	EEFT	30.46	20.97	52.36	94.98	23.35	NSDQ	76.52
Facebook, Inc.	FB	94.51	143.62	2889.98	100	19.05	NSDQ	158.5
Isle of Capri Casinos, Inc.	ISLE	82.45	65.79	41.36	94.45	50.74	NSDQ	176.47
NutriSystem Inc	NTRI	44.92	29.47	29.88	100	44.5	NSDQ	35.67
Tucows Inc.	TCX	50.23	50	10.49	93.3	48.95	NSDQ	41.26
Ulta Salon, Cosmetics & Fragrance, Inc.	ULTA	25.63	30.92	62.23	98.54	28.68	NSDQ	28.05
Willdan Group, Inc.	WLDN	45.35	86.54	8.41	86.36	18.08	NSDQ	94.86

- **Source:** (https://www.zacks.com/screening/stock-screener)

Stock Trades

Entered	Filled/Canceled	Symbol	Type	Quantity	Qty Filled	Qty Left	Limit	Filled Price	Order Status	Route	Duration
05/02/17 10:59:14 AM	05/02/17 10:59:14 AM	BEAT(1)	Sell	100	100	0	33.55	33.55	Filled	Intelligent	Day
04/28/17 2:42:24 PM	04/28/17 3:07:51 PM	FB	Sell	100	100	0	150.11	150.11	Filled	Intelligent	Day
04/28/17 2:30:34 PM	04/28/17 2:32:14 PM	TCX(HB, 3)	Sell	100	100	0	58.65	58.7	Filled	Intelligent	Day
04/20/17 10:38:05 AM	04/20/17 10:38:38 AM	FB	Buy	100	100	0	143.19	143.19	Filled	Intelligent	Day
04/13/17 11:11:11 AM	04/13/17 2:28:09 PM	WLDN(HB,0)	Sell	100	100	0	30.65	30.66	Filled	Intelligent	Day
04/11/17 2:39:22 PM	04/11/17 2:39:22 PM	BEAT(1)	Buy	100	100	0	30.75	30.75	Filled	Intelligent	Day
04/11/17 10:18:56 AM	04/11/17 12:21:11 PM	ULTA	Sell	100	100	0	284.71	284.73	Filled	Intelligent	Day
04/10/17 3:24:52 PM	04/10/17 3:38:53 PM	BLDR	Sell	100	100	0	15.23	15.23	Filled	Intelligent	Day
04/06/17 2:32:43 PM	04/06/17 2:32:43 PM	BLDR	Buy	100	100	0	14.99	14.99	Filled	Intelligent	Day
04/06/17 2:32:14 PM	04/06/17 2:34:00 PM	ULTA	Buy	100	100	0	284.13	284.08	Filled	Intelligent	Day
04/06/17 2:30:44 PM	04/06/17 2:30:44 PM	FB	Sell	100	100	0	141.24	141.24	Filled	Intelligent	Day
04/03/17 10:59:11 AM	04/03/17 10:59:11 AM	NTRI(2)	Sell	100	100	0	55	55	Filled	Intelligent	Day
04/03/17 10:58:08 AM	04/03/17 1:30:04 PM	EEFT	Sell	100	100	0	85.04	85.07	Filled	Intelligent	Day
03/27/17 2:05:05 PM	03/27/17 2:09:25 PM	EEFT	Buy	100	100	0	83.72	83.72	Filled	Intelligent	Day
03/23/17 2:38:19 PM	03/23/17 2:38:19 PM	TCX(HB, 3)	Buy	100	100	0	50.7	50.7	Filled	Intelligent	Day

03/22/17 9:46:38 AM	03/22/17 9:48:16 AM	NTRI(2)	Buy	100	100	0	54.05	54.05	Filled	Intelligent	Day
03/22/17 9:04:29 AM	03/22/17 10:44:00 AM	WLDN(HB,0)	Buy	100	100	0	29.95	29.95	Filled	Intelligent	Day
03/21/17 11:34:29 AM	03/21/17 11:34:36 AM	FB	Buy	100	100	0	139.62	139.62	Filled	Intelligent	Day

Stock Charts

- **Tucows, Inc. (TCX)**

- **Facebook, Inc. (FB)**

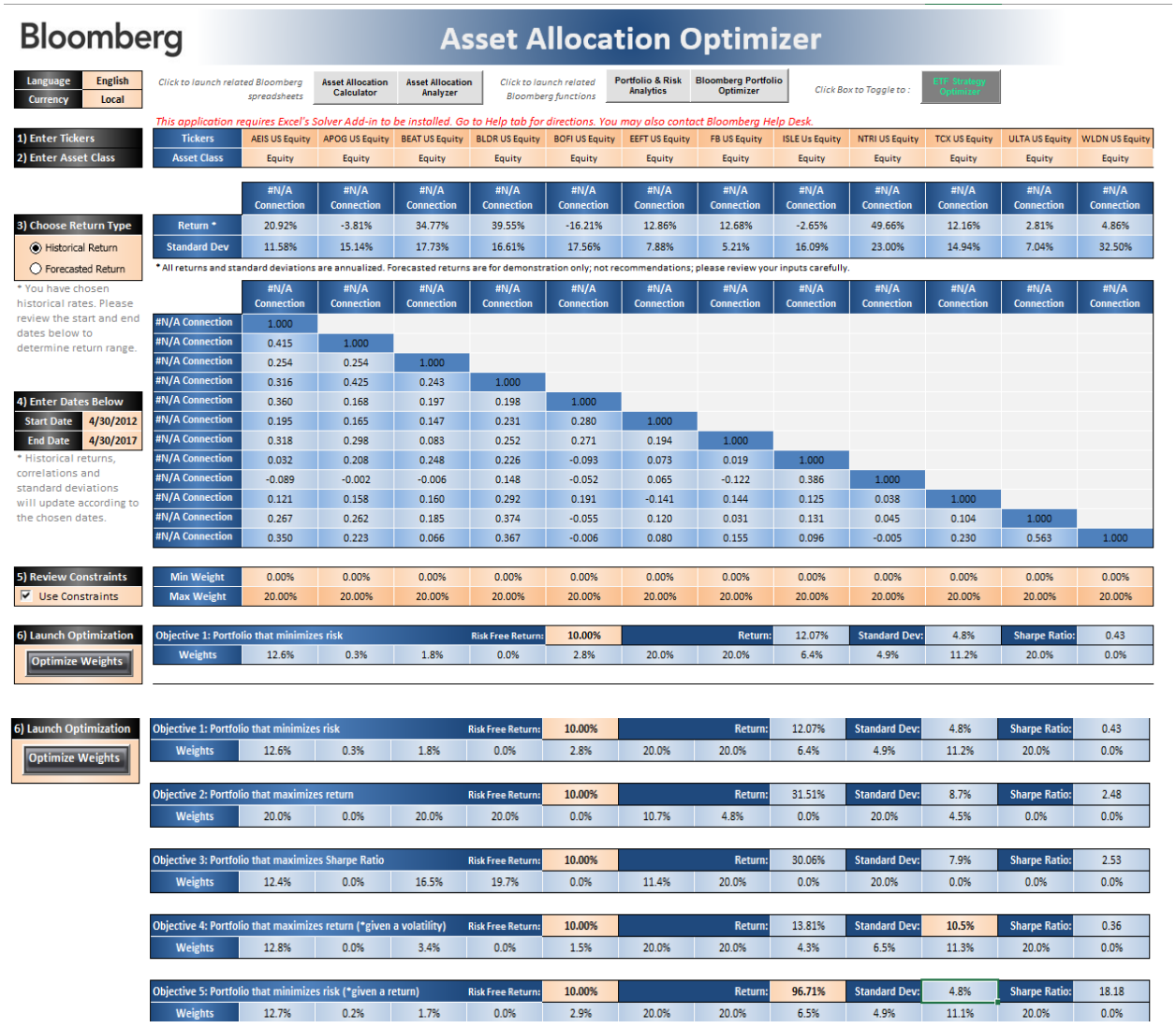
- 

  - **BioTelemetry, Inc. (BEAT)**

- 

  - **Euronet Worldwide, Inc. (EEFT)**

- **NutriSystem, Inc. (NTRI)**



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Asset Allocation Optimizer

Language: English | Currency: Local

Click to launch related Bloomberg spreadsheets: Asset Allocation Calculator | Asset Allocation Analyzer

Click to launch related Bloomberg functions: Portfolio & Risk Analytics | Bloomberg Portfolio Optimizer

Click Box to Toggle to : ETF Strategy Optimizer

This application requires Excel's Solver Add-in to be installed. Go to Help tab for directions. You may also contact Bloomberg Help Desk.

1) Enter Tickers
2) Enter Asset Class

Tickers	AEIS US Equity	APOG US Equity	BEAT US Equity	BLDR US Equity	BOFI US Equity	EEFT US Equity	FB US Equity	ISLE Us Equity	NTRI US Equity	TCX US Equity	ULTA US Equity	WLDN US Equity
Asset Class	Equity	Equity	Equity	Equity	Equity	Equity	Equity	Equity	Equity	Equity	Equity	Equity
	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection
Return *	20.92%	-3.81%	34.77%	39.55%	-16.21%	12.86%	12.68%	-2.65%	49.66%	12.16%	2.81%	4.86%
Standard Dev	11.58%	15.14%	17.73%	16.61%	17.56%	7.88%	5.21%	16.09%	23.00%	14.94%	7.04%	32.50%

3) Choose Return Type
- (•) Historical Return
- ( ) Forecasted Return

* You have chosen historical rates. Please review the start and end dates below to determine return range.

*All returns and standard deviations are annualized. Forecasted returns are for demonstration only; not recommendations; please review your inputs carefully.

	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection	#N/A Connection
#N/A Connection	1.000											
#N/A Connection	0.415	1.000										
#N/A Connection	0.254	0.254	1.000									
#N/A Connection	0.316	0.425	0.243	1.000								
#N/A Connection	0.360	0.168	0.197	0.198	1.000							
#N/A Connection	0.195	0.165	0.147	0.231	0.280	1.000						
#N/A Connection	0.318	0.298	0.083	0.252	0.271	0.194	1.000					
#N/A Connection	0.032	0.208	0.248	0.226	-0.093	0.073	0.019	1.000				
#N/A Connection	-0.089	-0.002	-0.006	0.148	-0.052	0.065	-0.122	0.386	1.000			
#N/A Connection	0.121	0.158	0.160	0.292	0.191	-0.141	0.144	0.125	0.038	1.000		
#N/A Connection	0.267	0.262	0.185	0.374	-0.055	0.120	0.031	0.131	0.045	0.104	1.000	
#N/A Connection	0.350	0.223	0.066	0.367	-0.006	0.080	0.155	0.096	-0.005	0.230	0.563	1.000

4) Enter Dates Below
- Start Date: 4/30/2012
- End Date: 4/30/2017

* Historical returns, correlations and standard deviations will update according to the chosen dates.

5) Review Constraints	Min Weight	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
☑ Use Constraints	Max Weight	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%

6) Launch Optimization — Optimize Weights

Objective 1: Portfolio that minimizes risk	Risk Free Return:	10.00%	Return:	12.07%	Standard Dev:	4.8%	Sharpe Ratio:	0.43
Weights	12.6%	0.3%	1.8%	0.0%	2.8%	20.0%	20.0%	6.4%	4.9%	11.2%	20.0%	0.0%

6) Launch Optimization — Optimize Weights

Objective 1: Portfolio that minimizes risk	Risk Free Return:	10.00%	Return:	12.07%	Standard Dev:	4.8%	Sharpe Ratio:	0.43
Weights	12.6%	0.3%	1.8%	0.0%	2.8%	20.0%	20.0%	6.4%	4.9%	11.2%	20.0%	0.0%

Objective 2: Portfolio that maximizes return	Risk Free Return:	10.00%	Return:	31.51%	Standard Dev:	8.7%	Sharpe Ratio:	2.48
Weights	20.0%	0.0%	20.0%	20.0%	0.0%	10.7%	4.8%	0.0%	20.0%	4.5%	0.0%	0.0%

Objective 3: Portfolio that maximizes Sharpe Ratio	Risk Free Return:	10.00%	Return:	30.06%	Standard Dev:	7.9%	Sharpe Ratio:	2.53
Weights	12.4%	0.0%	16.5%	19.7%	0.0%	11.4%	20.0%	0.0%	20.0%	0.0%	0.0%	0.0%

Objective 4: Portfolio that maximizes return (*given a volatility)	Risk Free Return:	10.00%	Return:	13.81%	Standard Dev:	10.5%	Sharpe Ratio:	0.36
Weights	12.8%	0.0%	3.4%	0.0%	1.5%	20.0%	20.0%	4.3%	6.5%	11.3%	20.0%	0.0%

Objective 5: Portfolio that minimizes risk (*given a return)	Risk Free Return:	10.00%	Return:	96.71%	Standard Dev:	4.8%	Sharpe Ratio:	18.18
Weights	12.7%	0.2%	1.7%	0.0%	2.9%	20.0%	20.0%	6.5%	4.9%	11.1%	20.0%	0.0%

Bloomberg

Asset Allocation Optimizer - Efficient Front

Press button to plot efficient frontier. Efficient frontier will change every time you update your portfolio assets, historical date ranges, forecasts and constraints.

Find Efficient Frontier

Asset Class	Return	Risk
Equity	20.92%	11.6%
Equity	-3.81%	15.1%
Equity	34.77%	17.7%
Equity	39.55%	16.6%
Equity	-16.21%	17.6%
Equity	12.86%	7.9%
Equity	12.68%	5.2%
Equity	-2.65%	16.1%
Equity	49.66%	23.0%
Equity	12.16%	14.9%
Equity	2.81%	7.0%
Equity	4.86%	32.5%

Portfolio Return and Risk Along Efficient Frontier:*

My Portfolio		

* You may input actual performance numbers in the amber boxes above.