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Stock Market Simulation

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Submitted:

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Abstract

Applying research from print and internet resources, an eight week stock-market simulation was conducted to investigate the investment performance of different trading methods. The experiences gained through this project provided us with important insights into the theory and practice of equity trading.

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1 Introduction

1.1 Project Goals

The primary objective of the project is to develop an introductory understanding of the concepts and techniques involved in equity investment. Using the knowledge gained from research, we ran two simulations of stock trading. The results of our simulations are were analyzed to determine if we could successfully make profits, as a percentage of our initial investments.

First we researched the basics workings of stock trading. We looked and familiarized ourselves with the core concepts of technical analysis, which we would try to apply as part of our simulations. We examined different stocks in order to select ones that seemed promising for positive return.

We conducted a simulation using the swing trading method. We invested virtual \$1,000,000 evenly into five stocks, then kept observing their charts for opportunities to buy and sell at points in time that would result in a profit for a duration of 8 weeks.

The second simulation involved the passive trading of five indexed ETFs. Four index funds were bought with virtual \$1,000,000 at the beginning of the 8 weeks. The securities were held without any trades until the end of the simulation, when they were sold. The results of the two simulation were compared.

1.2 History of the Stock Market

Markets, as institutions that facilitate the exchange of goods and services, have existed for centuries. Early markets traded commodities, most importantly grain, and currency. Later

exchanges developed to trade more complicated negotiable instruments. State loan stocks were invented and traded amongst moneylenders and investors. The Venetians pioneered the practice of trading government securities in the thirteenth century, and other Mediterranean cities of Pisa, Florence, Genoa, Valencia, and Barcelona, whose economies heavily focused on commerce, followed the Venetian's lead.

The first stock exchange was established in Antwerp in 1531, although no real stocks as we understand them today existed at the time. Brokers and moneylenders met at the exchange to trade government and individual debt issues in the form of bonds and promissory notes [6]. The discovery of ocean trade routes in the 16th century gave birth to government chartered trading companies. The Dutch, British and French empires gave trading monopolies to their respective East India trading companies, which would pay dividends on the profit made from their Asian trade voyages. These companies were the first joint stock companies. The first stock issued on certificate, for the Dutch United East India Company, date to 1606 [8].

The London Stock Exchange (LSE) was official established in 1773 and became the leading stock exchange in Europe. The New York Stock Exchange (NYSE) was formed 19 years quickly became the leading stock exchange in the world over the next two centuries. Subsequently stock exchanges developed in countries around the world, although major international companies still listed their stock in NYSE. In 1971, the National Association of Securities Dealers (NASD) founded the NASDAQ, which uniquely did not inhabit a physical location. Instead, the NASDAQ consists of a network of computers and execute trades electronically. The efficiency of electronic trading reduced the bid-ask spread compared to physical exchanges [6].

2 Technical Analysis

2.1 Overview

Technical analysis is the study of stock market data for the purpose of trading and investing. The basic assumptions of technical analysis, as outlined by Edwards and Magee in their *Technical Analysis of Stock Trends* [4]:

- Stock prices are determined solely by the interaction of demand and supply.
- Stock prices tend to move in trends.
- Shifts in demand and supply cause reversals in trends.
- Shifts in demand and supply can be detected in charts.
- Chart patterns tend to repeat themselves.

Technical analysts make predictions and decisions solely on the market movements, rather than on the goods being traded in the market. In the context of this project, the goods are the capital stocks. Factors such as company performance and general economic conditions are assumed to be fully reflected in the prices of company shares and therefore are not of interest to technical analysts.

2.2 Technical Analysis vs. Fundamental Analysis

Fundamental analysis is the method of evaluating securities by measuring their intrinsic values, taking into account factors such as economic conditions and reported financial indicators. Fundamental analysts attempt to identify stocks whose price do not match their measured value and profit from taking long positions on undervalued stocks and short positions on overvalued stocks. Fundamental analysis is different from technical analysis in that the latter states the factors that affect a stock's value are already reflected in the prices and are therefore of no interest.

2.3 History

The development of technical analysis is not well-recorded. It is imaginable that traders and brokers have used technical analysis by memorizing prior price movements as long as markets have existed. The earliest evidence of technical analysis comes from the rice markets in Japan during the 18th century. Sokyō Honma (1724-1803), a rice merchant from Sakata, Japan, is credited with being the earliest known market technician as well as the father of the candlestick charts (see Section 2.4). Honma recorded his trading rules in his *The Fountain of Gold—The Three Monkey Record of Money*, considered to be the oldest book on technical analysis [1].

Modern technical analysis began through the work of Charles Dow (1851-1902), a newspaper journalist who specialized in covering financial news. In 1882, Dow formed Dow Jones & Company with Edward Jones and Charles Bergstresser. The company distributed news bulletins to its subscribers. In 1884, Dow published the first version of a stock index consisting of 9 railroad and 2 industrial stocks to represent the overall price movement of U.S. stocks. By 1896, Dow had recognized the importance of the industrial sector and his index consists solely of 12 industrial stocks, later known as the Dow Jones Industrial Average (DJIA). The list grew to include 20 stocks in 1916 and to 30 stocks in 1928.

Charles Dow founded and presided as the first editor of the *Wall Street Journal*. Dow's written statements and observations for the *Wall Street Journal* were formalized and refined into what later became to be known as the Dow Theory after his death by William Peter Hamilton, Robert Rhea and S. A. Nelson. The Dow Theory recognizes repetitive patterns in stock prices in the form of trends and seeks to explain stock market action using economic rationale.

Little progress was made in technical analysis until 1948 with the publication of Robert Edwards and John Magee's *Technical Analysis of Stock Trends*. Edwards and Magee made technical interpretations based on hundreds of stock patterns. Their work is relevant to this day and is regarded as the "bible of technical analysis."

Market technicians continued to develop new tools using advanced mathematics to describe market actions. Joseph Granville, a renowned technician of his day, introduced the concepts of on-balance volume and the 200-day moving average in the 1950's. The 1960's saw the usage of the concept of rate of change, or momentum, for technical analysis. Advances in computer technology in the 1970's would revolutionize market analysis by giving analyst a way to accurately and quickly draw charts and calculate indicators. J. Welles Wilder, Jr, a mechanical engineer, developed several important technical indicators, including Average True Range, the Relative Strength Index (RSI), Average Directional Index, and the Parabolic SAR, in the 1970's. A variety of technical indicators and tools were developed by other prominent technicians including Richard Donchian, Martin Zweig, Fred Hirschler and Gerald Appel [4].

2.4 Charting

Charts record the prices of a stock over a desired period of time. They provide a visual representation of price movements, which allows analysts to observe them for patterns. The most popular form of stock chart is the candlestick chart in which each data point visually presents the opening, high, low, and closing prices in the shape of a candle (see Figure 1). The body, a space between the open and close, is either hollow or shaded to show whether if the stock closed higher or lower than its opening price.

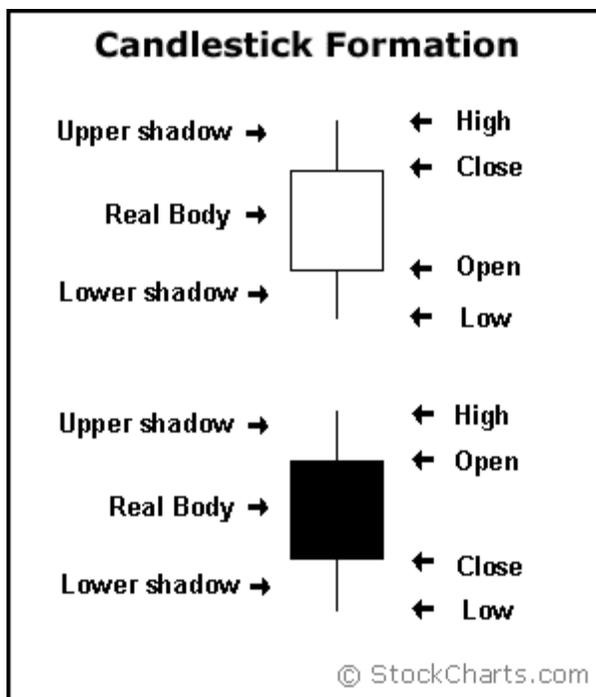


Figure 1. Candlestick representation.

2.5 Trends

A trend is a directional movement of prices that remains long enough to be both identifiable and playable by investors. Technical analyst seek to use visual and calculated indicators to determine the trend itself, spot changes in the trend, and use these predictions to determine when to enter and exit a position. A trend where prices reach higher peaks and higher troughs is known as an uptrend. Similarly, a downtrend occurs when prices reach lower peaks and lower troughs. Sometimes prices trade in a range without displaying significant upward or downward movement, resulting in a sideways trend. Figure 2 shows the three basic types of trends.

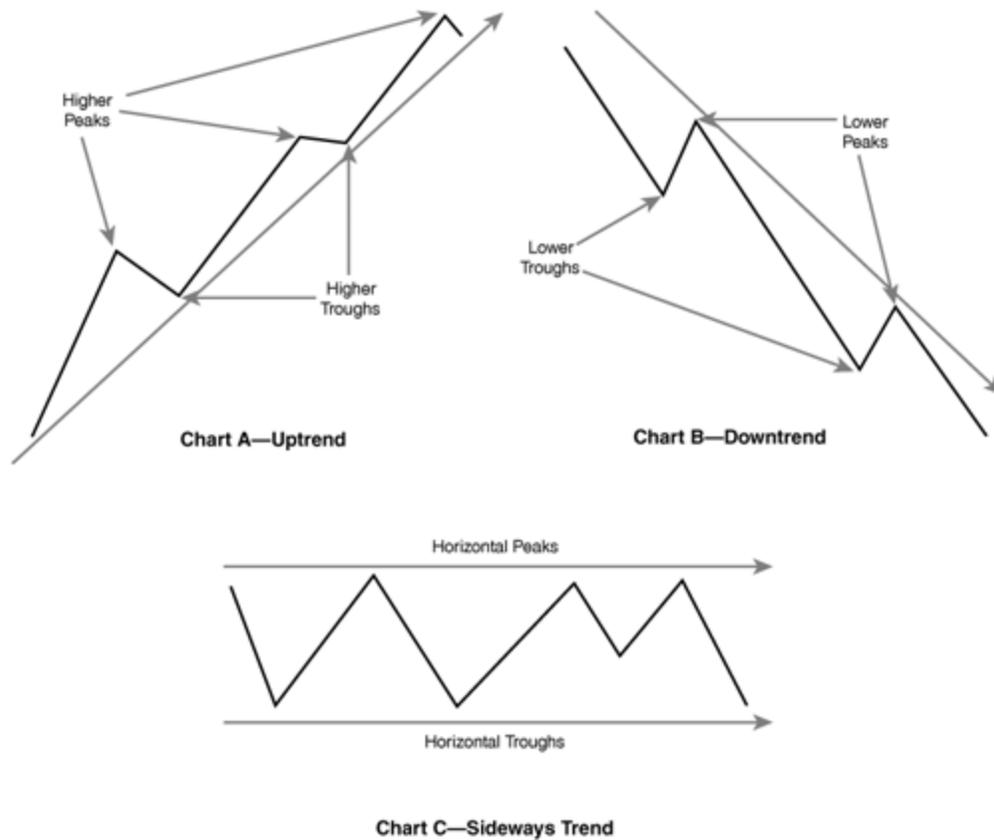


Figure 2. Theoretical examples of uptrend, downtrend, and sideways trend. From *Technical Analysis: The Complete Resource for Financial Market Technicians* by Kirkpatrick, Charles D. and Dahlquist, Julie R.

Price trends exist over different lengths of time. Different length trends display similarities, and such repetition over different scale identifies the fractal nature of trends. Traders should focus on trends whose period matches their investment horizon. They must also take larger and smaller trends into consideration, since larger trends result from the interactions of smaller trends.

Technical analyst classify trends into primary trends (measured in months or years), secondary trends (measure din weeks or months), short-term trends (measured in days), and the intraday trend (measured in minutes or hours). Charles Dow (see Section 5.2) introduced this division, with the exception of the intraday trend. Trends tend to continue but do reverse

direction, and Dow was amongst the first to identify technical indicators for identifying primary trend reversals [4].

Support and resistance are levels at which prices repeatedly fail to fall under or rise above, respectively. They are the result of the interactions of demand and supply. Support is thought to exist when strong demand prevents price from dropping below a certain point. Resistance exists when high supply prevents price from rising above a certain point. Although price will often repeatedly bounce between support and resistance, price will eventually break out of either one or the other. Old support levels may become new resistance and vice versa (Support and Resistance, n.d.). Figure 3 gives an example of a stock showing such a case.



Figure 3. HAL price chart showing price breaking below support, and support level reestablished as resistance, from stockcharts.com

3 Simulations

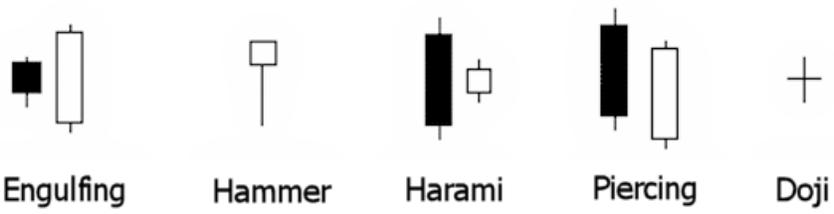
3.1 Swing Trading

Swing trading is a method by which technical traders try to capture profits from short-term waves or swings. Swing traders attempt to buy into stocks when the prices are at their lowest before the trend change direction, then sell the shares when prices are at their highest before a swing downward. Swing trading is typically done within the 1-4 day range. It is suitable for our project due to its active nature and its match with our investment horizon. Swing trading requires frequent trades for traders to exploit short term price movements.

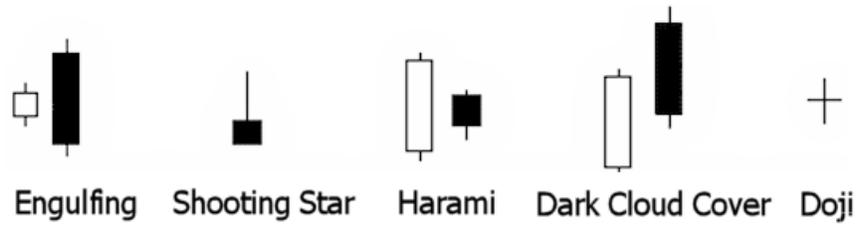
Swing trading does not specify what techniques and tools may be used to when a stock is about to, or has already, hit a low or a high. For the simulation only basic concepts—support and resistance, candlestick chart patterns, visual trends, and moving average crossovers—were utilized. Other technical tools and indicators, including Bollinger Bands, Rate of Change, MACD-Histogram, Average True Range, etc, can be used to make judgments regarding when to trade in a particular stock. Despite their usefulness, we did not use them for the sake of simplicity. Moving Average Convergence-Divergence (MACD) is an indicator which measures the momentum of price movements by calculating the difference between two moving averages, commonly between the 12-day and 26-day exponential moving averages. For our simulation we instead looked at crossovers between the 10-day simple moving average (MA10) and the 30-day exponential moving averages (EMA30), as advocated by the author of www.swing-trade-stocks.com [3].

Figure 4 shows some candlestick patterns which can be interpreted as buy or sell signals when taken into account in conjunction with all other information.

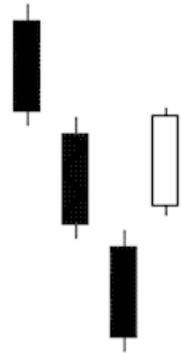
Bullish candlestick patterns



Bearish candlestick patterns



Bullish Kicker



Bearish Kicker

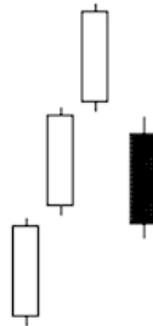


Figure 4. Candlestick patterns, from www.swing-trade-stocks.com

3.1.1 EMC



Figure 5. EMC Price Chart - 6 Months.

EMC price history suggested mixed signals. After the uptrend running from April 22 to May 30, the stock traded sideways until it broke support on June 21 (see Figure 5). We decided to order a buy for EMC on July 2 because the bearish Engulfing candlestick pattern from July 1 to July 2 and the high trading volume on June 28. Because the signal was not strong, we decided to only invest half of the \$200,000 allocated to the stock.



Figure 6. EMC Price Chart - Simulation. Grey arrows indicate buy and pink arrows indicate sell.

Figure 6 shows EMC stock prices during our simulation. After consecutively closing up for five days, the stock closed down with a long body on July 10. We thought this signaled for a pullback and sold our positions. The pullback was short-lived, and we decided to buy into the stock with all of the available capital on July 12 after another bullish Engulfing pattern. The MA(10) had also crossed above the EMA(30), and the stock was trading above its 200-day Moving Average. We sold our entire position on July 22 after a clear trend reversal. The stock price experienced a large upward gap on July 24. Fearing the market will corrected down the gap and seeing no clear bullish signals, we did not make a trade order until August 21, when the price closed up after six consecutive days of closing down (bullish Kicker). We ended our simulation on August 24 by selling our positions. Table 1 shows the EMC trading simulation transaction history. Overall our trading in EMC gave us a positive return of 5.08%.

Ticker: EMC

Date	Order	Shares	Price	Proceed	Available Capital
2-Jul	BUY	4205	23.78	-\$99,994.90	\$100,005.10
10-Jul	SELL	4205	24.46	\$102,854.30	\$202,859.40
12-Jul	BUY	8133	24.94	-\$202,837.02	\$22.38
22-Jul	SELL	8133	25.22	\$205,114.26	\$205,136.64
21-Aug	BUY	7966	25.75	-\$205,124.50	\$12.14
23-Aug	SELL	7966	26.38	\$210,143.08	\$210,155.22

Table 1. EMC Transaction History.

3.1.2 CSCO



Figure 7. CSCO Price Chart – 6 Months.

CSCO has been trading sideways since gapping up on May 16, after the MA(10) crossed over the EMA(30) on the previous day. We invested \$200,000 in the stock on July 9, after the

price had broken the previous resistance of 24.65 set on June 18 and the candlestick formed a hammer pattern.



Figure 8. CSCO Price Chart - Simulation.

We sold our position in CSCO on July 16 after the price seemed to have found a resistance on July 12 and two subsequent days of lower close prices. Although the price seemed to have begun a reversal on August 30, we were hesitant if it was a clear bullish signal since the price had not broken the support from July 12. We re-entered our position in CSCO on August 2 after the July 12 resistance was broken. Although the trend appeared bearish between August 6 and August 8, we did not sell our stocks because the stock was trading below the price we entered on August 2. CSCO unexpectedly gapped down on August 15, with combined with the high trade volume suggests perhaps institutional traders made a significant sale. On August 21, after the price failed to fill the gap, the price closing below the low from July 2, and the MA(10)

crossing below the EMA(30), we decided to exit our position despite losing significant amount of our investment (-6.09% of our initial investment). Table 2 details the CSCO trading transaction history.

Ticker: CSCO

Date	Order	Shares	Price	Proceed	Available Capital
9-Jul	BUY	7949	25.16	-\$199,996.84	\$3.16
16-Jul	SELL	7949	25.71	\$204,368.79	\$204,371.95
2-Aug	BUY	7803	26.19	-\$204,360.57	\$11.38
21-Aug	SELL	7803	24.07	\$187,818.21	\$187,829.59

Table 2. EMC Transaction History.

3.1.3 PFG



Figure 9. PFG Price Chart - 6 Months.

PFG had been in uptrend with MA(10) above EMA(30) before our simulation took place. On July 8, its price closed above the peak of June 27 and we entered our position. July 7 and July 8 also saw increased trading volume which suggested there were interest in the stock. The MA(10) re-crossed above EMA(30) on the same day. These observations convinced us there was a bull signal.



Figure 10. PFG Price Chart - Simulation.

The price of PFG started to uptrend after our initial entrance. When the stock closed down on July 23, after a wide range candle closing up a day prior, we feared its price may pull back. We sold our position on July 23. The price gapped up on July 26 and continued to trend upward until August 1. The bearish Harami pattern with a shooting star on July 26-7 made us hesitant to enter during this time. PFG's price trended slightly downward from August 1 onward. We bought into the stock on August 16 after a weak bullish Engulfing, and exited the stock on

August 23 at the end of our simulation time frame after the price traded sideways. Our investment in PFG returned 5.03% (see Table 3)

Ticker: PFG

Date	Order	Shares	Price	Proceed	Available Capital
8-Jul	BUY	5219	38.32	-\$199,992.08	\$7.92
23-Jul	SELL	5219	40.41	\$210,899.79	\$210,907.71
16-Aug	BUY	4964	42.48	-\$210,870.72	\$36.99
23-Aug	SELL	4964	42.31	\$210,026.84	\$210,063.83

Table 3. PFG Transaction History.

3.1.4 SLF



Figure 11. SLF Price Chart - 6 Months.

SLF had been trading sideways since May 8 with resistance and support as shown in Figure 11. We decided to enter on July 8 after the previous resistance was broken. The stock then began to trend upward.



Figure 12. SLF Price Chart - Simulation.

We exited our position on July 12 after what appeared to be a peak. The wide bodied candle closing up on July 18, after five consecutive days of price closing down, suggested an upswing, and we bought back into SLF. We sold on July 23 on a falling star candle pattern. The stock then traded sideways, gapped up on August 8. High volume of sellers on August 12 seemed to have blunted the momentum from the gap up. We re-entered the stock on August 16 on a bullish Engulfing pattern. However, the price fell on the following days, and we exited the stock on August 20. The price seemed to be going upswing on August 22 and August 23, but our simulation had ended by those dates. Our investment in SLF returned 3.85%.

Ticker: SLF

Date	Order	Shares	Price	Proceed	Available Capital
8-Jul	BUY	6600	30.3	-\$199,980.00	\$20.00
12-Jul	SELL	6600	31.64	\$208,824.00	\$208,844.00
18-Jul	BUY	6506	32.1	-\$208,842.60	\$1.40
23-Jul	SELL	6506	32.55	\$211,770.30	\$211,771.70
16-Aug	BUY	6478	32.69	-\$211,765.82	\$5.88
20-Aug	SELL	6478	32.06	\$207,684.68	\$207,690.56

Table 4. SLF Transaction History.

3.1.5 TSLA



Figure 13. TSLA Price Chart - 6 Months.

TSLA prices were experiencing strong uptrend movement as we begun the simulation. Its MA(10) had stayed above the EMA(30) since April. We decided to enter on July 17 on what appeared to be a reversal candlestick pattern and high trade volume on a day closing up.



Figure 14. TSLA Price Chart - Simulation.

We sold our position in TSLA on April 6 after it closed down following four days of closing up. The price filled down the up gap from April 8. We waited until August 19 to be sure that the downward trend after the gap was reversing. The price on August 19 also was midway between the gap. We exited our position on August 23 due to the conclusion of the simulation time frame. Our investment returned unusually high at 32.02%.

Ticker: TSLA

Date	Order	Shares	Price	Proceed	Available Capital
17-Jul	BUY	1663	120.25	-\$199,975.75	\$24.25
6-Aug	SELL	1663	142.15	\$236,395.45	\$236,419.70
19-Aug	BUY	1631	144.9	-\$236,331.90	\$87.80
23-Aug	SELL	1631	161.84	\$263,961.04	\$264,048.84

Table 5. TSLA Transaction History.

3.2 Index ETF Trading

Exchange-traded funds (ETF) are index funds that trade like stocks and are given their own ticker symbols. Index funds are investment products that replicates the overall movement of their underlying assets, in this case the securities that make up the indices. The advantages of index funds include simplicity, passive management, inherit diversification, and lower taxes on gains. Investors can trade in the overall market or specific sectors without having to select individual stocks. ETFs on average have lower fees than mutual funds [7].

Four index ETF are chosen for our simulation: the SPDR S&P 500 (SPY), the QQQ (QQQ), the Dow Jones Industrial Average ETF (DIA), and the iShare Russel 2000 ETF (IWM). Three of them are indexed to the popular indices, while the IWM is based on the Russel 2000, an index of small cap stocks. See the Appendix for a more detail descriptions of the ETFs used during simulation.

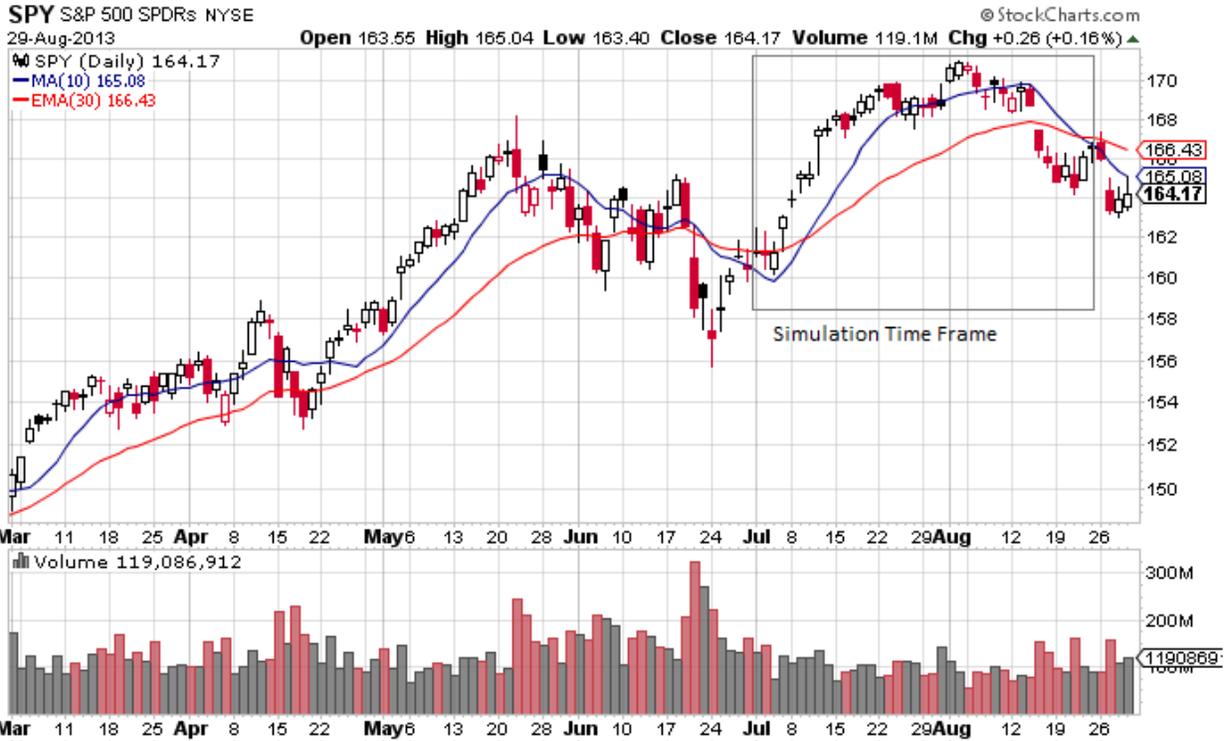


Figure 15. SPY Price Chart - 6 Months.



Figure 16. QQQ Price Chart - 6 Months.

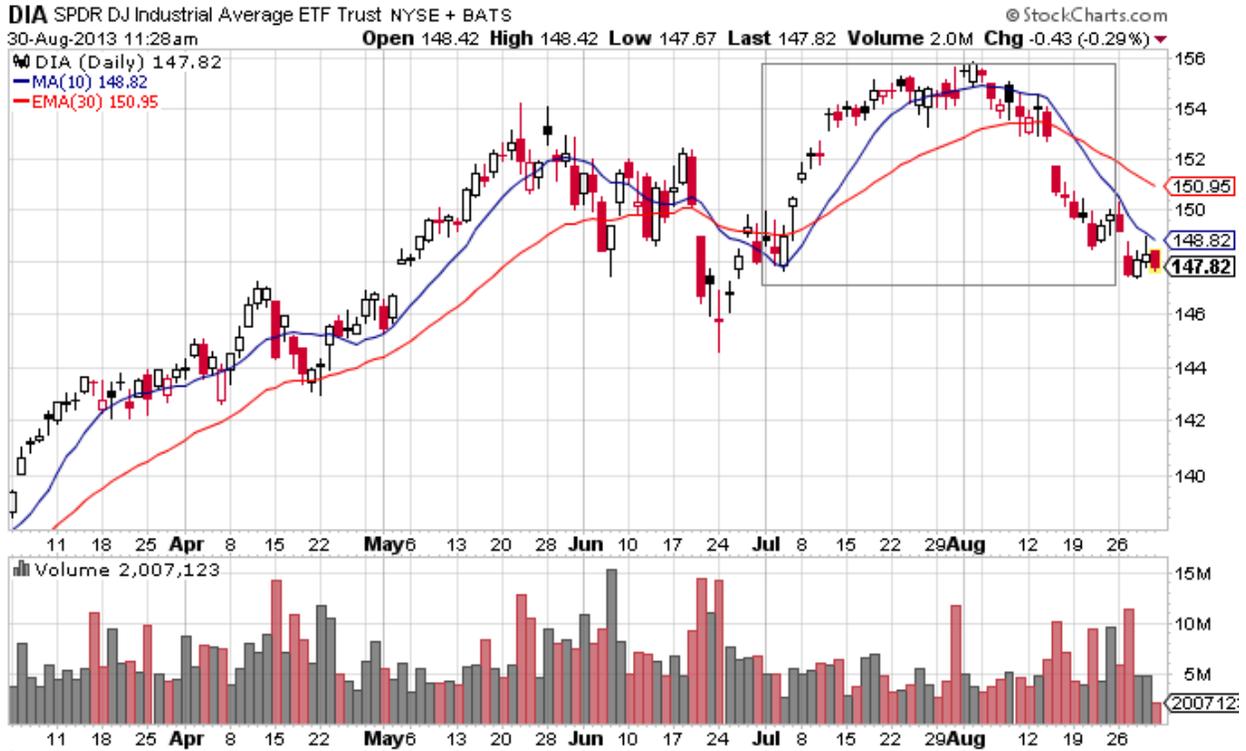


Figure 17. DIA Price Chart - 6 Months



Figure 18. IWM Price Chart - 6 Months.

Although ETFs can be actively traded just like any stocks, we decided to conduct a passive trading simulation. The rationale behind using passive trading is that we wanted to compare it with the results of our active swing trading simulation. In doing so, we sought to gain some insight into whether our technical trading beat the overall market action during the matching time frame of the simulations. Approximately \$250,000 were invested in each of the five ETFs on July 1, and all positions were held until sold on August 23. See Table 7 in Section 8.2 for ETF trading simulation transaction history and results.

4 Analysis

4.1 Swing Trading Performance

Table 6 below details the overall performance of our swing trading simulation. Trading in EMC, PFG, and SLF all produced small positive returns. Trading in CSCO resulted in a negative return of 6.09% over the 2 month trading period. TSLA stands out with a high positive return of 32.02%. This particular result should be treated as a consequence of luck. Whereas the other four stocks exhibited relatively volatile price and their trends frequently changed during the simulation period, the price of TSLA was consistently trending upward. The total percentage return for the swing trading simulation is 7.98%. If the unusual result from TSLA is excluded, the return stands at 1.97%. It is important to note that we did not include commissions in our calculation of returns, and that in real trading commissions may significantly reduce returns depending on the frequency and volume of trades. Table 7 shows the change in prices of the stocks we used for our simulation over the simulation period. In the case of the four stocks that gained in share prices over the time period, we underperformed compared to the overall price

change. In the case of CSCO which finished down, our performance was worse than the drop in price. These results suggest that our active trading requires more work.

Swing Trading Combined

Ticker	Initial Investment	Final Return	% Return
EMC	\$200,000.00	\$210,155.22	5.08%
CSCO	\$200,000.00	\$187,829.59	-6.09%
PFG	\$200,000.00	\$210,063.83	5.03%
SLF	\$200,000.00	\$207,690.56	3.85%
TSLA	\$200,000.00	\$264,048.84	32.02%
Total	\$1,000,000.00	\$1,079,788.04	7.98%

Table 6. Swing Trading Simulation Results.

Stock Price Change over Simulation Period

Ticker	July 1 Close	August 23 Close	% Change
EMC	23.61	\$26.38	11.73%
CSCO	24.34	\$23.86	-1.97%
PFG	37.82	\$42.31	11.87%
SLF	29.75	\$31.89	7.19%
TSLA	117.18	\$161.84	38.11%

Table 7. Swing Trading Stock Price Change.

The major challenges during the simulation come from the difficulty of accurately predicting when prices reverse trends, identifying bullish and bearish signals, and identifying the price swing peaks and troughs. For example, in entering position in PFG on August 16, we incorrectly assume the prices would begin an uptrend, when in reality the prices continued to trade sideways. Large gaps also created difficulty for us to interpret. In the cases of EMC, PFG, SLF, and TSLA, price gaps were filled during the simulation period. In the case of down gap on

August 15 was not filled, and prices continued to trend downward. We were cautious of incorrectly identifying swing points and often waited for the peak and troughs to become more certain before entering and exiting positions. In doing so, we attempted to minimize risks but missed out on profits.

We only used rudimentary technical techniques and tools—visual trend drawing, chart patterns, moving average cross overs, and volume confirmation—in making our decisions. We did not use more sophisticated technical indicators which may have given us more information for the purpose of making trade decisions. The limited number of stocks chosen and the short duration of the simulation made it uncertain whether if we can use the swing trading method to consistently profit from the market over a longer period. We also lacked experience prior to trading. For technical traders, practiced intuition is invaluable, especially given that no technical rule is infallible.

4.2 Index ETF Trading Performance

Table 8 below records the transactions involved in the ETF trading simulation and its results. All four index ETF closed higher at the end of the 8-week period. Two ETF's—DIA and IWM—paid out dividends during the simulation, and these dividends are included in the calculated returns. Similar to the omission of commission fees, we did not take fund fees into consideration. The average ETF has an expense ratio of 0.44% per annum.

ETF Trading

Ticker	Initial Investment	July 1 Closing Price	August 23 Closing Price	Shares Bought	Dividend Received	Return	% Return
SPY	\$249,946.64	161.36	166.62	1549	\$0.00	\$258,094.38	3.26%
QQQ	\$249,981.06	71.71	76.67	3486	\$0.00	\$267,271.62	6.92%
DIA	\$249,979.66	149.42	149.83	1673	\$985.40	\$251,650.99	0.67%
IWM	\$249,998.88	98.58	103.17	2536	\$1,090.48	\$262,729.60	5.09%
Total	\$999,906.24	-	-	-	\$2,075.88	\$1,039,746.59	3.98%

Table 8. ETF Trading Simulation Results.

Compared with the swing trading simulation, the ETF trading produced lower percentage return (although the opposite is the case if TSLA is excluded from the former). The fact that all four indices gained during the shared simulation period also casts doubt to the contribution of technical analysis to the swing trading results, since these results may largely reflect the overall market action rather than active trading decisions.

Although we choose to passively trade with ETFs, they may be actively traded just like any stock. Technical analysis can be applied to the trading of ETFs since technical analysis does not care about the underlying goods, and stock index movements are driven by the same interactions between supply and demand as individual securities.

5 Conclusion

After 8 weeks of simulated trading, both of our methods resulted in net positive return on initial investment. We applied what we learned about the ideas and practices behind technical analysis in the swing trading simulation and found ourselves too cautious to make more decisive

trades. With the exception of TSLA which produced unusual gains, our selected securities all resulted in reasonable gains or losses over the course of the 8 weeks.

After the end of our stock market simulations, we were not able to fully assess the quality of our trading decisions. The returns from active trading were similar to those from passive trading. Therefore it was unclear to us how much our trading decisions contributed to the profits made from swing trading, and how much of the profits were the result of general improvement of the market and economy. We also conducted our swing trades without the additional information that are available through more advanced technical overlays and indicators.

In addition to developing a deeper understanding of technical analytic tools, we also suggest the use of active trading on indexed ETFs, which would allow us to further apply technical trading, with the added benefits inherent to indexed funds which are not present in individual securities.

The experience from working on this project introduced us to a deep field of study and its important applications. We understand that we have only skimmed the surface through our stock market simulations. The difficulty of uncertainty in stock trading, even with the availability of useful tools, has made us admire for the people and institutions who put very real money at risk around the world.

6 Appendix

6.1 Swing Trading Simulation Company Profiles

Source: Yahoo Finance [9].

6.1.1 EMC – EMC Corporation

Section: Technology

Industry: Data Storage Devices

Market Cap: 53.64B

EMC Corporation, together with its subsidiaries, develops, delivers, and supports information infrastructure and virtual infrastructure technologies, solutions, and services. The company offers enterprise storage systems and software deployed in storage area networks (SAN), networked attached storage (NAS), unified storage combining NAS and SAN, object storage, and/or direct attached storage environments, as well as provides backup and recovery, and disaster recovery and archiving solutions. It also offers information security solutions in various areas, such as enterprise governance, risk and compliance, data loss prevention, security information management, continuous network monitoring, fraud protection, identity assurance and access control, and encryption and key management. In addition, the company provides information intelligence software, cloud solutions, and services, including EMC Captiva for intelligent enterprise capture; EMC Document Sciences for customer communications management; EMC SourceOne Kazeon for e-discovery; EMC Documentum xCP for building business and case management solutions; the EMC Documentum platform for creating,

managing, and deploying business applications and solutions; and the EMC OnDemand private cloud deployment model for enterprise-class applications. Further, it offers VMware virtualization and cloud solutions that enable organizations to aggregate multiple servers, storage infrastructure, and networks together into shared pools of capacity that could be allocated to applications as needed. Additionally, the company provides consulting, technology deployment and integration, customer support, training and certification, and managed services. EMC Corporation markets its products through various distribution channels, as well as directly in North America, Latin America, Europe, the Middle East, South Africa, and the Asia Pacific region. The company was founded in 1979 and is headquartered in Hopkinton, Massachusetts.

6.1.2 CSCO – Cisco Systems, Inc.

Sector: Technology

Industry: Networking & Communication Devices

Market Cap: 125.23B

Cisco Systems, Inc. designs, manufactures, and sells Internet protocol (IP) based networking and other products related to the communications and information technology industries worldwide. It offers switching products, including fixed-configuration and modular switches, and storage products that provide connectivity to end users, workstations, IP phones, access points, and servers, as well as function as aggregators on local-area networks and wide-area networks; and routers that interconnects public and private IP networks for mobile, data, voice, and video applications. The company also provides set-top boxes; cable modem CPE products, such as data, EMTA, and gateways; cable modem termination systems products; videoscope software products; and headend equipment, which include encoders, decoders, and

transcoders. In addition, it offers collaboration products comprising IP phones, call center and messaging products, unified communications infrastructure products, and Web-based collaborative offerings, as well as telepresence systems that integrates voice, video, data, and mobile applications on fixed and mobile networks; and security products consisting of firewall, intrusion prevention, remote access, virtual private networks, unified clients, network admission control, Web gateways, and email gateways, which deliver identity, network, and content security solutions for mobile, collaborative, and cloud-enabled businesses. Further, the company provides wireless products, such as wireless access points, controllers, antennas, and integrated management solutions; data center products, which include blade and rack servers, fabric interconnects, and server access virtualization; and home networking and other networking products. Additionally, it offers technical support services; and responsive, preventive, and consultative support services for its technologies. Cisco Systems, Inc. was founded in 1984 and is headquartered in San Jose, California.

6.1.3 PFG – Principal Financial Group Inc.

Sector: Financial

Industry: Asset Management

Market Cap: 12.02B

Principal Financial Group, Inc. provides retirement savings, investment, and insurance products and services. It operates in four segments: Retirement and Investor Services, Principal Global Investors, Principal International, and U.S. Insurance Solutions. The Retirement and Investor Services provides a portfolio of asset accumulation products and services for retirement savings and investment to businesses, institutional clients, and employees. It offers products and

services for defined contribution pension plans, including 401(k) and 403(b) plans, defined benefit pension plans, nonqualified executive benefit plans, and employee stock ownership plan consulting services; investment-only products; and annuities, mutual funds, and bank products. The Principal Global Investors segment provides various equity, fixed income, and real estate investments, as well as currency management, asset allocation, stable value management, and other structured investment strategies. The Principal International segment offers retirement products and services, annuities, mutual funds, institutional asset management, and life insurance accumulation products in Brazil, Chile, China, Hong Kong SAR, India, Mexico, and Southeast Asia. The U.S. Insurance Solutions segment provides individual life insurance products comprising universal and variable universal life insurance and traditional life insurance, as well as specialty benefits consisting of group dental and vision insurance, individual and group disability insurance, and group life insurance in the United States, as well as wellness services and fee-for-service claims administration. Principal Financial Group, Inc. was founded in 1879 and is based in Des Moines, Iowa.

6.1.4 SLF – Sun Life Financial Inc.

Sector: Financial

Industry: Property & Casualty Insurance

Market Cap: 18.57B

Sun Life Financial Inc., an international financial services organization, provides a range of protection and wealth accumulation products and services to individuals and corporate customers. The company operates in five segments: Sun Life Financial Canada, Sun Life Financial U.S., MFS Investment Management, Sun Life Financial Asia, and Corporate. It offers

insurance products, such as universal life, term life, permanent life, participating life, critical illness, long-term care, and personal health insurance; savings and retirement products, including accumulation annuities, guaranteed investment certificates, payout annuities, mutual funds, and segregated funds; provides life, dental, drug, extended health care, disability, and critical illness benefit programs to employers; and voluntary benefit solutions, including post-employment life and health plans to individual plan members. The company also offers pension and retirement products and services, including investment-only segregated funds and fixed rate annuities, stock plans, group life annuities, pensioner payroll services, guaranteed minimum withdrawal benefits, and solutions for de-risking defined benefit pension plans. In addition, it provides asset management services to individual and institutional investors, as well as independent financial advisors through mutual funds, separately managed accounts, and retirement plans; and offers run-off reinsurance services. The company markets and distributes its products through its own sales force and third-party distribution channels, as well as through partnership with independent advisors and benefits consultants in Canada, the United States, the United Kingdom, Ireland, Hong Kong, the Philippines, Japan, Indonesia, India, China, Australia, Singapore, Vietnam, and Bermuda. Sun Life Financial Inc. was founded in 1999 and is headquartered in Toronto, Canada.

6.1.5 TSLA – Tesla Motors, Inc.

Sector: Consumer Goods

Industry: Auto Manufacturers - Major

Market Cap: 20.5B

Tesla Motors, Inc. designs, develops, manufactures, and sells electric vehicles and electric vehicle powertrain components. The company also provides services for the development of

electric powertrain systems and components, and sells electric powertrain components to other automotive manufacturers. It markets and sells its vehicles through Tesla stores, as well as over the Internet. As of March 31, 2013, the company operated a network of 32 stores in North America, Europe, and Asia. Tesla Motors, Inc. was founded in 2003 and is headquartered in Palo Alto, California.

6.2 ETF Profiles

Source: www.etfdb.com [2]

6.2.1 SPY – SPDR S&P 500

Issuer: State Street

Expense Ratio: 0.09%

SPY tracks the Standards & Poors 500 Index, which measures the performance of the large capitalization section of the U.S. equity market.

6.2.2 QQQ – QQQ

Issuer: Invesco PowerShares

Expense Ratio: 0.20%

QQQ tracks the NASDAQ-100 Index, which measures the performance of the 100 highest capitalized domestic and international nonfinancial companies on the NASDAQ Stock Market.

6.2.3 DIA – Dow Jones Industrial Average ETF

Issuer: State Street

Expense Ratio: 0.16%

DIA tracks the Dow Jones Industrial Average, a price-weighted index of 30 “blue-chip” U.S. stocks.

6.2.4 IWM – iShares Russel 2000 ETF

Issuer: iShares

Expense Ratio: 0.28%

IWM tracks the Russell 2000 Index, which measures the performance of the small-cap segment of the U.S. equity market.

7 References

1. Dormeier, B. (2011). *History of Technical Analysis*. FT Press.
2. ETF Database. (n.d.). Retrieved from ETF Database: <http://etfdb.com>
3. Ferguson, C. (n.d.). Retrieved from The Ultimate Swing Trading Guide: <http://www.swing-trading-stocks.com>
4. Kirkpatrick, C. D., & Dahlquist, J. R. (2006). *Technical Analysis: The Complete Resource for Financial Market Technicians*. FT Press.
5. *Support and Resistance*. (n.d.). Retrieved from Stockcharts: http://stockcharts.com/help/doku.php?id=chart_school:chart_analysis:support_and_resistance
6. *The Birth of Stock Exchanges*. (2009, February 26). Retrieved from Investopedia: <http://www.investopedia.com/articles/07/stock-exchanges-history.asp>
7. The Wall Street Journal. (n.d.). *How to Choose an Exchange-Traded Fund (ETF)*. Retrieved from The Wall Street Journal: <http://guides.wsj.com/personal-finance/investing/how-to-choose-an-exchange-traded-fund-etf/>
8. Tschoepe, R. (n.d.). Retrieved from The Oldest Share in the World: <http://www.oldest-share.com>
9. Yahoo. (n.d.). Retrieved from Yahoo! Finance: <http://finance.yahoo.com>