The Changing Realities of the Stock Markets, Financial Advising and Trading

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Objectives:

Flying an airplane today is not what it used to be; flying an Airbus 380 means working with a complex computer system and software which makes things easier under routine condition and hair raising when things go awry. Finance is not any different as digitization takes over. This paper attempts to capture a picture of how markets, financial advising and trading are being transformed by technology essentially through the application of mechanical and electrical engineering principles with the underlying mathematics involved all captured through sophisticated software. There are thus many changes affecting the stock markets, financial advising and trading and there is a glut of information on these subjects. The main objective of this paper is to sort out the most important elements among these changes so that professionals in the field can have a clear picture of their changing operating world. The secondary objective is to provide key material to faculty members who teach 'Securities Analysis' and 'Advance Finance'.

Note: this is a **compilation paper** making use of authoritative information from credible sources as well as the insights of the author. Due credit is given to the cited authors and sources.**I also wish to give credit to my brother Sam Owarish for his constructive suggestions and comments regarding both the content and format of the paper.**

Executive summary: key points

(1) The use of computer technology along with principles of mechanical and electrical/electronic engineering is transforming the stock markets (with advantages and issues), as well as financial advising and trading; financial engineering is coming of age.
(2) Computerization of trading has allowed novel and fast methods of trading using more rational approaches.
(3) Computerization has allowed the appearances of a number of private/alternative exchanges with novel and fast methods of conducting transactions.
(4) Advance in telecommunication has allowed near instant global communication leading to inter-connectedness of exchanges scattered around the globe.
(5) Central banks are now playing a larger role in the stock markets.
(6) Financial advising is being taken over by 'robo advising'.
(7) Computer technology is leveling the playing field by bringing innovations such as 'Robinhood', a trading platform where trades are carried out with no commission costs.
(8) Companies are operating at the cutting edge of conceptual principles.

(9) Efforts are being made to use advance mathematics, such as the Fast Fourier Transform, as part of algo trading and market behavioral predictions. An interesting approach is the use of vibration analysis, reinforcing the idea that under normal circumstances, the stock market operates according to principles found in Mechanical Engineering. Finance Engineering which dominates the playing field is in effect a combination of principles of Electrical/Electronic Engineering and Mechanical Engineering.

Introduction

Computer applications have been having tremendous impact on all human undertakings and were bound to have significant effect of the stock markets, financial advising and trading. Recent changes are to say the least dramatic. The stock markets constitute a network which is a vast array of complex machinery best understood when looked at from the angle of mechanical engineering. The dynamics of the markets via trading is essentially an electronic 'game' applying principle of Signal Analysis. Financial engineering is a blend of principles of mechanical and electronic engineering with the 'quants' in command.

This paper is not about'Mechanical Investing', which is based trading financial instruments on some criteria, but rather on the complex exchanges and trading methodology built on advance engineering technology.

Traditional stock markets and trading

A market in the traditional way is basically a place, physical in nature where those interested in selling and buying meet and conduct an exchange transaction. The New York Stock Exchange is well known and Wall Street is world famous as the physical locations where stocks are traded. The financial instruments themselves have changed over the years as well as the trading methods

Major factor impacting operating modalities

Perhaps the single most important factor which has impacted the markets in the recent years, both positively and negatively, is securitization. According to Chris Galant (Investopedia) "Securitization is the process of taking an illiquid asset, or group of assets, and through financial engineering, transforming them into a security."
Source: http://www.investopedia.com/ask/answers/07/securitization.asp#ixzz42uXoTEoz

Securitization has opened up many possibilities in terms of financial instruments, the so-called asset classes. They are rather complex and often not easy to understand. The relative obscurity can and has created abuses. As a matter of fact, the root of the financial crisis of 2008 goes to the so-called mortgage-backed security. Chris Galant goes on to state that "This security can be sold to participants in the secondary mortgage market. This market is extremely large, providing a significant amount of liquidity to the group of mortgages, which otherwise would have been quite illiquid on their own." (ibid).

This relative new category of securities can be handled wiselyand is used widely.After a period of disgrace during the financial crisis of 2008-2010, during which the volume of issuance dropped sharply, there has been recovery in the asset-backed securities market. In the US, the new issue volume of the asset-backed securities of the United States was US$ 225 billion in 2014. Source:www.statista.com/statistics.

Technological change of the stock market: a comprehensive case study

The evolution of the London Stock Exchange is a wonderful account of the technological changes that have occurred in the financial markets through the last three centuries. These keys points have been extracted from the articled entitles "The evolution of stock market technology" by Karl Flinders, Service Editor of ComputerWeekly.com dated 2nd of November 2007 as follows:

"Technology has contributed to a bang and a crash at the London Stock Exchange and created an invisible world where billions of pounds changes hands in milliseconds. But with EU red tape altering the financial sector's landscape, technology's evolutionary journey at the London Stock Exchange is far from over."

"For a trading venue, the faster and more efficiently it can carry out a deal and the more up to date information it can store and retrieve, the more attractive it is to investors. These investors want to buy or sell shares quickly, to prevent changes in price during the transaction. Accurate market data is also important for investors to make informed choices."

"Share trading took centre stage almost 300 years after share prices were published twice a week on a 10-by-4-inch sheet of paper and distributed from Jonathan's Coffee-house in London. The year 1986 saw what is known as the financial sector's Big Bang.
It was the end of October 1986 when the Stock Exchange Automated Quotation system replaced the trading floor. This screen-based quotation system was used by brokers to buy and sell stock rather than meeting face to face."

The introduction of this new technology had a major impact as follows:

"Cheap and efficient trading is what securities traders wanted and that is what they got. Volumes transacted saw unprecedented increases, with the average daily number of trades going through the ceiling."

"In 1987 the London Stock Exchange was transacting as much business in a month as it did in a whole year before 1986, with an average daily value of £1bn. Today, the average daily number of shares traded is 566,000, with an average daily value of £16.6bn.

> *These figures would be impossible to reach without technology that can reduce the time taken to complete a deal and handle massive volumes."*

The new technology, though highly beneficial in democratizing the stock market brought with it an increased fragility, some of which could be been because of its lack of maturity and speed at which transactions were carried out:

> *"But the technological transformation was not plain sailing. No major technological advance with such a deep impact on how an industry operates can be introduced without a hitch.*
> *This was no exception, and the stock market crash of 20 years ago that saw share prices plummet was more than a hitch, and was partly a result of the immaturity of the new technologies introduced in the Big Bang.*
> *Trading in certain stocks could not be stopped and spiraled out of control. Eventually stocks across the world lost billions of pounds in value, and the London Stock Exchange lost 23% of its value in a single day."*

The new technology had introduced a positive feed-back loop in which a small change in share creates more changes in a way that cause the market to get out of control. Circuit breakers were therefore introduced to damp down the speed at which share values could fall.

The new technology also facilitated the creating of "algo trading", in which trading is no longer the activity of human beings, but is carried out by computers to buy and sell when certain parameters are reached.

Although written in 2007, the author could see how "algo trading" will expand rapidly in the following years.

London Stock Exchange also had to adopt the directives from the EU, the Markets in Financial Instruments Directive, known as "MiFID", which aims to harmonize the stock exchange across the EU and increase transparency. One of the side effects of the directive has been the increased fragmentation of the market.

Source: Karl Flinders http://www.computerweekly.com/news/2240083742/The-evolution-of-stock-market-technology

Global market

Technology has also promoted a globalization of the markets in various countries so that in addition to the individual market there exist a virtual global market. Technology allows us to have a picture of what is going on in stock markets around the world. Of course, it is possible for

investors to invest in various markets. It is obvious that with high-speed communication what happens in one major market may influence what happen in other markets. Time difference is a major factor in 'market interconnection'.

http://www.moneycontrol.com/markets/global-indices/
http://www.cnbc.com/world-markets/
http://www.bloomberg.com/research/markets/world/worldmarkets.asp
http://www.investing.com/indices/major-indices
List of stock exchanges: https://en.wikipedia.org/wiki/List_of_stock_exchanges
List of commodities exchanges: https://en.wikipedia.org/wiki/List_of_commodities_exchanges

Advance Analysis of Market Data

Mechanical markets blog

One of the many blogs containing advance analysis of the modern stock market is the "Mechanical Markets"by Kipp Rogers who founded a company specializing in algorithmic trading called Anamnesis LLC. Some of the recent posts are as follows:

- Pershing Square and Information Leakage on IEX
- Possible Compromises for IEX
- Can We Tell Who Trades on Which Dark Pools?
- Could HFTs Benefit from a Cancellation Tax?
- IEX Peg Orders: Last Look for Equity Markets?
- A Close Look at the Treasury Flash Rally Report
- IEX, Ideology, and the Role of an Exchange
- Plain, Old Fraud in the Twitter-Hack Flash-Crash?
- Are Data Centers that Host Exchanges Utilities?
- Market Impact, Informational Efficiency, and the Value of Liquidity
- Blind Analysis, Inefficient Markets, and UK Polling Accuracy
- The Flash Crash, Systems Failures, and Mission-Critical Engineering
- Market Data Patterns, Order Anticipation, and An Example Trading Strategy
- Sarao Spoofing Allegations and Queue Position
- Spoofing Corrupts Markets: A Reply to John Arnold
- A Few Notes about HFT as a Business and the Virtu IPO
- Manipulation Using Compliance Tools: Equities Analysis Inspired By Allston Case
- Who Executes Retail Trades? A Look at Market Share and Payment for Order Flow
- Should IEX Become a Full Exchange? Incentives for Exchanges to Compete by Increasing Delays
- Ending Market Abuse: Limits on Anonymous Trading
- Protecting Client Interests: Anonymity in US Equities
- Order Size in the HFT Era: Identifying Trader Type Pt. 3
- Creating an HFT Strategy: Identifying Trader Type Pt. 2

- Finding Low-Alpha Orders: Identifying Trader Type Pt. 1

Source: https://mechanicalmarkets.wordpress.com/2015/04/30/market-data-patterns-order-anticipation-and-an-example-trading-strategy/

Mechanical models for understanding and predicting market behavior

A number of authors have written about the inadequacy of current economic models of the financial markets and the assumption that these will lead to a complete knowledge of the markets. Some of these are:

Prof. Roman Frydman and Prof. Michael D. Goldberg published a book entitled ***Beyond Mechanical Markets: Asset Price Swings, Risk and the Role of the State*** warns about the dangers of relying only on a mechanistic accounts of markets

In the book entitled ***The Myth of the Rational Market*** Justin Fox, a financial journalist, commentator gives an
"engaging history of the rise and the fall of the efficient market hypothesis (EMH)." The book also highlights the continuous battle of ideas between academic leaders at the forefront of the discipline"

A noteworthy critique of these works is given by Robert Teitelman, editor in chief of The Deal at http://www.huffingtonpost.com/robert-teitelman/frydman-and-goldbergs-bey_b_866143.html

Central banks have become major players

Central banks are known to play a key role during economic downturn and when the stock markets face unusual challenges. They intervene though the widely known quantitative easing which injects huge amount of money in the markets for the purchase of bonds. A recent article shows a central bank is propping up share prices. It is obvious in this context that the market price of stocks is likely to have nothing to do with the traditional way by which price relates to company valuation. This kind of approach is likely to become more common and is thus a significant factor impacting the market. The following article gives an account of this type of intervention: see http://www.straitstimes.com/business/companies-markets/bank-of-japan-quietly-buying-up-huge-stakes-in-nations-blue-chip

Changes in financial advising

Robo advisor: software which invest the resources of someone who does not want to go through the traditional method of financial advising; it is also lower in cost than the latter and perhaps less self-interest and more objectivity.

Below is a list of several robo-advisors:
AssetBuilder
Betterment.com
LearnVest
MarketRiders
Motif Investing
Personal Capital
RebalanceIRA
Schwab Intelligent Portfolios
SigFig
TradeKing
Vanguard VPAS
Wealthfront
WiseBanyan

Read more: Robo-advisor (robo-adviser) Definition | Investopediahttp://www.investopedia.com/terms/r/roboadvisor-roboadviser.asp#ixzz42ubZ3FLF

Operating changes in companies

Of course, one also has to focus on the particular stock and bond of a specific company involved and the guiding principle here is that of market value added which is a calculation that shows the difference between the *market value* of a company and the capital contributed by investors (both bondholders and shareholders). In other words, it is the sum of all capital claims held against the company plus the *market value* of debt and equity. A company always has the choice between issuing stocks i.e. equity or debt, in essence bonds, often combining the former and the latter.

The guiding theory was developed by Modigliani, 1985 Nobel Prize in Economics), and Miller1990 Nobel Prize in Economics with Harry Markowitz and William F. Sharpe. These extracts are from Wikipedia:

> *"The Modigliani–Miller theorem (of Franco Modigliani, Merton Miller) is a theorem on capital structure, arguably forming the basis for modern thinking on capital structure. The basic theorem states that under a certain market price process (the classical random walk), in the absence of taxes, bankruptcy costs, agency costs, and asymmetric information, and in an efficient market, the value of a firm is unaffected by how that firm is financed. Since the value of the firm depends neither on its dividend policy nor its decision to raise capital by issuing stock or selling debt, the Modigliani–Miller theorem is often called the capital structure irrelevance principle".*

> *"The key Modigliani-Miller theorem was developed in a world without taxes. However, if we move to a world where there are taxes, when the interest on debt is tax deductible, and ignoring other frictions, the value of the company increases in proportion to the amount of*

*debt used. And the source of additional value is due to the amount of taxes saved by issuing debt instead of equity."*Source:https://en.wikipedia.org/wiki/Modigliani%E2%80%93Miller_theorem

Company financials

The following case study shows a complex reality emerging; one should not make broad generalization. Gretchen Morgenson wrote about "**Fantasy Math Is Helping Companies Spin Losses Into Profits**".
She states that

"Companies, if granted the leeway, will surely present their financial results in the best possible light. And of course they will try to persuade investors that the calculations they prefer, in which certain costs are excluded, best represent the reality in their operations.Call it accentuating the positive, accounting-style." She added "What's surprising, though, is how willing regulators have been to allow the proliferation of phony-baloney financial reports and how keenly investors have embraced them. As a result, major public companies reporting results that are not based on generally accepted accounting principles, or GAAP, has grown from a modest problem into a mammoth one," and "According to a recent study in The Analyst's Accounting Observer, 90 percent of companies in the Standard & Poor's 500-stock index reported non-GAAP results last year, up from 72 percent in 2009."

Source:http://www.nytimes.com/2016/04/24/business/fantasy-math-is-helping-companies-spin-losses-into-profits.html

A comprehensive look at the transformation of trading

Trading of stocks has changed tremendously in the recent past mainly spurred by technological developments. Today, ordinary investors have access to trading platforms and the cost for so doing has gone lower and lower.

Streetdirectory gives a basic picture of trading, namely that

"there are two methods of stock market trading. The traditional way of trading occurs in an open outcry manner on the stock exchange floor of the stock market. Modern stock trading is conducted via electronic exchanges and all occurrences take place in real time online."

Source:http://www.streetdirectory.com/travel_guide/144427/trading/how_does_stock_market_trading_work.html

A comprehensive picture of trading is provided by Kristina Zucchi from Investopedia:

"active trading is the act of buying and selling securities based on short-term movements to profit from the price movements on a short-term stock chart. The mentality associated with an

active trading strategy differs from the long-term, buy-and-hold strategy. The buy-and-hold strategy employs a mentality that suggests that price movements over the long term will outweigh the price movements in the short term and, as such, short-term movements should be ignored. Active traders, on the other hand, believe that short-term movements and capturing the market trend are where the profits are made. There are various methods used to accomplish an active-trading strategy, each with appropriate market environments and risks inherent in the strategy."

See: 4 Common Active Trading Strategies | Investopediahttp://www.investopedia.com/articles/active-trading/11/four-types-of-active-traders.asp#ixzz46f478bag
The following source may also be of interest: (*How To Outperform The Market*.)

Investopedia explores:

1. Day Trading (*Day Trading Strategies For Beginners*.)
2. Position Trading.
3. Swing Trading (*Introduction To Swing Trading*.)
4. Scalping

(*Risk Management Techniques For Active Traders*.)

Algorithmic trading

Algorithmic Trading Strategies
- Trend Following Strategies:
- Arbitrage Opportunities:
- Index Fund Rebalancing:
- Mathematical Model Based Strategies:
- Trading Range (Mean Reversion):
- Volume Weighted Average Price (VWAP):
- Time Weighted Average Price (TWAP):
- Percentage of Volume (POV):
- Implementation Shortfall:
- Beyond the Usual Trading Algorithms:

Read more: Basics of Algorithmic Trading: Concepts and Examples | Investopediahttp://www.investopedia.com/articles/active-trading/101014/basics-algorithmic-trading-concepts-and-examples.asp#ixzz46f7Vr9Tb

High frequency trading

Investopedia provides useful information on this growingly important subject as follows:

"High-frequency trading (HFT) is a program trading platform that uses powerful computers to transact a large number of orders at very fast speeds. High-frequency trading uses complex algorithms to analyze multiple markets and execute orders based on market conditions. Typically, the traders with the fastest execution speeds will be more profitable than traders with slower execution speeds. As of 2009, it is estimated more than 50% of exchange volume comes from high-frequency trading orders."

"High-frequency trading became most popular when exchanges began to offer incentives for companies to add liquidity to the market. For instance, the New York Stock Exchange has a group of liquidity providers called supplemental liquidly providers (SLPs), which attempt to add competition and liquidity for existing quotes on the exchange. As an incentive to the firm, the NYSE pays a fee or rebate for providing said liquidity. As of 2009, the SLP rebate was $0.0015. Multiply that by millions of transactions per day and you can see where part of the profits for high frequency trading comes from."

"The SLP was introduced following the collapse of Lehman Brothers in 2008, when liquidity was a major concern for investors."

Source: [High-Frequency Trading (HFT) Definition | Investopediahttp://www.investopedia.com/terms/h/high-frequency-trading.asp#ixzz46f5ioDIi](http://www.investopedia.com/terms/h/high-frequency-trading.asp#ixzz46f5ioDIi)

Dark pools

Companies can issue stocks publicly or privately and can switch from one to the other. Stocks which are public trade on the open markets whereas those that are private are exchanged over the counter. Companies at times buy back their stocks and this process is mostly perceived as being beneficial to both the companies and the investors. Trading is mostly in the open but at times companies operate in the dark pools with the implied complexity and possibly lack of transparency.

"Dark pool liquidity refers to the amount of trading activity that occurs directly between parties without the use of an exchange, thereby keeping the transaction private. Dark pool liquidity usually is created by institutions. For example, let's assume that Company XYZ and Company ABC are pension funds in California and Oregon, respectively. Company XYZ wants to sell 2 million shares of McDonald's (MCD) to Company ABC. However, the trade is so large that investors might regard the transaction as a sell signal on MCD, which could tank the stock and make further sales more difficult for the seller. Thus, the two companies decide to do the trade off the exchange (i.e., in a "dark pool"). The transaction costs might also be lower.
Accordingly, they make the trade on the over-the-counter market, directly between themselves, or even on a regional exchange. Securities and Exchange Commission Rule

19c3 allows stocks listed on any equity exchange after April 26, 1979, to trade off board -- that is, off an exchange.

Dark pool liquidity provides anonymity. It also provides a way to avoid destabilizing the markets if a trade is particularly large, and it can increase liquidity in the markets by increasing the ease with which buyers can buy and sellers can sell. However, dark pools are controversial because they prevent all investors and market participants from knowing the true prices at which specific securities are valued in all arm's-length transactions. Given that dark pool trading reportedly constitutes 20% of all marketvolume, according to some sources, the controversy is bound to continue or increase with its popularity."

Source: http://www.investinganswers.com/financial-dictionary/stock-market/dark-pool-liquidity-5469

'Iceberg Order'

"An iceberg order is a large single order that has been divided into smaller lots, usually through the use of an automated program, for the purpose of hiding the actual order quantity."

"When large participants, such as institutional investors, need to buy and sell large amounts of securities for their portfolios, they can divide their large orders into smaller parts so that the public sees only a small portion of the order at a time - just as the 'tip of the iceberg' is the only visible portion of a huge mass of ice. By hiding its large size, the iceberg order reduces the price movements caused by substantial changes in a stock's supply and demand."

Source: http://www.investopedia.com/terms/i/icebergorder.asp

The Financial Times gives a detail description of Iceberg Orders which starts as follows:

"An iceberg order is a type of order placed on a public exchange. The total amount of the order is divided into a visible portion, which is reported to other market participants, and a hidden portion, which is not. When the visible part of the order is fulfilled, a new part of the hidden portion of the same size becomes visible."

The entire article may be read at: http://lexicon.ft.com/Term?term=iceberg-order

Conclusion

Perhaps the major thrust of the changes going on can be captured by what Robinhood is doing.

"For removing all the barriers to stock trading, Robinhood is one of our Most Innovative Companies of 2016. Robinhood's Vlad Tenev (left) and Baiju Bhatt dream of a world where a new generation can invest with the ease of ordering an Uber. Founded in Palo Alto in 2014 by the former Stanford roommates, Robinhood is an app-based stock brokerage that offers commission-free trading. The various fees attached to trading stocks often deter young people from entering the market, but by eliminating fees and streamlining the process, Robinhood hopes to open up trading to a new demographic. The tool is the fastest-growing brokerage in history, with hundreds of thousands of customers and more than $2 billion in transactions. In 2015, it raised $50 million in funding and won an Apple Design Award--the first finance app to do so. Now, the company is letting developers build its functionality into existing products like StockTwits and Quantopian, which could revolutionize trading. And next up is international expansion: Robinhood already has 20,000 people on the waitlist for its upcoming launch in Australia."

Robinhood points out that it

"makes money in many of the same ways as traditional online brokerages. These include:
- Collecting interest from customers who choose to upgrade to a margin account. We are testing margin in beta and will offer margin accounts later this year.
- Accruing interest from customers' uninvested cash balances. It is important to note that our customers are not charged.
Robinhood has raised $66 million from NEA, Index Ventures, Ribbit Capital, Vaizra Investments, Google Ventures, Andreessen Horowitz, Social Leverage, Box CEO Aaron Levie, Path CEO Dave Morin, Jared Leto, Snoop Dogg, Linkin Park, and Nas, which gives us the freedom to focus on building an outstanding experience rather than short-term profits."

Source: https://www.instagram.com/p/BC_Sd52hrpO/

APPENDICES

Appendix 1: The Stock Market's Long-Term Outlook: Two Predictions
This extract is taken from article by William Reichenstein, published Sep 11, 2015 on Wall Street Journal website. The author stresses the difficulty that models have in predicting the degree and timing of a market correction.

"Empirical evidence from two Nobel Prize winning economists suggests we have some ability to predict long-horizon stock returns.
Robert Shiller's research concludes that the cyclically adjusted price/earnings ratio (CAPE) has some ability to predict 10-year-ahead real (i.e., inflation-adjusted) S&P 500 returns. CAPE is the current level of S&P 500 divided by average real earnings over the last 10 years. Thus CAPE tells you how many dollars the S&P 500 costs per average real

dollar of earnings. Historically, when CAPE has been above its historic average of about 17, future 10-year real stock returns have usually been below average, and vice versa. Although today's minuscule interest rates suggest the justified price/earnings level today should be above average, today's CAPE of about 23 still suggests below-average returns. Eugene Fama and Ken French's research concludes that the Baa-Aaa interest-rate spread has some ability to predict long-horizon stock returns. This spread represents the additional yield demanded by investors for bearing the lower credit quality of triple-B bonds instead of the highest quality triple-A bonds. The argument for this spread's predictability is that it should move with the unobservable equity risk premium, which is the additional return investors demand for bearing the risk of stocks compared to bonds. Historically, when this spread has been above average, future 5- and 10-year real stock returns have usually been above average, and vice versa. Today's Baa-Aaa spread of 1.05% is slightly below its average since 1919, but slightly above its median spread. Thus, this spread suggests long-horizon stock prospects are about average. Shiller and Fama recently shared the Nobel Prize in economics.

To repeat, CAPE and Baa-Aaa spread have shown some *ability to predict long-horizon stock returns. The explanatory power of the regressions is about 30%. To put this in perspective, suppose someone was trying to predict whether stock returns the next 10 years will be above average or below average. Historically, these metrics made the right prediction about 65% of the time, but missed about 35% of the time.* These forecasts are far from perfect.

Separately, no one has the ability to predict short-term returns like the market correction that occurred late August. Attempts to do so usually depress investors' long-term returns. Short-term volatility is the price investors must pay to garner stocks' larger long-run average returns.

How do I suggest that you use these forecasts?

Before this correction, I had a 50% stock exposure, which is about 5% below the stock allocation recommended for a typical investor my age (63), and thus reflected somewhat below-average stock prospects. Such tilts of 5% to 10% away from my normal asset allocation are examples of tactical asset allocation. Should the S&P 500 enter a bear market–20% below its prior peak–then I probably will rebalance back to 55% stocks since future long-run return prospects after such a market decline would be better than they were before the market decline.

I believe this type of tactical rebalancing with the stock allocation deviating slightly around a normal stock allocation makes sense. It encourages investors to buy when prices are low and to sell when prices are high, while avoiding strong deviations from their normal stock allocation. History suggests that such tactical asset allocation can enhance long-run portfolio returns compared to a fixed-weight strategy with periodic rebalancing."

William Reichenstein is Powers Professor at Baylor University and head of research at socialsecuritysolutions.com*.*
Source: http://blogs.wsj.com/experts/2015/09/11/the-stock-markets-long-term-outlook-two-predictions/

Appendix 2: Modeling financial markets

MODELING FINANCIAL MARKETS USING CONCEPTS FROM MECHANICAL VIBRATIONS AND MASS-SPRING SYSTEMS– Thesis by MICHAEL XAVIER GANDIA, 2014.

This thesis is a fascinating study of the application of Mechanical Engineering principles to predicting the behavior of the stock market. The author states that events "*cannot be predicted but the responses to those events can be*". In order to view this work in context, it must be noted that according to some writers unpredictable and extreme events can happen, while writers state that crisis events are brought about by the cumulative actions or non-actions of market participants and governments over a period of time.

The abstract of the thesis is given below:

"This thesis describes a method of modeling financial markets by utilizing concepts from the mechanical vibration. The models developed represent multi-degree of freedom, mass-spring systems. The economic principles that drive the design are supply and demand, which act assprings, and shareholders, which act as masses. The primary assumption of this research is thatevents cannot be predicted but the responses to those events can be. In other words, economicstimuli create responses to a stock's price that is predictable, repeatable and scientific. Theapproach to determining the behavior of various financial markets encompassed techniques suchas Fast Fourier Transform and discretized wavelet analysis. The researched developed in threestages; first an appropriate model of causation in the stock market was established. Second, amodel of steady state properties was determined. Third, experiments were conducted to determine the most effective model and to test its predictive capabilities on ten stocks. The experiments were evaluated based on the model's hypothetical return on investment. The results showed a positive gain on capital for nine out of the ten stocks and supported the claim that stocks behave in accordance to the natural laws of vibration. As scientific approaches tomodeling the stock market are beginning to develop, engineering principles are proving to be the most relevant and reliable means of financial market prediction"

The entire thesis can be read using the link below:
Source: http://etd.fcla.edu/CF/CFH0004657/Gandia_Michael_X_1407_BS.pdf

Appendix 3:Modeling of Stock Market

ATTEMPT TO PREDICT THE STOCK MARKET – project report submitted at Worcester Polytechnic Institute, Massachusetts by Artur Wojtak, 2007.

The report contains an attempt to use Fast Fourier Transform to predict the future performance of shares based on historical data. Some successful prediction were made in the study, but the author recognized the difficulty of predicting the market in uncertain economic situations. This extract is taken from the Executive Summary of the report:

> *"Many have tried predicting the stock market, but very few have succeeded. It is nearly impossible to predict the market for a long period of time, but with the correct mathematical algorithms, and if other major factors that affect the stock market remain unchanged, we can predict how the stock will act from its previous behavior. For the past six months, Professor Humi and I have been working on a design of a MatLab program, which would be able to predict the price of the stock. We constructed two programs; however one seems to provide us with a better prediction than the other. Both of these programs use many mathematical algorithms to predict the price of the stock.*
> *The program that seems to provide us with a better prediction was Program 1. This program first took the best-fit curve of the actual price, and interpolated it for the amount of days we wish to predict the price of the stock. We then took a Fast Fourier Transformation of the actual price, cleaned out noise, and took the Inverse Fourier Transformation, in order to clean out small noises in the stock. Once we had the cleaned Inverse Fourier Transformation, we interpolated it again for the same amount of days as the interpolation of the best-fit curve, 5 and added the two components together. These two components provided us with the prediction for a certain number of days. The prediction we computed was fairly accurate, once small modifications were made. Certain stocks gave us a reasonable prediction without any modifications, while other predictions needed to be modified by a certain percentage (10%), after that small modification was made, the prediction was reasonable once again. From this project we realized that predicting the stock market is very difficult due to the everyday changing of economy which we cannot predict. We however attempted to predict the stock market in ideal situations, and in some manner we have succeeded."*

Source: https://www.wpi.edu/Pubs/E-project/Available/E-project-022808-142909/unrestricted/FullIQPReport7.pdf