Project Number: DZT 2313

Stock Market Simulation

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By

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Abstract

The stock market simulation was a 9-week project including two weeks of background research, four weeks of simulation, and 3 weeks of analysis. The objective of the project was to learn the basics of the market and compare different trading methods. The two methods used for their own simulation during this period were Buy and Hold strategy and Swing Trading strategy. The resulting returns were 7.5% for the Buy and Hold strategy, and 7.6% for the Swing Trading strategy. The lessons learned from this project would be valuable for future investments in the stock market.

Acknowledgements

I would like to acknowledge the guidance, time, and effort provided by multiple individuals and institutions over the past couple months. Prof. Dalin Tang created the outline for this project and many like it. His dedication to each individual has made it possible for me and others to complete this project and our Interactive Qualifying Project. I would also like to thank my parents for not only supporting me throughout the project, but also funding my tuition at WPI as well as this E-term program. Lastly, I would like to thank WPI for the opportunity and support for the project.

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Chapter 1: Background and Basics

1.1 Goal:

While the objective of this project is to make money, the intention of the IQP is to take a student new to the market, teach them about it and to expose them to it. It is both a research project and simulation of the stock market. Research will take place throughout the entirety of the project, however most of the research will be done and recorded during the first two weeks of the project, paving the way and preparing for success in the simulation. The simulation itself will last four weeks using two different trading strategies: buy and hold as well as swing trading. Since the project is a sort of experiment, each method will invest in the same companies to help with analysis. During this time data will be collected for analysis throughout the simulation and the week following. In addition to meeting the aim and the objective of the project, there are personal goals as well in order to make stock market trading feasible for someone with a full-time job. These goals are to make it work within a busy schedule and to make the process itself enjoyable.

1.2 The Market

The stock market is the financial marketplace where companies looking to sell their stocks can find buyers interested in purchasing them. A company on the stock market is known as publicly traded and their stocks can be purchased and sold by anyone on the market. A publicly traded company is looking to raise funds while a trader is looking to use the company's increase in value to increase their own capital or generate income. The trader makes money when a share is sold at a price greater than the purchase price or when the company pays out a dividend to its investors [26].

1.3 Market Influences

The stocks within the market go up and down due to a multitude of factors, but it all comes down to supply and demand. If more people want a stock, the price goes up, and if fewer people want a stock, the price goes down. This change can affect particular companies or the entire market. This change is generally influenced by basic factors, major economic factors, and market sentiment.

The two most basic driving forces for an individual stock price are an earnings base and a valuation multiple. An earnings base in simple terms is how much money a company makes per number of pieces, or stocks, it is broken up into. It is a simple way of determining the value of the company. A widely used earnings base is earnings per share, or EPS, simply taking the company's earnings and dividing it by the number of shares making up the company. This shows what the company is doing for every share owned. A valuation multiple is used to compare an earnings base to the stock price of the company. Essentially, what is that piece of the company worth versus what the stock price says it is worth. A price-to-earnings ratio, or P/E ratio, is used to compare an EPS to the company's stock price. The company's stock price can diverge from its EPS if traders expect the company to start doing better or worse. This anticipation comes from major economic factors and market sentiment [19].

Major economic factors that influence the market are things such as inflation, interest rates, gross domestic product, and anything else that affects the overall economy. In general, the largest of these influences are inflation and interest rates. Inflation and interest rates are commonly linked as the Federal Reserve usually must increase interest rates in order to combat inflation. Simply put, low inflation and low interest rates are good for the market, high inflation and high interest rates are bad for the market [31].

Market sentiment is what trader's feel the market is going to do. The previously stated economic factors can play a role in this as if they start to look like they may worsen, or are worsening, traders are more likely to act bearish. If they start to look like they may improve or are improving, traders are more likely to act bullish. Market sentiment is influenced by anything that traders find to affect or appear to affect the stock market. The news and media often contribute a large portion to this as they report on these things whether they be natural disasters, political changes, war, even the economic factors previously listed. They can influence how traders feel, and therefore the stock market [20].

1.4 Indices

`A market index is a collection of publicly traded companies that is used to reflect the overall trend of the market. The three most popular indices are the Dow Jones Industrial Average, the S&P 500, and the NASDAQ composite.

The Dow Jones Industrial Average is made up of thirty companies from different sectors that are the largest in those sectors. This index is weighted so some companies affect the index more than others, meaning that a more heavily weighted company's performance can greatly affect the entire index's performance. The Dow weighs companies based on their stock price. The greater the price, the greater the weight. The Dow Jones is a good indicator of the overall performance of the stock market [21].

The S&P 500 is made up of five hundred of the largest publicly traded companies in the United States. The S&P is also weighted, but in a different way than the Dow Jones. Instead of weighted by stock price, it is weighted by market cap. Market cap is calculated by multiplying the price per share by the number of shares, giving the greatest weight to the company with the greatest

market value. The S&P is also a good indicator of the overall performance of the stock market [15].

The NASDAQ composite is made up of three thousand companies, all of the ones that trade on the NASDAQ exchange. This includes both large and small companies, with an emphasis on the technology sector. Because of this, the NASDAQ is not only a good indicator of how companies on the NASDAQ are doing, but also how the technology sector is doing [22].

1.5 Indicators

A market indicator is an investment aid that helps an investor make predictions about trends in the stock market. There are many types of market indicators, but three basic types of market indicators for beginners are moving averages, advance-decline lines, the relative strength index, and Bollinger Bands.

1.5.1 Moving Average

A moving average is an indicator based on the mean value of a stock over a period of time. With each new day, the oldest day in whatever the time period is, is replaced. It acts to smooth out a stock chart and to show larger trends that help investors to determine when to buy and when to sell. The two types of moving averages are simple moving averages (SMA) and exponential moving averages (EMA). A simple moving average is the total sum of the stock price over X number of days, divided by X days. That calculation is the simple moving average for that day. An exponential moving average is similar to a simple moving average, just putting more weight on more recent prices. This makes it faster to react to quick changes in a stock's price. Both are used to show larger trends in a stock's price. If the moving average is moving up, it could mean that the price is on an upswing, and if it is moving down, it could mean that the price is on a

downswing. There are many different buy and sell signals derived from a moving average, but the most basic is watching the stock price relative to the moving average. If the stock price rises above an MA with a positive slope, or the stock price bounces off the top of an MA, that could signify a time to buy. If the stock price falls below an MA with a negative slope, or the stock price bounces off the bottom of an MA, that could signify a time to sell [13]. Shown below, figure 1.1 shows examples of these buy and sell points [5]

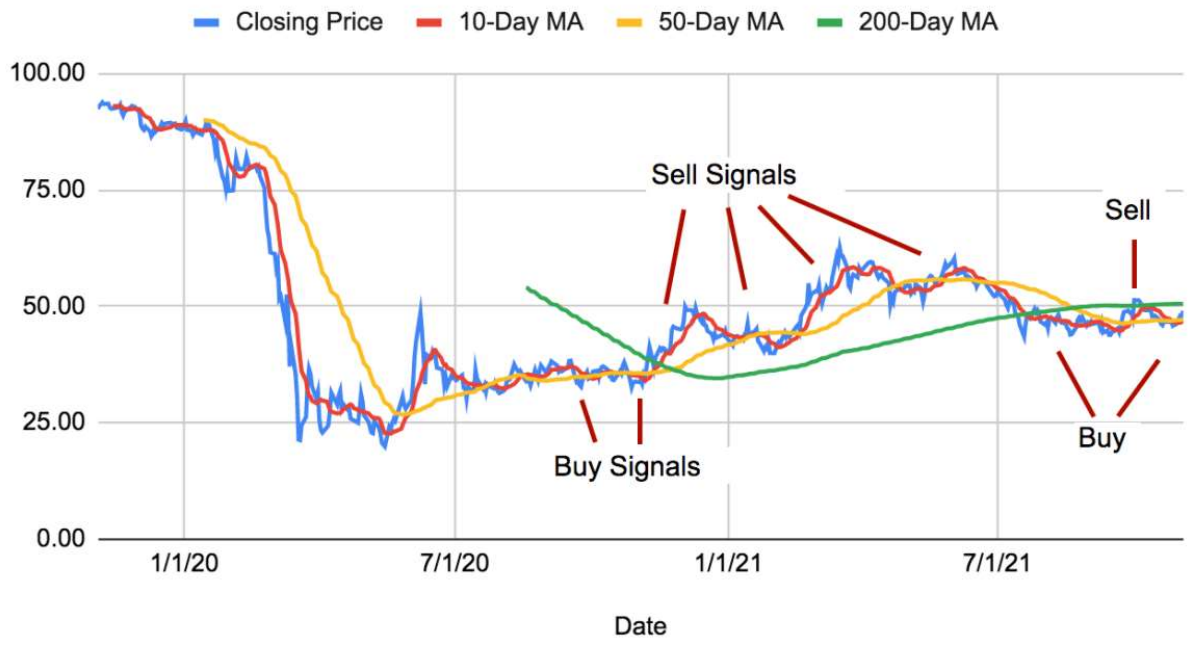

Figure 1.1 Buy and Sell Signals from Different Moving Averages [5]

1.5.2 Advance-Decline

An advance-decline line, or A/D line, is essentially a running total of the number of stocks increasing and decreasing. It is used to determine if the majority of stocks are affecting the market's direction, or just a few stocks making it go in that direction. It is calculated by totaling the stocks going up, subtracting the stocks going down, and then adding that to yesterday's total to get today's total. Comparing the A/D line to market indices generally shows similar trends also known as "broad participation". Broad participation shows that everything is behaving as normal

and that the index is properly reflecting the state of the market. If the A/D line diverges from the trends of the index, that can indicate an upcoming change in the market's direction. If the A/D line is going down while the market is going up, it can be expected that soon the market will go down, while vice versa applies [10]. A couple divergences of the A/D line from the NASDAQ, one correctly predicting a market decline, are shown below in Figure 1.2 [1].

Figure 1.2 NASDAQ Advance Decline Line showing divergence [1]

1.5.3 Relative Strength Index

The relative strength index, or RSI, is an indicator that shows the momentum of a stock. The momentum of a stock is the speed and magnitude of a stock's price change. An RSI is calculated by dividing the average gains by the average losses of a stock in a given time period. It is then plotted on a graph from 0 to 100. For most traders, an RSI above 70 means a stock has been overbought and an RSI below 30 means a stock has been oversold. An overbought stock has gained a great deal of value over a short time and tends to reverse lower. An oversold stock has lost a great deal of value over a short time and tends to reverse higher. The most basic buy indicator for an RSI is when the RSI has dropped below 30 and then crosses back above it. The most basic sell

indicator for an RSI is when the RSI has climbed above 70 and then crosses back below it [32]. An RSI chart and how it shows when a stock has been overbought or oversold is shown below in Figure 1.3 [32]

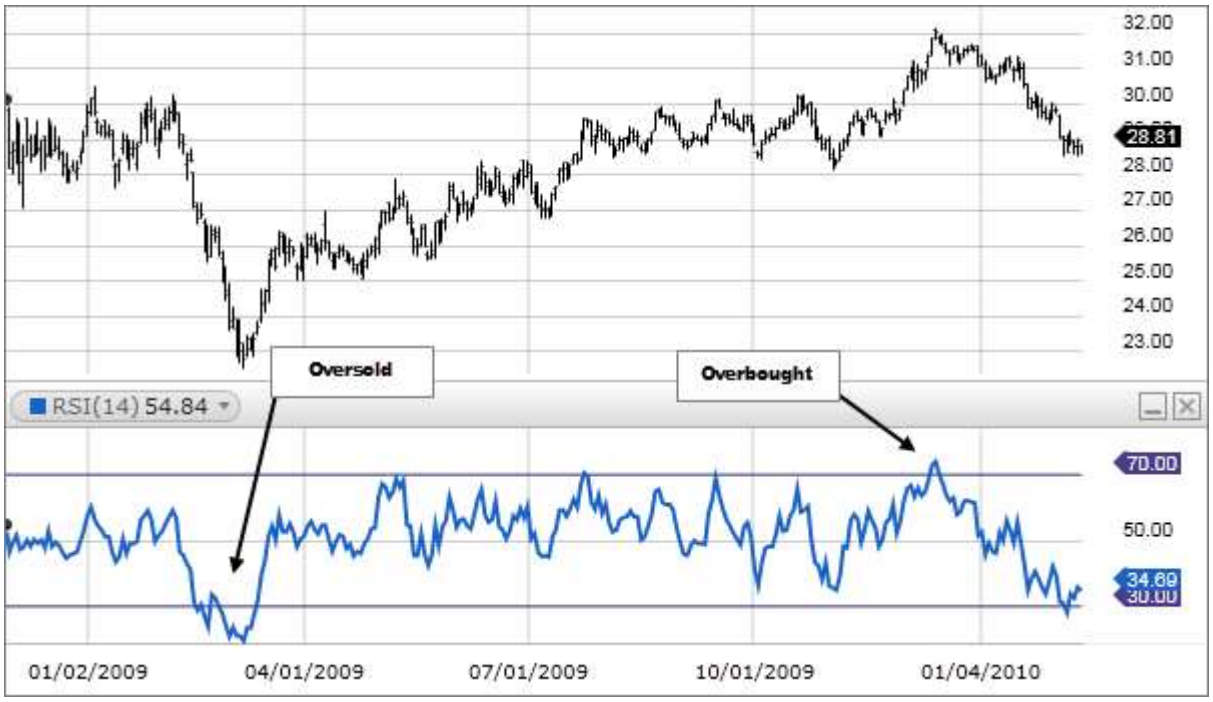

Figure 1.3 RSI plot showing when the stock could be oversold or overbought [32]

1.5.4 Bollinger Bands

Bollinger Bands are an indicator that set two boundaries around the stock price, one above and one below. They indicate when a stock could be overbought or oversold, identifying a good time to buy or sell [11]. Similar to how a stock price moves across moving average, the buy signal for Bollinger Bands is when the stock price falls below the bottom band, and the sell signal is when the stock price rises above the top band. Since the Bollinger Bands show a clear indication of both, they are popular technical analysis tools for new traders, particularly when using swing trading [18].

1.6 Risk

Any investment comes with risk, and it is the investor's job to manage that risk. The first step in risk management is understanding risk. Risk is in everything from getting out of bed in the morning, to jumping out of an airplane without a parachute. With investing, risk is the potential of loss with one's investment.

After knowing what risk is, one can determine risk tolerance. Risk tolerance, as it sounds, is an investor's ability to handle risk. A multitude of factors affect an investors risk tolerance including: age, capital, and financial goals. Essentially, it boils down into four questions, 'how long until you plan to retire?', 'how much money do you have?', 'how much money do you want', and 'how much are you willing to lose?'. Investors are generally categorized into three levels of risk tolerance: aggressive, moderate, and conservative.

An aggressive investor tolerates larger amounts of risk while seeking higher returns. Aggressive investors tend to be younger people that are further from retirement who are more focused on building capital. Aggressive investing is generally for people who do not have a lot to lose, and time to recoup anything they may have lost.

A conservative investor tolerates a small amount of risk for a small amount of gain. Conservative investors tend to be retired or close to retired people who are more focused on generating income and protecting their existing capital. Conservative investing is generally for people who have a lot to lose and are just trying to sustain on what they have.

A moderate investor is somewhere in between aggressive and conservative. Generally, they make both aggressive and conservative investments at the same time, looking to gain a bit of capital on one hand, but also looking to protect some of what they have.

Determining one's risk tolerance by taking one of the many tests available online, however it is ultimately up to the individual and what they feel they should do. The stock market is considered a high-risk investment due to its volatile nature, however within the market itself there are more risky, and less risky investments. At the end of the day, every stock can make money and every stock can lose everything. Understanding what makes the market risky helps an investor minimize risk and avoid losses.

There are different types of risk with investing: inflation risk, interest rate risk, political risk, currency risk, liquidity risk, credit risk, business risk, etc. Most risks can be categorized into three types: market risk, sector-specific risk, and company-specific risk.

Market risk is due to what affects the market as a whole, such as a recession, changes in leadership, inflation, and interest rates. If the entire market goes down, the value of individual stocks will go down.

Sector-specific risk is due to afflictions faced by an entire sector. This can be the result of things such as government regulations, new technologies, and public opinion. For example, if humans were suddenly able to photosynthesize, this could negatively impact the agriculture sector.

Company-specific risk is due to afflictions faced by an individual company. This can be the result of a new competitor, a decrease in sales, a scandal, anything that negatively affects or reflects the company or sector. For example, if a competitor of Apple releases a better product than the iPhone, Apple stock may go down.

Minimizing risk is generally done through diversification of investments within the market and within a sector. It can be done differently from strategy to strategy [14].

Chapter 2: Strategies and Simulation

2.1 Simulation

A new investor can research all they want about investing strategies and reading the market, but there is a difference between knowing and doing. A smart first step in trying out the stock market is first using a simulation. A simulation allows a would-be investor to try out what they know and to learn about the market without being at any real risk of losing their money.

The first step in starting a stock market simulation is determining what simulation platform to use. There are many platforms available online. Developing a list of criteria helps narrow the list down. Reliable, easy to use, real-time data, resources, and the ability to trade outside of market hours all lead to Investopedia's stock market simulator, "Investopedia Simulator". In addition to the simulator, Investopedia has a plethora of resources and information available allowing for the user to continue the growth of knowledge and skills while using the platform. The next step is learning how to use the platform. Investopedia has a step-by-step video guide explaining its features and how the 'game' works.

There are three primary sections to the Investopedia simulator, the portfolio section, the trading section, and the research section. The portfolio section is where the trader can track their entire portfolio as well as individual stocks. The trading section is where the trader can make moves in the market, allowing the trader to select the stock, quantity, put stop orders in place, as well as sell their holdings. The research section, as it sounds, allows the trader to do research on individual stock prices as well as look at aspects of the market as a whole.

2.2 Buy and Hold

Buy and hold trading, as the name suggests, is when a trader purchases a stock and holds onto it for an extended period of time, in most cases this is years or possibly decades, but in this case it will be for the 4 week duration of the simulation.

Following a buy and hold strategy is simple to follow, at the end of the day the key is to buy a stock and to not sell it. The most important part of buy and hold is selecting companies that are reliable and the most likely to increase in value over time. The all time stock price of Apple, one of the most notable and reliable companies in the world, that also is a great example of the benefits of the buy and hold strategy, is shown below in Figure 2.1 [24]

Figure 2.1 Apple Stock since its Initial Public Offering [24]

Another important aspect is buying at the right time. It is important to try to buy stocks when they are at their lowest in order to maximize the profits made off of holding those stocks while also minimizing the risk of those stocks dropping and not recovering before the exit point.

Compared to other strategies, it is one of the least time consuming. Rather than buying and selling constantly, it generally involves one time period of buying, and one time period of selling. Buy and hold trading is a passive strategy that does not require an individual to regularly follow the market.

A major negative of buy and hold investing is that investors may be ready to sell at a poor time in the market. The strategy is focused on holding onto stocks through any sort of market downturn, however if someone is looking to retire or needs cash during any sort of recession, their holdings may not be worth much. Buy and hold also takes a great deal of time before any substantial profits come to fruition. Along with that, it can also hold up capital over this long time period.

2.3 Swing Trading

Swing trading is a shorter-term strategy that focuses on buying the dip and selling the peak. In swing trading, a trader uses analysis, whether numerical or graphical, to determine and predict trends of a particular stock. They use these trends to buy stock before its value climbs and sell before its value falls. The duration of the holding could be anywhere from a couple days to months. There are many ways to swing trade, but the simplest and most suited for beginners is using support and resistance.

Support and resistance are boundaries of a stock's recent price movement with support being the lowest and resistance being the highest. Figure 2.2, shown below, shows an example of support and resistance of an example stock. [33]

Figure 2.2 Support and Resistance bands as a price of a stock oscillates [33]

They are used to determine the entry and exit points of a swing trader. There are two ways a stock behaves around its boundaries: bounces and breakouts. With a bounce the stock has reached or neared its boundary and then started to change direction towards its other boundary. When a stock bounces off its support, swing traders look at this as an entry point and generally set their target exit point at the stock's resistance point. A breakout is when the stock's price exceeds its resistance or falls below its support. When a stock breaks out above its resistance, swing traders will often set their target exit point at the difference of the current support and resistance, plus the current resistance. Stop orders are also commonly used in order to prevent a substantial loss if stock price moves in the wrong direction. For a bounce or breakout, the stop order is generally placed a little below the buy price, and it gradually moves up if the stock price climbs.

Using Bollinger Bands is another popular way to swing trade. Similar to support and resistance, there is a top and a bottom band. The Bollinger Bands indicator consists of three lines. The middle line is generally a twenty-day moving average, the top band is the moving average

plus twice the daily standard deviation, and the bottom band is minus twice the daily standard deviation. It is an effective tool for determining when a stock is overbought and oversold while showing clear buy and sell indicators. When the price reaches or breaks out beyond the bottom band, it indicates to sell and the opposite is true for the top band. Traders often wait for the stock's price to reverse direction before making a move, but also often using a momentum indicator in conjunction in order to make a move before the stock price reverses [18].

After determining an entry and exit point, a swing trader must determine how many shares to buy. For this strategy it is a common first step to calculate the portfolio risk by multiplying the amount of capital one's trading portfolio by the percentage the trader is willing to lose. Taking this value and then dividing it by the trade risk, or the entry price minus the stop price, gives you the number of shares to buy.

On paper, swing trading exceeds buy and hold ability to make profit in the short term. Instead of holding through a downswing, it allows a trader to capture profits before it falls too low. While not simple, swing trading is simpler compared to most other trading strategies and can be done relying entirely on technical analysis and indicators. In addition, the support and resistance lines being used are found in all charting time periods which is conducive to a four-week simulation.

Swing trading does also come with a few cons, the most substantial being that traders are exposed to closed market risks. Since swing trading positions are held during closed market hours and over a longer period than day trading, traders are at risk of stock prices dramatically falling overnight or over the weekend. Another major con to swing trading is that traders can miss out on longer term gains if they sell according to their strategy. Also, in comparison to buy and hold, it is much more time-consuming as traders must actively monitor the market day to day. In addition,

when using stop orders a swing trader is still at risk of missing out on gains following a stock price hitting the stop order and traders can also suffering losses if the stock value drops while the market is closed [16].

Chapter 3: Companies

3.1 Introduction

There are over two thousand companies on the United States stock exchange. For a new trader, about 10 companies is a good place to start. 10 companies allow a trader to gain experience across multiple sectors, while staying manageable for an inexperienced individual. The selected sectors are medical, retail, automotive, communications, and energy. By investing in multiple sectors an investor is also able to diversify their investments within the stock market

3.2 Healthcare

In the medical sector the selected companies are Johnson & Johnson and UnitedHealth. Healthcare companies often will continue to provide returns even if the stock market is in a downturn [6].

UnitedHealth is the largest health insurer in the world. UnitedHealth's size and stability provides consistent returns even when the stock market is not doing well. With the ever-rising population and the increase in life expectancy creates a greater need for healthcare. Shown below in figure 3.1 is UNH's 6-month performance [8].

Figure 3.1 UnitedHealth Group 6-month performance [8]

Johnson & Johnson is a good investment as the company itself is diversified with everyday things that most people need. It produces affordable products that are used both by the individual as well as healthcare providers. In addition, Johnson and Johnson provides consistent returns and its large size provides stability [29]. Shown below in Figure 3.2 is JNJ's 6-month performance [8].

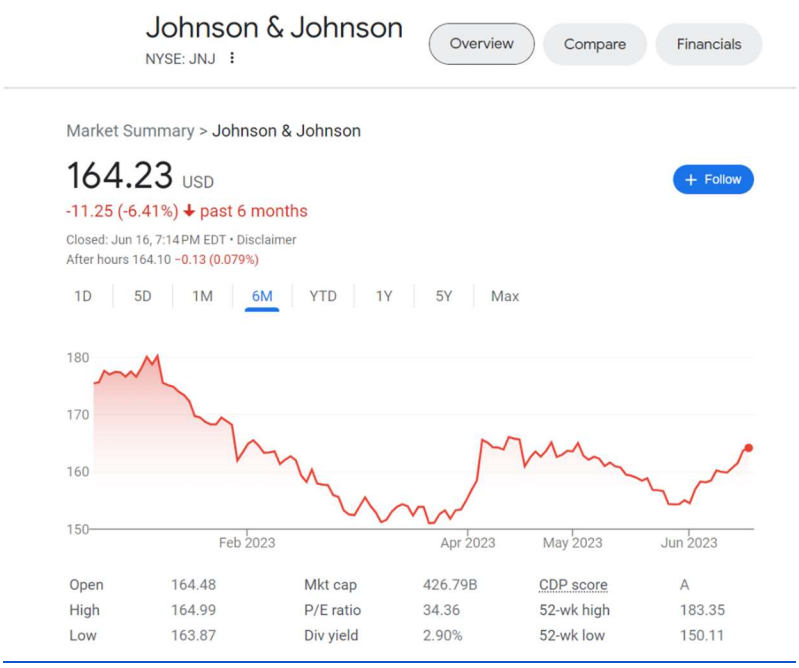

Figure 3.2 Johnson & Johnson 6-month performance [8]

3.3 Consumer Staples/ Discretionary

In the consumer sectors the selected companies are Amazon and Walmart. Amazon being the nation's largest online retailer and Walmart being the nation's largest 'brick and mortar' retailer.

Amazon is a consumer discretionary company that supplies people with goods that are considered to be more 'wants' rather than 'needs'. Amazon is the second largest company in the United States by revenue. With almost 150 million people being Amazon Prime members, there is consistent revenue for the ecommerce company. [4]. Shown below in Figure 3.3 is AMZN's 6-month performance [25].

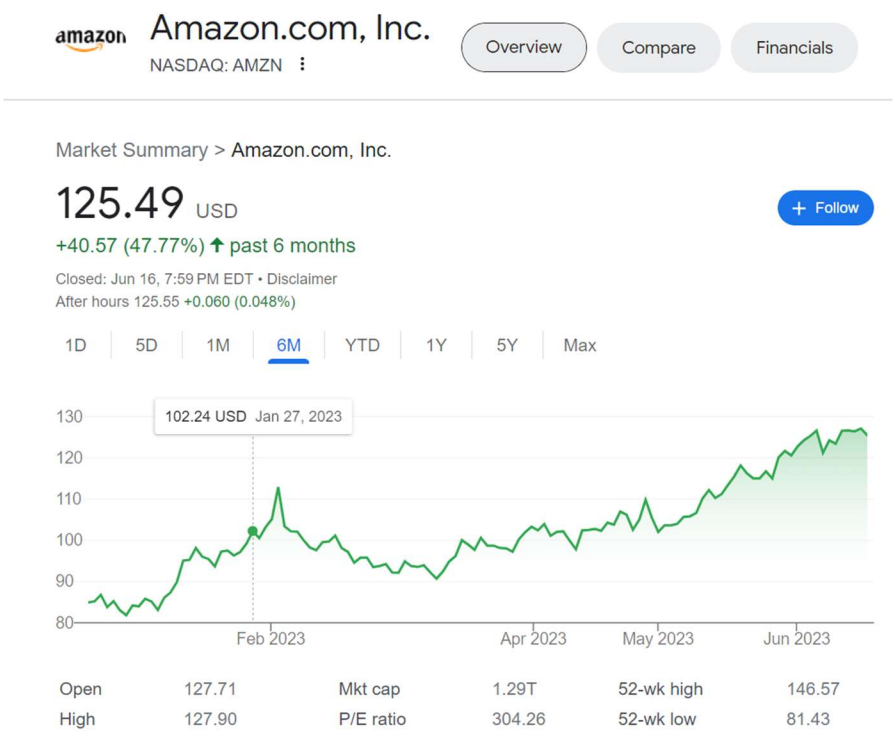

Figure 3.3 Amazon 6-month performance [25]

Walmart is a consumer staple that supplies people with goods that are considered to be more ‘needs’ rather than ‘wants’. Walmart is the largest company in the United States by revenue with that number continuing to grow. Walmart’s customer base has grown as people from high income households have begun to spend more with Walmart in recent years [9]. Shown below in Figure 3.4 is WMT’s 6-month performance [8].

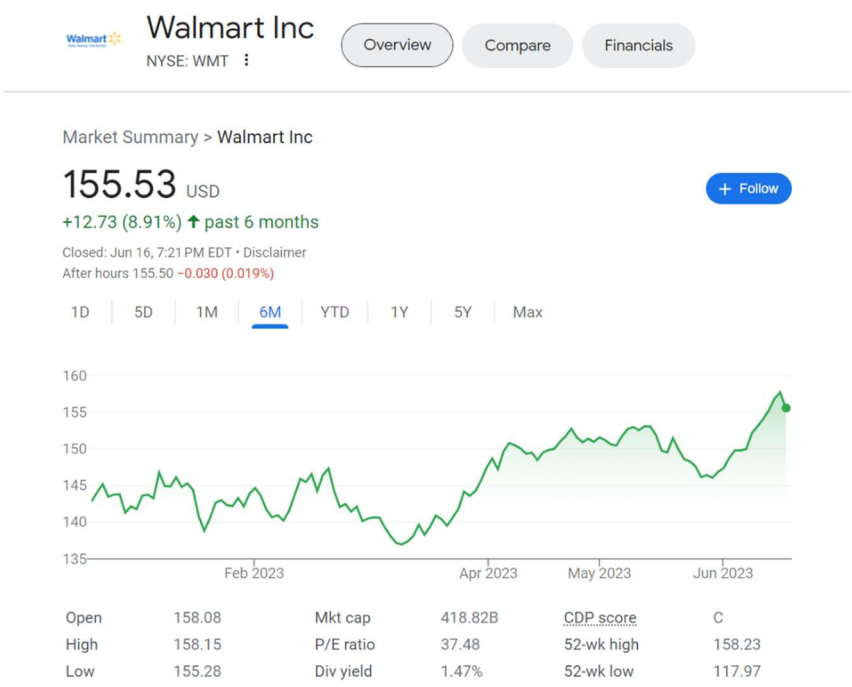

Figure 3.4 Walmart 6-month performance [8]

3.4 Automotive

In the automotive sector the selected companies are Tesla and Rivian. With the rise in popularity of electric cars, and the increased regulation on fossil fuels, electric car companies may be the future of the automotive sector.

Tesla being the most valuable automotive manufacturer in the world, it is a modern staple in both buy and hold as well as swing trading. It is the leader in electric cars leaving it in a good position has the government further regulates the development and use of fossil fuels [7]. Figure 3.5 shows over the last six months Tesla had a gentle decline starting in early 2023, but has steadily risen since then. Shown below in Figure 3.5 is TSLA's 6-month performance [25].

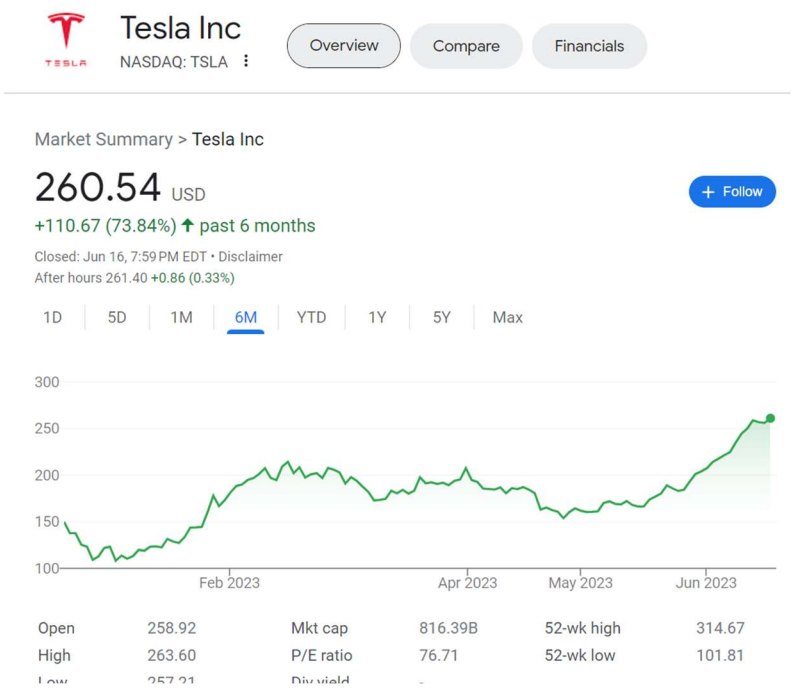

Figure 3.5 Tesla 6-month performance [25]

Tesla will need a competitor in the world of electric cars, and that competitor could be Rivian. Although the price has gone down by over $80 per share since its IPO, Rivian's struggles have been based on a lack of ability to produce. As Rivian expands its ability to produce, its revenue should go up, driving up stock prices [30]. Shown below in Figure 3.6 is Rivian's 6-month performance [25].

Figure 3.6 Rivian 6-month performance [25]

3.5 **Communications**

In the communications sector the selected companies are Verizon and Alphabet. The internet has become a vital component to almost everyone's daily life, making a service provider and an internet browser solid purchases.

Verizon is an internet and cell service provider. It has the most coverage of any cell service provider in the nation as well as the best upload and download speeds of any provider in most regions [17]. As more Americans move out of big cities, the companies that are able to provide them with internet service the quickest will able to capitalize on the population shift [34]. Shown below in Figure 3.7 is Verizon's 6-month performance [8].

Figure 3.7 Verizon 6-month performance [8]

Alphabet is the parent company to the largest internet browser in the world, Google. Over 89% of internet browser users in the United States use Google, making it the leader in one of the most widely used technologies in the United States. It is also a leader in AI, an emerging

technology that has become popular with many tech giants. Shown below in Figure 3.8 is Alphabet's 6-month performance [25].

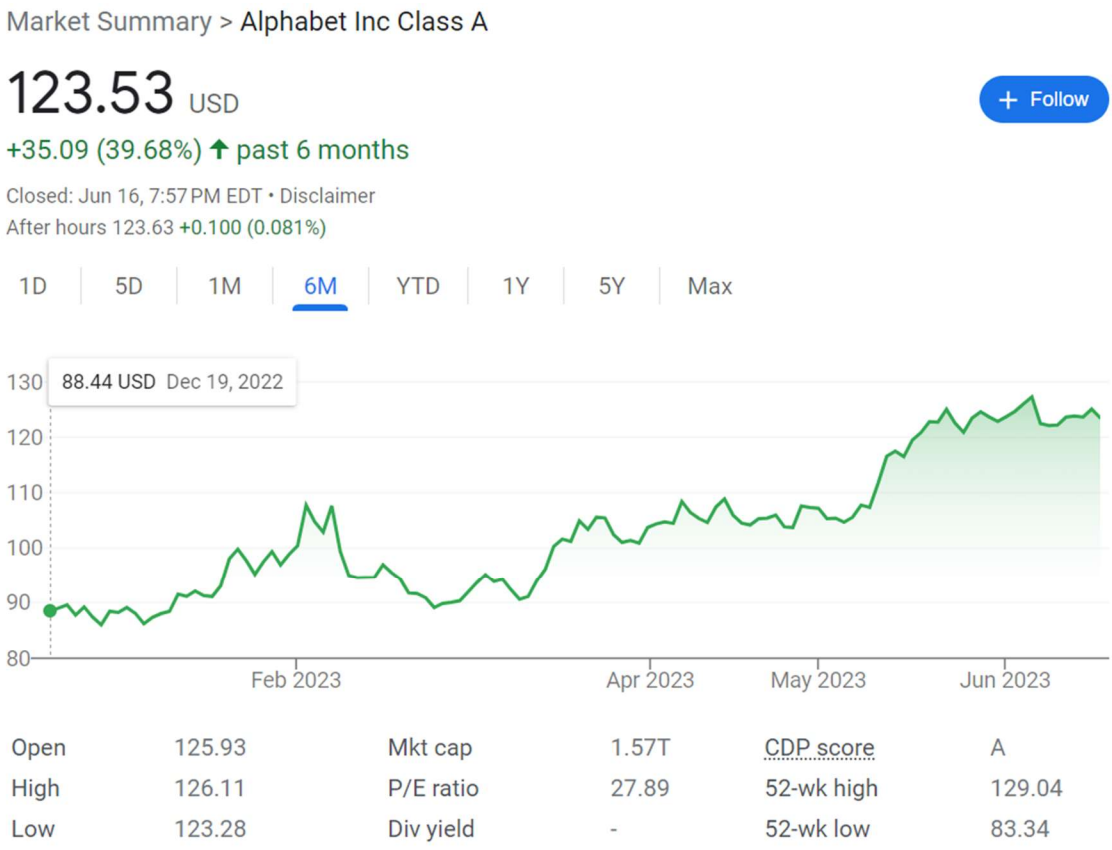

Figure 3.8 Alphabet 6-month performance [25]

3.6 Renewable Energy

In the renewable energy sector the selected companies are General Electric and BrookField Renewable. Year by year renewable energy has become more popular with the increased awareness about climate change and the improvements in renewable energy technology [23]

General Electric produces household appliances as well as renewable energy technology. It is one of the world leaders in the production of wind, hydro, and solar energy equipment [35].

Shown below in Figure 3.9 is GE's 6-month performance [8].

Figure 3.9 General Electric 6-month performance [8]

BrookField Renewable is a company that invests their portfolio into renewable energy. BrookField is a good investment as it encompasses many small companies that make up the growing renewable energy market. Since renewable energy can be a very volatile market, investing in BrookField should protect an investor from just one company's stock going down [23]. Shown below in Figure 3.10 is BEPC's 6-month performance [8].

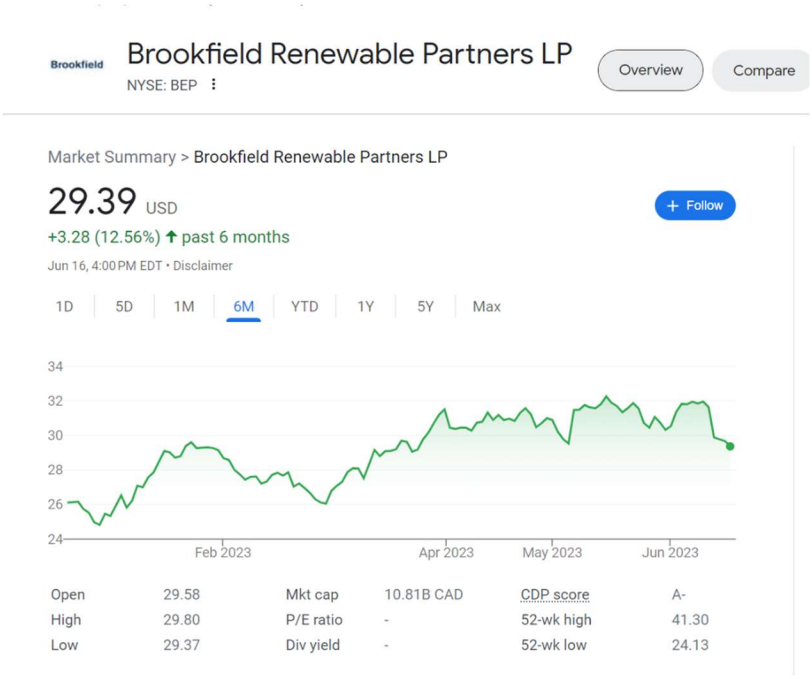

Figure 3.10 Brookfield Renewable Partners 6-month performance [8]

Chapter 4: Buy and Hold

To simplify the process, about $10,000 was allocated to each company from the previous chapter to start off. Seeing that it is the purpose of buy and hold trading to not make any transactions over a long period of time, no transactions were made following the initial purchase. In order to track the progress of the stocks, each stock price was to be checked each evening and the results at the end of the week were recorded. The three primary figures recorded from each week were: the total value of the portfolio, the weekly gain/loss, and the total gain/loss. In order to calculate these, the buy price, number of shares, net cost, price previous Friday, price current Friday, the asset value that current Friday, the weekly change, and total change. The net cost and current asset value of each stock is used to calculate the change to be able to assess the performance of each stock.

4.1 Week 1

Week 1 ended with a .16% return. All but three stocks increased in value this week: BEPC, GE, and UNH. All of these were expected to rise the following week from swing trading analysis. A notable event from the week was, The Federal Reserve did not increase interest rates, positively affecting the market this week. Shown on the following page, Table 4.1 shows the asset change from the purchase date of 6/12 to market close on Friday 6/16.

Table 4.1 Buy and Hold Asset Changes from Week 1

Start Date	Symbol	Buy Price	Shares	Net Cost	Price Last Friday	Price This Friday (6/16)	Asset this Friday	Week Gain/ Loss	Total Asset Gain/ Loss
6/12	AMZN	$124.02	81	$10,045.62	N/A	125.49	10164.69	119.07	119.07
6/12	WMT	$153.43	65	$9972.95	N/A	155.53	10109.45	136.50	136.50
6/12	VZ	$35.66	280	$9,984.80	N/A	36.46	10208.8	224.00	224.00
6/12	GOOGL	$122.79	80	$9,822.80	N/A	123.53	9882.4	59.60	59.60
6/12	GE	$106.31	94	$9,993.14	N/A	106.29	9991.26	39.06	39.06
6/12	BEPC	$34.92	285	$9,952.20	N/A	32.89	9373.65	-578.55	-578.55
6/12	JNJ	$160.00	62	$9,920.00	N/A	164.23	10182.26	262.26	262.26
6/12	UNH	$492.30	20	$9,846.00	N/A	458.49	9169.8	-676.20	-676.20
6/12	RIVN	455$14.03	720	$10,101.60	N/A	14.88	10713.6	612	612
6/12	TSLA	$247.94	41	$10,165.54	N/A	260.54	10682.14	516.60	516.60
Total:							100478.05	714.34	714.34

4.2 Week 2

Week 2 ended with a return of -.11%. Most stock prices fell this week due to the Federal Reserve announcing that there will most likely be an increase in interest rates in the near future. Half of the stocks rose this week and half fell. It was expected that all would rise next week after

the market settles following the Federal Reserve's announcements. The asset value ended at $99170.96 which is a weekly change of -$1307.09 and a total change of -$592.75. Table 4.2, shown below gives Week 2 price and asset changes from opening on 6/19 to closing on 6/23.

Table 4.2 Buy and Hold Asset Changes from Week 2

Start Date	Symbol	Buy Price	Shares	Net Cost	Price Last Friday (6/16)	Price This Friday (6/23)	Asset This Friday	Week Gain/ Loss	Total Asset Gain/ Loss
6/12	AMZN	$124.02	81	$10,045.62	125.49	129.33	10475.73	311.04	430.11
6/12	WMT	$153.43	65	$9972.95	155.53	155.46	10104.9	-4.55	131.95
6/12	VZ	$35.66	280	$9,984.80	36.46	35.51	9942.8	-266	-42
6/12	GOOGL	$122.79	80	$9,822.80	123.53	122.34	9787.2	-95.2	-35.6
6/12	GE	$106.31	94	$9,993.14	106.29	103.78	9755.32	-235.94	-196.88
6/12	BEPC	$34.92	285	$9,952.20	32.89	31.73	9043.05	-330.6	-909.15
6/12	JNJ	$160.00	62	$9,920.00	164.23	165.48	10259.76	77.5	339.76
6/12	UNH	$492.30	20	$9,846.00	458.49	477.00	9540	370.2	-306
6/12	RIVN	$14.03	720	$10,101.60	14.88	13.53	9741.6	-972	-360
6/12	TSLA	$247.94	41	$10,165.54	260.54	256.60	10520.6	-161.54	355.06
Total:							99170.96	-1307.09	-592.75

4.3 Week 3

Stock prices recovered this week following their fall in the previous week. The two previous weeks were largely affected by the Federal Reserve's announcements about interest rates.

The stock prices largely continued to follow the previous upward trend. However, BEPC and GOOGL continued to lose. The asset value ended at $102644.93 which is a weekly change of $3473.97 and a total change of $2881.22. Table 4.3, shown below, records the asset change from week 2 to week 3 from opening on 6/26 to closing on 6/30 as well as the overall.

Table 4.3 Buy and Hold Asset Changes from Week 3

Start Date	Symbol	Buy Price	Shares	Net Cost	Price Last Friday (6/23)	Price This Friday (6/30)	Asset This Friday	Week Gain/ Loss	Total Asset Gain/ Loss
6/12	AMZN	$124.02	81	$10,045.62	129.33	130.36	10559.16	83.43	513.54
6/12	WMT	$153.43	65	$9,972.95	155.46	157.18	10216.7	111.8	243.75
6/12	VZ	$35.66	280	$9,984.80	35.51	37.19	10413.2	470.4	428.4
6/12	GOOGL	$122.79	80	$9,822.80	122.34	120.97	9677.6	-109.6	-145.2
6/12	GE	$106.31	94	$9,993.14	103.78	108.99	10245.06	489.74	292.86
6/12	BEPC	$34.92	285	$9,952.20	31.73	31.52	8983.2	-59.85	-969
6/12	JNJ	$160.00	62	$9,920.00	165.48	165.52	10262.24	2.48	342.24
6/12	UNH	$492.30	20	$9,846.00	477	478	9560	20	-286
6/12	RIVN	$14.03	720	$10,101.60	13.53	16.66	11995.2	2253.6	1893.6
6/12	TSLA	$247.94	41	$10,165.54	256.6	261.77	10732.57	211.97	567.03
Total:							102644.93	3473.97	2881.22

4.4 Week 4

Stock prices continued to climb this week. Notably, RVN announced late in the previous week that they had exceeded their production numbers for the first quarter which caused an

enormous increase in their share value. The asset value ended at $107306.69 which is a weekly change of $4661.76 and a total change of $7502.04. This was the final week of the simulation, giving a total change of $7502.04, which 62% of that was achieved in the final week. Table 4.4 gives Week 4 price and asset changes from opening on 7/3 to closing on 7/7.

Table 4.4 Buy and Hold Asset Changes from Week 4

Start Date	Symbol	Buy Price	Shares	Net Cost	Price Last Friday (6/30)	Price This Friday (7/7)	Asset This Friday	Week Gain/ Loss	Total Asset Gain/ Loss
6/12	AMZN	$124.02	81	$10,045.62	130.36	129.78	10512.18	-46.98	466.56
6/12	WMT	$153.43	65	$9,972.95	157.18	153.49	9976.85	-239.85	3.9
6/12	VZ	$35.66	280	$9,984.80	37.19	35.9	10052	-361.2	67.2
6/12	GOOGL	$122.79	80	$9,822.80	120.97	119.48	9558.4	-119.2	-264.4
6/12	GE	$106.31	94	$9,993.14	108.99	108.27	10177.38	-67.68	184.24
6/12	BEPC	$34.92	285	$9,952.20	31.52	31.19	8889.15	-94.05	-1063.05
6/12	JNJ	$160.00	62	$9,920.00	165.52	159.25	9873.5	-388.74	-46.5
6/12	UNH	$492.30	20	$9,846.00	478	461.58	9231.6	-328.4	-614.4
6/12	RIVN	$14.03	720	$10,101.60	16.66	24.7	17784	5788.8	7682.4
6/12	TSLA	$247.94	41	$10,165.54	261.77	274.43	11251.63	519.06	1086.09
Total:							107306.69	4661.76	7502.04

Chapter 5: Swing Trading

Swing trading commenced on the same day as the Buy and Hold simulation, however unlike the buy and hold simulation, the majority of the portfolio was not invested from the start. Stocks were only purchased when conditions were favorable, and only sold when stocks were expected to go down. Each stock was analyzed each evening in order to take advantage of any short-term changes in the market. For this simulation, about 20% of the available cash was allocated to each sector. Since a company may not show indications of buying in a four week period, up to 20% of the available cash could be put into one company to put it to use, however a sector could not exceed about 20% in order to keep the portfolio properly diversified. Unlike the Buy and Hold simulation, rather than track the performance of the stocks as they sit, for the Swing Trading only the values of the transactions were recorded.

5.1 Week 1

The swing trading simulation was started on June 12th however, no stocks were purchased. Using Bollinger Bands, with the help of additional indicators, it was determined that prices were most likely to go down and that no stocks should be purchased at this point. The uncertainty with interest rates at the beginning of the week also played a part in waiting to invest. On June 13th $20,000 of Tesla and $20,000 of Brookfield Renewable was purchased. Brookfield was the only company below the middle Bollinger band and had bounced back from the band. Tesla was purchased as its price continued to climb showing no sign of changing. On June 15 about $10,000 of UnitedHealth was purchased, as the price dropped below the lower Bollinger band and stock momentum began to increase.

Week 1 ended with a return of -.13% and a loss of $239.74. Both BEPC and UNH proceeded to fall after purchase, however I expect them to rise next week as their fall is slowing.

TSLA continued to rise this week and is expected to steadily rise in the future. Table 5.1, shown below, shows the transactions made during week 1.

Table 5.1 Swing Trading Transactions from Week 1

Date	Symbol	Buy/Sell	Price	Shares	Net Cost	Profit/Loss	Total Cash	Total Profit
6/12							$100,000	
6/13	TSLA	Buy	$259.76	77	$20,001.52		$79,998.48	
6/13	BEPC	Buy	$33.12	605	$20,037.60		$59,960.88	
6/15	UNH	Buy	$465.89	21	$9,783.69		$50,177.19	

5.2 Week 2

With week 2 many stock prices fell across all sectors. This drop in prices has resulted in no transactions being made this week, however it has set up for three companies to be potentially bought in week 3: GE, RVN, and GOOGL. Each has dropped below the moving average and has reached, or nearly reached the bottom Bollinger band. In addition, GOOGL and GE had positive shifts in momentum just prior to the market close on Friday. This indicates their prices may start to increase, initiating a purchase of stocks for the simulation. UNH had climbed above its buy price, however it did not reach a sell point and has come back down some. TSLA's price per share has come down by about $3, however I plan to hold through this downswing. BEPC proceeded to drop after rising slightly after purchasing shares, however it has begun to slightly rise again as well as the momentum shifting into a positive direction.

5.3 Week 3

Week 3 brought a positive turn in the stock market and two of the three anticipated stocks were bought: RIVN and GOOGL. Both stocks rose this week with GOOGL producing a .39%

return and RIVN producing a 19.86% return. With this, indicators show that RIVN will most likely be sold towards the beginning of the week, while GOOGL will be held onto along with the rest of the stocks as they do not indicate to sell. The third stock mentioned in last week's analysis, GE, also rose this week, however it did not fall to a point that indicated a buy. None of the other companies of focus indicate that they will be traded going into the final week. Table 5.2, shown below, shows the transactions of week 3.

Table 5.2 Swing Trading Transactions from Week 3

Date	Symbol	Buy/Sell	Price	Shares	Net Cost	Profit/Loss	Total Cash	Total Profit
6/28	RIVN	Buy	$13.90	717	$9,966.30		$40,210.89	
6/29	GOOGL	Buy	$119.24	83	$9,896.92		$30,313.97	

5.4 Week 4

Week 4 wrapped up the swing trading simulation. Selling out of all owned stocks produced a profit of $7,629.70. The stocks in the automotive sector did very well, especially Rivian after they exceeded production estimates. BEPC was by far the worst performing stock coming in with an almost $1,200 loss. Table 5.3, shown on the following page, shows the transactions of week 4.

Table 5.3 Swing Trading Transactions from Week 4

Date	Symbol	Buy/Sell	Price	Shares	Worth	Profit/Loss	Total Cash	Total Profit
7/7	TSLA	Sell	274.43	77	21,131.11	Profit	$100,000	1,129.59
7/7	RIVN	Sell	24.70	717	17,709.90	Profit	$79,998.48	7,743.60
7/7	GOOGL	Sell	119.48	83	9,916.84	Profit	$59,960.88	19.92
7/7	UNH	Sell	461.58	21	9,693.18	Loss	$50,177.19	-95.76
7/7	BEPC	Sell	31.19	605	18,869.95	Loss		-1,167.65
Total								7,629.70

Chapter 6: Analysis

6.1 Initial Thoughts:

Each simulation was analyzed primarily for their performance, but also their performance in relation to the amount of time taken to maintain their respective trades. The goal of the project was not only to produce a profit, but also to efficiently use available time.

Both trading techniques yielded positive results while the market itself stayed largely neutral. At the commencement of both simulations, the S&P 500 opened at 4352.61 and the Nasdaq composite opened at 13,573.32. At the conclusion of the simulations, the S&P 500 closed at 4398.95 for a 1% increase and the Nasdaq composite closed at 13,660.72 for a .6% increase. While this does not reflect all stocks during this period, these are the two major indices that are most closely related to the simulation's portfolio [2]. A major influence over the stock market during this period was the Federal Reserve's decisions on interest rates. They first announced that they would not raise interest rates, positively affecting the stock market. Soon after announcing that, they announced they planned to raise interest rates later in the year, negatively affecting the stock market. However, since then, there has been a bull market as the market continues to avoid any sort of recession [3]

A large factor in the performance of both simulations was Rivian's huge increase in value. Without Rivian, both simulations would have concluded with a loss. BEPC was the only significant loss endured in both simulations, and without both RVN and BEPC, both simulations would have ended up in the black.

6.2 Buy and Hold:

Buy and hold finished with a profit of $7502.04 and a return of 7.5%. In the four-week simulation there was a 7.5% increase in the value of the portfolio, outperforming both the S&P

500 and the Nasdaq. Figure 6.1, shown below, depicts the value of the portfolio throughout the simulation.

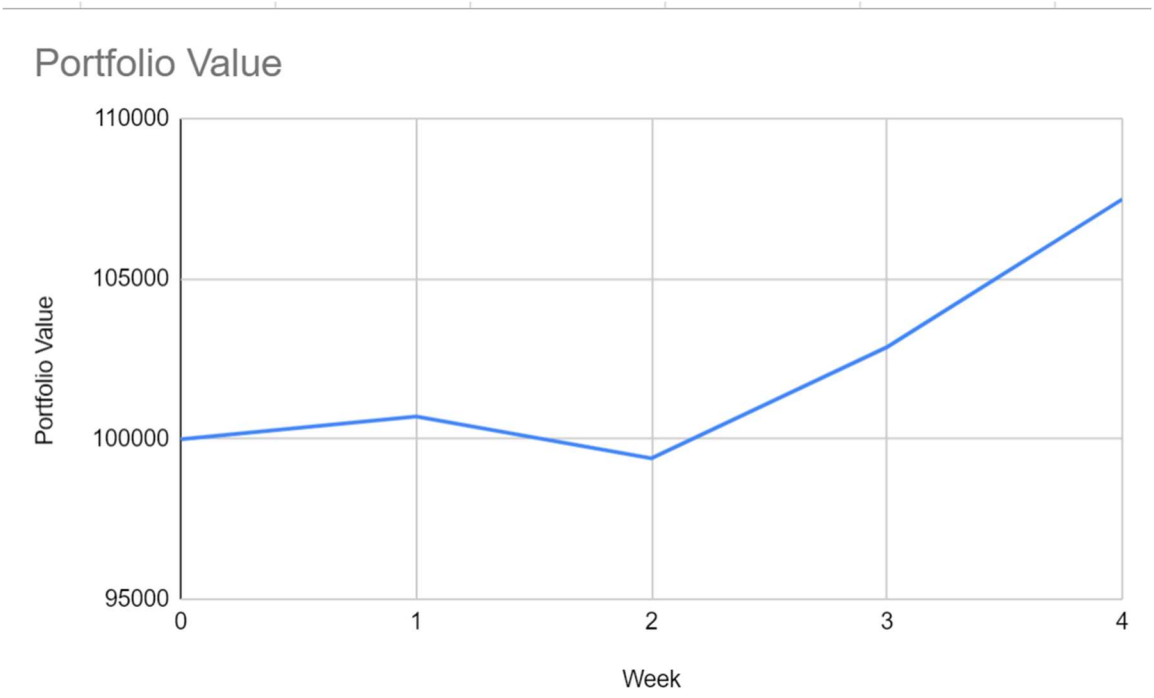

Figure 6.1: The portfolio's dollar value throughout the buy and hold simulation

When removing the two outliers from the analysis, the buy and hold technique the profit was $882.69, or about 1% in four weeks.

Out of the ten stocks purchased, 6 came out on top and 4 lost money. Out of the commerce sector, both AMZN and WMT increased over the four week period, although WMT's profits were nominal. In the communications sector, VZ and GOOGL, remained relatively constant . In the renewable energy sector GE did go up slightly positive, after taking a hit. BEPC dropped throughout. In the healthcare sector JNJ remained unchanged while UNH dropped throughout . In the automotive sector, both TSLA and RIVN did very well, outperforming the rest of the portfolio many times over. Figure 6.2, shown on the next page, depicts the profit/loss of each company.

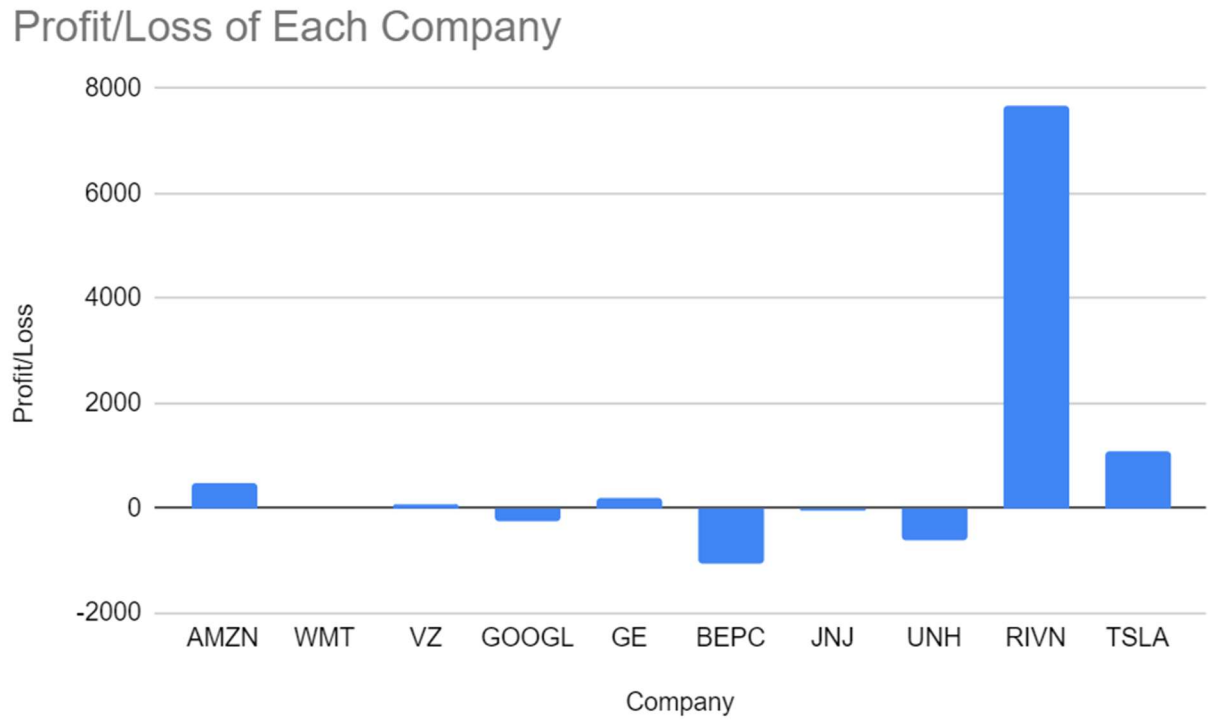

Figure 6.2: The profit/loss for each company in the simulation

The value of profit for each hour spent was about $937.755 per each hour spent, with the average week taking two hours for trades and recording performance.

6.3 Swing Trading

Swing trading finished with a profit of $7629.70 and an return of 7.6% outperforming both the S&P 500 and the Nasdaq. In the four-week simulation 10.95% of the money invested was profited. Figure 6.3, shown below, depicts the value of the portfolio throughout the simulation.

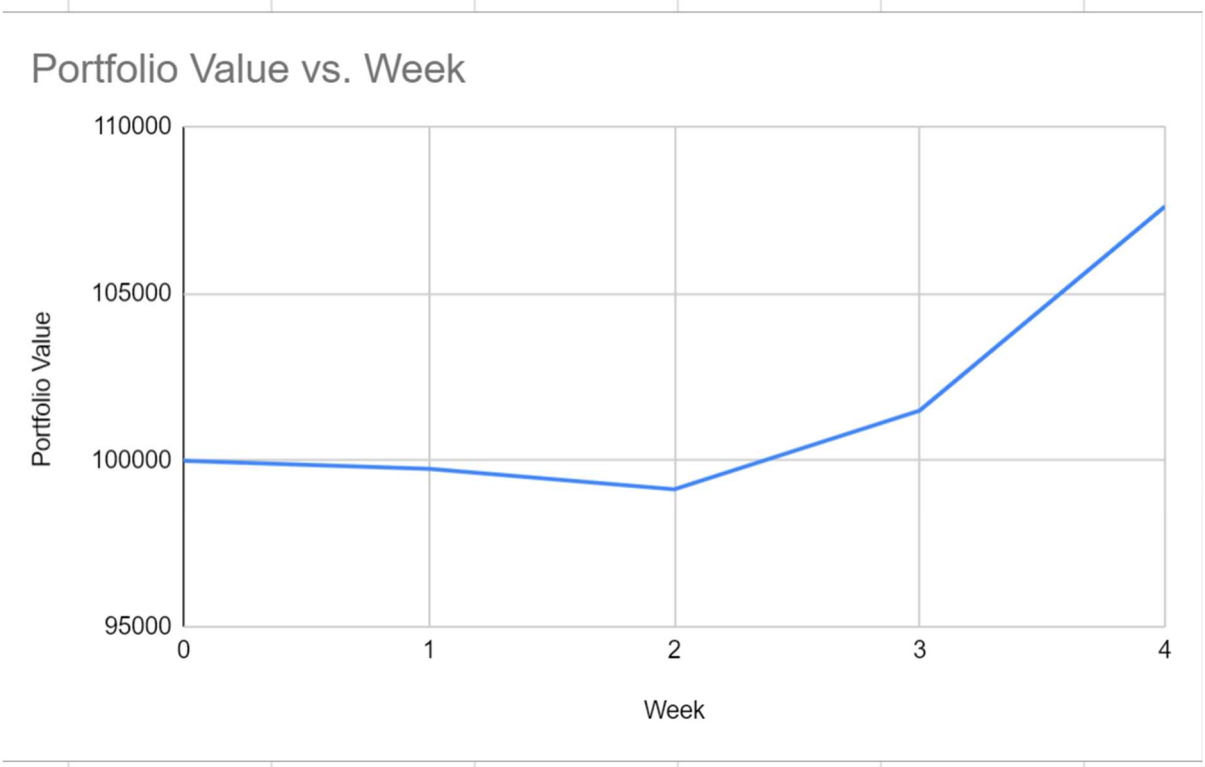

Figure 6.3: The portfolio dollar value throughout the swing trading simulation

Out of the five stocks purchased, three profited and two lost. RIVN did exceptionally well and did not yet show signs of slowing. It produced a 4-week return of 77.7%. TSLA was the second best purchase producing a 4-week return of 5.6%. GOOGL produced a return of nearly 0% in the 4-week span. UNH produced a 4-week return of about -1% . BEPC performed very poorly, however it was expected that eventually it would rise. It produced a 4-week return of -5.8%. If there were something to have required more research, it would be about when to sell a stock that is continuing to drop. However, BEPC was not at a point of jeopardizing the entire portfolio and began to show signs of recovering, so there was no point to selling it. Shown below in Figure 6.4 is a bar chart depicting the profit/loss for each company in the simulation.

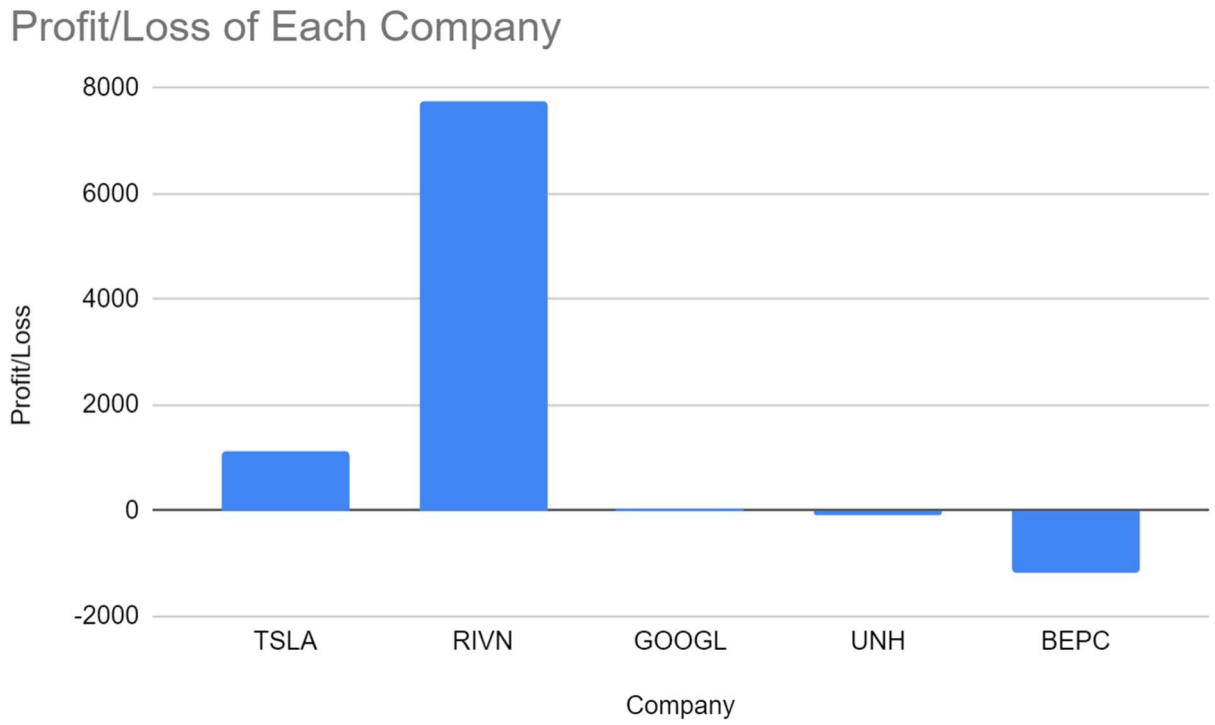

Figure 6.4: The profit/loss for each company in the simulation

The value of profit for each hour spent was about $635.80 per hour spent, with the average week taking three hours for trades and recording performance.

6.4 Comparison:

By profit, the swing trading out produced the buy and hold by $127.66 with nearly identical return percentages. When looking at the profited percentage of money invested, the swing trading outperformed the buy and hold by 3.45%, meaning it had a noticeably better return per dollar risked. With that being said, the buy and hold strategy had a much higher value per hour spent on investing, meaning it may be a more suitable technique for traders that do not have time for swing trading. It also had a much more diverse set of investments as it had double the amount of companies invested in at the conclusion.

Chapter 7: Conclusion

Results showed that swing trading produces a slightly higher return at the expense of some extra time put into trading. However, both trading simulations were successful as both produced strong returns.

The goals of this project were to teach and expose a student to the stock market, and to make money. Both goals were reached therefore the project was a success. Background research provided a solid base in order to start trading which was supplemented with further research throughout. The trading itself allowed for the application of the research in real world scenarios, cementing the basics of both utilized techniques. In addition to the project goals, the personal goals to be achieved during the project were also met: to make trading work within a busy schedule and to make the process itself enjoyable.

The project taught the basics of two trading techniques as well as the vocabulary, intricacies, and trends; all important to a new trader allowing them to succeed.

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