CHAPTER - 2

LITERATURE SURVEY

APPLICATION OF NEURAL NETWORKS IN INVESTMENT MANAGEMENT
2.0 LITERATURE SURVEY

2.1 FINANCE THEORY

Finance theory has a surprisingly short history. Early ideas about financial markets were largely intuitive, mostly formulated by practitioners. Pioneering theoretical work on financial markets can be traced to French mathematician Louis Bachelier whose Ph.D. dissertation titled "The Theory de la Speculation" (1900) included some remarkably insights and commentary. Bachelier came to the conclusion that "The mathematical expectation of the speculator is zero" and he described this condition as a "fair game." Unfortunately, his insights were so far ahead of the times that they went largely unnoticed for over 60 years until his paper was rediscovered and eventually translated into English and published in 1964.

This does not mean that the early researchers totally ignored financial markets. Irving Fisher (1906, 1907, 1930) had outlined the basic functions of credit markets for economic activity, specifically as a way of allocating resources over time and had recognized the importance of risk in the process. In developing their theories of money, John Maynard Keynes (1930, 1936), John Hicks (1934, 1935, 1939), Nicholas Kaldor (1939) and Jacob Marschak (1938) had already conceived of portfolio selection theory in which uncertainty played an important role.

However, for many, financial markets were considered as mere "casinos" rather than "markets". In their view, asset prices were determined largely by expectations and counter-expectations of capital gains and thus they were "held up by their own bootstraps" as it were. John Maynard Keynes's "beauty contest" analogy is representative of this attitude.

John Burr Williams (1938) was among the first to challenge the "casino" view of financial markets and questions of asset pricing. He argued that asset prices of financial assets reflected the "intrinsic value" of an asset, which can be measured by the discounted stream of future expected dividends.
from the asset. This "fundamentalist" notion fit well with Irving Fisher’s (1907, 1930) theory, and the "value-investing" approach of practitioners such as Benjamin Graham.

Harry Markowitz (1952, 1959) realized that as the "fundamentalist" notion relied on expectations of the future, then the element of risk must come into play and profitable use could be made of the newly developed expected utility theory of John von Neumann and Oskar Morgenstern (1944). Markowitz formulated the theory of optimal portfolio selection in the context of trade-offs between risk and return, focusing on the idea of portfolio diversification as a method of reducing risk and thus began what has become known as "Modern Portfolio Theory" or simply MPT.

Keynes, Hicks and Kaldor had already considered the idea of an optimal portfolio allocation in their theories of money. Thus it was a logical step for James Tobin (1958) to add money to Markowitz’s story and thus obtain the famous “two-fund separation theorem”. Effectively, Tobin argued that agents would diversify their savings between a risk-free asset (money) and a single portfolio of risky assets (which would be the same for everyone). Different attitudes towards risk, Tobin contended, would merely result in different combinations of money and that unique portfolio of risky assets.

The Markowitz-Tobin theory was not very practical. Specifically, to estimate the benefits of diversification would require that practitioners calculate the covariance of returns between every pair of assets. In their Capital Asset Pricing Model (CAPM), William Sharpe (1961, 1964) and John Lintner (1965) solved this practical difficulty by demonstrating that one could achieve the same result merely by calculating the covariance of every asset with respect to a general market index. With the necessary calculating power reduced to computing these far fewer terms ("betas"), optimal portfolio selection became computationally feasible. It was not long before practitioners embraced the CAPM.
The CAPM would be eventually challenged empirically in a series of papers by Richard Roll (1977, 1978). One of the alternatives offered up was the "intertemporal CAPM" (ICAPM) of Robert Merton (1973). Merton’s approach and the assumption of rational expectations led the way to the Cox, Ingersoll and Ross (1985) partial differential equation for asset prices and, perhaps only a step away, Robert E. Lucas’s (1978) theory of asset pricing.

A more interesting alternative was the "Arbitrage Pricing Theory" (APT) of Stephen A. Ross (1976). Stephen Ross’s APT approach moved away from the risk vs. return logic of the CAPM, and exploited the notion of "pricing by arbitrage" to its fullest possible extent. As Ross himself has noted, arbitrage-theoretic reasoning is not unique to his particular theory but is in fact the underlying logic and methodology of most of finance theory. The following famous financial theorems illustrate Ross’s point.

The famous theory of option pricing by Fisher Black and Myron Scholes (1973) and Robert Merton (1973) relies heavily on the use of arbitrage reasoning. Intuitively, if the returns from an option can be replicated by a portfolio of other assets, then the value of the option must be equal to the value of that portfolio, or else there will be arbitrage opportunities. Arbitrage logic was also used by M. Harrison and David M. Kreps (1979) and Darrell J. Duffie and Chi-Fu Huang (1985) to value multi-period (i.e. "long-lived") securities. All this spills over into the Neo-Walrasian theories of general equilibrium with asset markets (complete and incomplete) developed by Roy Radner (1967, 1968, 1972), Oliver D. Hart (1975) and many others since.

The famous Modigliani-Miller theorem (or "MM") on the irrelevance of corporate financial structure for the value of the firm also employs arbitrage logic. This famous theorem Franco Modigliani and Merton H. Miller (1958, 1963) can actually be thought of as an extension of the "Separation Theorem" originally developed by Irving Fisher (1930).
Effectively, Fisher had argued that with full and efficient capital markets, the production decision of an entrepreneur-owned firm ought to be independent of the intertemporal consumption decision of the entrepreneur himself. This translates itself into saying that the profit-maximizing production plan of the firm will not be affected by the borrowing/lending decisions of its owners, i.e. the production plan is independent of the financing decision.

Modigliani-Miller extended this proposition via arbitrage logic. Viewing firms as assets, if the underlying production plans of differently financed firms are the same, then the market value of the firms will be the same for, if not, there is an arbitrage opportunity there for the taking. Consequently, arbitrage enforces that the value of the firms to be identical, whatever the composition of the firm’s financial structure.

### 2.2 EFFICIENT MARKETS HYPOTHESIS

The second important strand of work on finance was the empirical analysis of asset prices. A particularly disturbing finding was that it seemed that prices tended to follow a random walk. More specifically, as documented by Louis Bachelier (1900) (for commodity prices) and later confirmed in further studies by Holbrook Working (1934) (for a variety of price series), Alfred Cowles (1933, 1937) (for American stock prices) and Maurice G. Kendall (1953) (for British stock and commodity prices), it seemed as there was no correlation between successive price changes on asset markets.

The Working-Cowles-Kendall empirical findings were greeted with horror and disbelief. Yet, others crowed that it proved the failure of traditional “statistical” methods to illuminate much of anything. High-powered time series methods were used by Clive Granger and Oskar Morgenstern (1963) but they came up with the same randomness result.
The concept EMH really starts with Nobel Laureate Paul Samuelson and his 1965 article, 'Proof that Properly Anticipated Prices Fluctuate Randomly'. However, it was Professor Eugene Fama with his 1970 paper 'Efficient Capital Markets' who coined the term EMH and made it operational with the foundational epithet that in efficient markets, 'prices fully reflect all available information'.

Fama persuasively made the argument that in an active market that includes many well-informed and intelligent investors, securities will be appropriately priced and reflect all available information. If a market is efficient, no information or analysis can be expected to result in outperformance of an appropriate benchmark.

An 'efficient' market is defined as a market where there are large numbers of rational, profit-maximizes actively competing, with each trying to predict future market values of individual securities, and where important current information is almost freely available to all participants. In an efficient market, competition among the many intelligent participants leads to a situation where, at any point in time, actual prices of individual securities already reflect the effects of information based both on events that have already occurred and on events which, as of now, the market expects to take place in the future. In other words, in an efficient market at any point in time the actual price of a security will be a good estimate of its intrinsic value.

There are three forms of the efficient market hypothesis

1. The "Weak" form asserts that all past market prices and data are fully reflected in securities prices. In other words, technical analysis is of no use.

2. The "Semi strong" form asserts that all publicly available information is fully reflected in securities prices. In other words, fundamental analysis is of no use.
3. The "Strong" form asserts that all information is fully reflected in securities prices. In other words, even insider information is of no use.

"A Random Walk Down Wall Street", written by Burton Malkiel in 1973, has become a classic in investment literature. Random walk theory jibes with the semi-strong efficient hypothesis in its assertion that it is impossible to outperform the market on a consistent basis. Malkiel puts both technical analysis and fundamental analysis to the test and reasons that both are largely a waste of time. In fact, he goes to great lengths to show that there is no proof to suggest that either can consistently outperform the market. Any success outperforming the market with technical analysis or fundamental analysis can be attributed to lady luck. If enough people try, some are bound to outperform the market, but most are still likely to under perform.

The basic random walk premise is that price movements are totally random. Prices have no memory, therefore past and present prices cannot be used to predict future prices (as implied in technical analysis). Prices move at random and adjust to new information as it comes available. The adjustment to this new information is so fast that it is impossible to profit from it. Furthermore, news and events are also random and trying to predict this (fundamental analysis) is a lesson in futility.

Malkiel maintains that a buy and hold strategy is best and individuals should not attempt to time (or beat) the market. Attempts based on technical, fundamental or any other analysis are futile. Admittedly, he does have a point. Statistics have shown that the majority of equity mutual funds fail to outperform the market, as measured by the S&P 500. Investors can easily buy index-based securities with very low transactions costs.
2.3 CHALLENGE TO THE EMH

While there are some good points to be gleaned from the random walk theory, it appears to be a bit dated and does not accurately reflect the investment climate.

A central challenge to the EMH is the existence of stock market anomalies: reliable, widely known and inexplicable patterns in returns. Commonly discussed anomalies include size effects, where small firms may offer higher stock returns than large ones; and calendar effects. There are also the supposed indicators of undervalued stocks used by value investors, such as low price-to-earnings ratios and high dividend yields. But while there is no doubt that anomalies occur in even the most liquid and densely populated markets, whether they can be exploited to earn superior returns in the future remains open to question. If anomalies do persist, transactions and hidden costs may prevent them being used to produce outperformance, as well as the rush of other investors trying to exploit the same anomalies. It may be possible that opportunities arise in quanta bursts and then disappear. If so, by the time we wish to measure the recurrence of an event, it has occurred and passed by, unlikely to be repeated in the same form.

2.4 PSYCHOLOGY & BEHAVIORAL FINANCE

Much of economic and financial theory is based on the notion that individuals act rationally and consider all available information in the decision-making process. However, researchers have uncovered a surprisingly large amount of evidence that this is frequently not the case. Dozens of examples of irrational behaviour and repeated errors in judgement have been documented in academic studies. Peter L. Bernstein in "Against The Gods" states that the evidence "reveals repeated patterns of irrationality, inconsistency, and incompetence in the ways human beings arrive at decisions and choices when faced with uncertainty."
A field known as "behavioural finance" has evolved that attempts to better understand and explain how emotions and cognitive errors influence investors and the decision-making process. Many researchers believe that the study of psychology and other social sciences can shed considerable light on the efficiency of financial markets as well as explain many stock market anomalies, market bubbles, and crashes. As an example, some believe that the out performance of value investing results from investor's irrational overconfidence in exciting growth companies and from the fact that investors generate pleasure and pride from owning growth stocks. Many researchers (not all) believe that these human flaws are consistent, predictable, and can be exploited for profit. As Albert Einstein noted "Only two things are infinite, the universe and human stupidity, and I'm not sure about the former."

2.5 COMMON INVESTMENT ANALYSIS TECHNIQUES

There are mainly two ways of analysing investments: fundamental analysis and technical analysis. With the former, investors try to calculate the value of an asset, asking questions like what is the present value of the likely future cash flows, and how does that compare to its current price. With the latter, they focus exclusively on the asset’s price data, asking what does it’s past price behaviour indicate about its likely future price behaviour.

2.5.1 FUNDAMENTAL ANALYSIS

Fundamental analysis is the examination of the underlying forces that affect the interests of the economy, industrial sectors and companies. As with most analysis, the goal is to derive a forecast for the future. The list of variables is quite long, but a few examples are provided. At the company level, fundamental analysis may involve the examination a company’s financial data, management, business concept and
competition. At the sector level, there might be an examination of the supply and demand forces for the products offered. For the national economy, fundamental analysis might focus on economic data to assess the present and future growth of the economy. To forecast future stock prices, fundamental analysis ties the economic, industry sector and company analysis together to derive a fair value for a stock and forecast its future value. If fair value is not equal to the current stock price, fundamental analysts believe that the stock is either over or under valued and the market price will ultimately gravitate towards fair value. Fundamentalists do not heed the advice of the random walkers and believe that markets are weak-form efficient. By believing that prices do not reflect all available information, fundamentalists look to capitalize on potential discrepancies.

**Economic Forecast**

First and foremost in a top down approach will be an overall evaluation of the general economy. When the economy expands, most sectors and companies usually benefit and grow with the economy. When the economy declines, most sectors and companies usually suffer. Although not exact, a correlation between stock prices and interest rates can be detected. Once a scenario for the overall economy has been developed, an investor can break down the economy into its various sectors.

**Sector Selection**

After a forecast of the economy, an investor might turn to an analysis of the various sectors and industry groups. If the prognosis is for an expanding economy, then some sectors are likely to benefit more than others. By utilizing a sector-by-sector approach, an investor can narrow the field to those sectors that best suit the economic situation and his or her style. If most companies are expected to benefit from an expansion, then the overall risk in stocks may be appear relatively low and an investor can venture into a more growth-oriented strategy. If the economy forecast is contraction, an
investor may opt for a more conservative strategy and seek out stable income-oriented companies.

To assess a sector’s potential, an investor might want to gauge the size of a sector’s market as well as its growth rate and importance to the economy. While the individual company is still important, its industry group is likely to exert just as much, or more, influence on the stock price. When stocks move, they usually move as groups; there are very few lone guns out there. Many times it is more important to be in the right industry than in the right stock!

Once the sector is chosen, an investor will need to narrow down the list of companies before proceeding to a more detailed analysis of each company. Investors are usually interested in finding the leaders and the innovators within a sector. The first task is to identify the current business and competitive environment within a sector as well as the future trends. How do the companies rank according to market share, product position and competitive advantage? Who is the current leader and how will the changes within the sector affect the current balance of power? What are the barriers to entry? Success depends on an edge, be it marketing, technology, market share or innovation. A comparative analysis of the competition within a sector will help identify those companies with an edge, and those most likely to keep it.

Company Selection

With a shortlist of companies, an investor should analyse resources and capabilities within each company to identify those companies that are capable of creating and maintaining a competitive advantage. The analysis should focus on selecting companies with a sensible business plan, solid management and sound financials.

Summing up

After all is said and done, an investor will be left with a handful of companies that stand out from the pack. Over the course of the analysis process, an understanding will develop
of which companies stand out as potential leaders and innovators. In addition, there will be other companies that will stand out as ones to avoid. The final step of the fundamental analysis process is to synthesize all data, analysis and understanding into actual picks.

Fundamental analysis can be valuable, but it should be approached with care. We all have personal biases and every analyst has some sort of bias. There is nothing wrong with this and the research can still be of great value. We must learn what the ratings mean and the track record of an analyst before jumping off the deep end. Corporate statements, and press releases offer good information, but should be read with a healthy degree scepticism to separate the facts from the spin. Press releases don’t happen by accident and are an important tool for companies. Investors should become skilled readers to weed out the important information and ignore the hype.

2.5.2 TECHNICAL ANALYSIS

Technical analysis is the examination of past price movements to forecast future price movements. Technical analysts are sometimes referred to as chartists because they rely almost exclusively on charts for their analysis.

Technical analysis is applicable to stocks, indices, commodities, futures or any tradable instrument where the price is influenced by the forces of supply and demand. Price refers to any combination of the open, high, low or close for a given security over a specific timeframe. The time frame can be based on intraday (tick, 5-minute, 15-minute or hourly), daily, weekly or monthly price data and last a few hours or many years. In addition, some technical analysts include volume or open interest figures with their study of price action.
The basis of Technical Analysis

Charles Dow is considered the father of technical analysis. Many of theories set out in Dow Theory form the foundation of technical analysis. The most important was Dow’s first assumption stating that the markets discount everything. This is similar to the strong and semi-strong forms of market efficiency. Technical analysts believe that the current price fully reflects all information. Because all information is already reflected in the price, this represents the fair value and should form the basis for analysis. After all, the market price reflects the sum knowledge of all participants, including traders, investors, portfolio managers, buy-side analysts, sell-side analysts, market strategist, technical analysts, fundamental analysts and many others. It would be folly to disagree with the price set by such an impressive array of people with impeccable credentials. Technical analysis utilizes the information captured by the price to interpret what the market is saying with the purpose of forming a view on the future.

Price Movements are not totally random

Most technicians agree that prices trend. However, most technicians also acknowledge that there are periods when prices do not trend. If prices were always random, it would be extremely difficult to make money using technical analysis.

A technician believes that it is possible to identify a trend, invest or trade based on the trend and make money as the trend unfolds. Because technical analysis can be applied to many different timeframes, it is possible to spot trends that are only a few minutes or a few years.

Concerned with What, not Why

Tony Plummer paraphrases Oscar Wilde in his book, The Psychology of Technical Analysis, by stating, “A technical analyst knows the price of everything, but the value of
nothing”. Technicians, as technical analysts are called, are only concerned with two things:

1. What is the current price?
2. What is the history of the price movement?

The price is the result of the battle between the forces of supply and demand for the company’s stock. The objective of analysis is to forecast the direction of the future price. By focusing on price and only price, technical analysis represents a direct approach. Fundamentalists are concerned with why the price is what it is. For technicians, the why portion of the equation is too broad and many times the fundamental reasons given are highly suspect. Technicians believe it is best to concentrate on what and never mind why. Why did the price go up? It is simple, more buyers (demand) than sellers (supply). After all, the value of any asset is only what someone is willing to pay for it. Who needs to know why?

**Overall Trend**

The first step is to identify the overall trend. This can be accomplished with trendlines, moving averages or peak/trough analysis. As long as the price remains above its uptrend line, selected moving averages or previous lows, the trend will be considered bullish.

**Support, Resistance & Momentum**

Areas of congestion or previous lows below the current price mark support levels. A break below support would be considered bearish.

Areas of congestion and previous highs above the current price mark the resistance levels. A break above resistance would be considered bullish.

Momentum is usually measured with an oscillator such as Moving Average Convergence Divergence (MACD). If MACD is trending up, above its n-day EMA (Exponential Moving Average),
then momentum will be considered bullish, or at least improving.

**Analyst Bias**

Just as with fundamental analysis, technical analysis is subjective and our personal biases can be reflected in the analysis. It is important to be aware of these biases when analyzing a chart. If the analyst is a perpetual bull, then a bullish bias will overshadow the analysis. On the other hand, if the analyst is a disgruntled eternal bear, then the analysis will probably have a bearish tilt.

**Open to Interpretation**

Furthering the bias argument is the fact that technical analysis is open to interpretation. Even though there are standards, many times two technicians will look at the same chart and paint two different scenarios or see different patterns. Both will be able to come up with logical support and resistance levels as well as key breaks to justify their position. While this can be frustrating, it should be pointed out that technical analysis is more like an art than a science, somewhat like economics. Is the cup half-empty or half-full? It is in the eye of the beholder.

**Summing up**

Technical analysts consider the market to be more psychological and less logical. Fundamental analysts consider the market to be less psychological and more logical. This may be open for debate, but whatever the case may be, there is no questioning the current price of a security. After all, it is available for all to see and nobody doubts its legitimacy. These are the forces of supply and demand at work. By examining price action to determine which force is prevailing, technical analysis focuses directly on the bottom line: What is the price? Where has it been? Where is it going?

Even though there are some universal principles and rules that can be applied, it must be remembered that technical
analysis is more an art form than a science. As an art form, it is subject to interpretation. However, it is also flexible in its approach to analysis and each investor should use only that which suits his or her style. Developing a style takes time, effort and dedication, but the rewards can be significant.

2.6 PRESENT SCENARIO

Random walk theory was popularised long ago when institutions dominated the market. These institutions had superior access to resources and the individual was at the mercy of the large brokerage houses for quality research. With the advent of online trading, power and influence are shifting from the institutions to the individual. Resources are now widely available to all at minimal cost, if not free. Not only can individuals access information, but also the Internet ensures that everyone will receive it almost instantaneously. They also have access to real time data and can trade like the professionals. With the availability of real time data and almost instant executions, individuals can act on information like never before.

As little as 5 years ago, transaction costs were high and figured into any investment or trading strategy. Again, with the advent of online trading, transaction costs have become minimal. This has increased the amount of trading volume and probably volatility. Higher volatility increases the possibility that anomalies will develop. With better trading resources and low commissions, more traders and investors are able to capitalize on potential anomalies.

For obvious reasons, the investment establishment is not thrilled about Random Walk theory. After all, investment is in the business of analysis, strategy and money management. However, it is a fact that about 75% of equity mutual funds under perform the S&P 500 year after year. Some of this underperformance can be blamed on transactions cost and management fees. With the advent of index-linked securities,
the onus will be on the money managers to figure out a way to outperform the market or lose business.

In truth, 75% of equity mutual funds underperforming is not as bad as it sounds. When Malkail introduced the Random Walk theory in 1973, around 90% of equity mutual funds underperformed the market. Since this number seems to have improved, it would appear that either stock picking is getting better or fees are getting smaller, or both. 15 years ago, the stock market and mutual funds were much more homogeneous. Even though there were tech stocks, they did not exert nearly as much influence. With the explosion of the NASDAQ, tech stocks play a much larger role in today’s market. Internet stocks, which have also come to the forefront, did not even exist 15 years ago. With an increase in specialty mutual funds catering to tech and internet, the total number of mutual funds has proliferated over the last few years. With the increase in mutual funds has also come and increase in the diversity of such funds. There are funds for almost every sector, industry or index imaginable and investors have a wide array of choices. The more homogeneous mutual funds there are, the less chance there is to outperform. However, this specialization has created possibility to outperform benchmarked Index.

History has proven that a buy and hold strategy outperforms most attempts to time the market in absolute returns. In risk-adjusted returns, the argument loses some of its credibility. Buy and hold may take the guesswork out of beating the market, but it does little to compensate for the risk associated with a continuous investment in the market. There is a direct correlation with risk and return: the higher the expected return, the higher the associated risk. A portfolio with a timing strategy that seeks to move into risk-free treasuries when a bear market is signaled (Dow Theory for example), significantly reduces the amount of risk associated with that portfolio.

In a 1992 study by William Brock, Josef Lakonishok, and Blake LeBaron (BLL), the authors analyzed moving averages and
trading range breaks on the Dow Jones Industrial Index from 1897 to 1985. The trading rules addressed in the study were the following.

1. **Moving Averages.** Buy and sell signals were generated by a long and short moving average crossing. They tested long moving averages of 50, 150 and 200 days with short averages of 1, 2 and 5 days. The results - "All the buy-sell differences are positive and the t-tests for these differences are highly significant..."

2. **Trading Range Break (Support and Resistance).** A buy signal was generated when the price penetrated the resistance level and a sell signal was generated when the price penetrated the support level. Technical analysts believe that investors sell at the resistance level and buy at the support level. They tested support and resistance based on past 50, 150 and 200 days with signals generated when a maximum or minimum was violated by 1% and computed 10-day holding period returns following the buy and sell signals. The results for both buy and sell signals supported the technical viewpoint.

The authors concluded:

- "Our results are consistent with technical rules having predictive power. However, transactions costs should be carefully considered before such strategies can be implemented."

- "In sum, this paper shows that the returns-generating process of stocks is probably more complicated than suggested by the various studies using linear models. It is quite possible that technical rules pick some of the hidden patterns. We would like to emphasize that our analysis focuses on the simplest trading rules."

- Contrary to previous tests, they found that both types of rule work quite well. The previous conclusion that technical analysis is useless was, "premature".
In another study by Stephen Brown, William Goetzmann and Alok Kumar, the Dow theory system was tested against buy-and-hold for the period from 1929 to Sept-98. Over the 70-year period, the Dow theory system outperformed a buy-and-hold strategy by about 2% per year. In addition, the portfolio carried significantly less risk. If compared as risk-adjusted returns, the margin of outperformance would even be greater. Over the past 18 years, the Dow theory system has underperformed the market by about 2.6% per year. However, when adjusted for risk, the Dow theory system outperformed buy-and-hold over the past 18 years.

There is another school of thought that considers the markets efficient yet predictable. One of the leading proponents is Andrew Lo. Lo and Mackinlay's book A Non-Random Walk Down Wall Street debunks many of the theories put forth in the 1973 classic of Burton Malkiel "A Random Walk Down Wall Street". Lo's research concluded the following:

It is not only plausible that market is efficient, but participants can also profit from efficient markets. However, Lo asserts that even though it is possible to outperform the markets, it requires ongoing research, continuous improvement and constant innovation. Beating the market does not come easy, nor is it something that is easy to maintain. Lo likens the pursuit of above-average returns to that of a company trying to maintain its competitive advantage. After introducing a hot new product, a company cannot just sit back and wait for the money to roll in. In order to remain above the competition, management must be flexible and look for ways to continuously improve and innovate. Otherwise, the competition will overtake them. Money managers, traders and investors who find ways to outperform the market must also remain flexible and innovative. Just because a method works today, does not mean it will work tomorrow. In an interview with Technical Analysis of Stocks and Commodities, Lo sums it up by stating:
"The more creativity we bring to the investment process, the more rewarding it will be. The only way to maintain ongoing success, however, is to constantly innovate. That's much the same in all endeavours. The only way to continue making money, to continue growing and keeping the profit margins healthy, is to constantly come up with new ideas."

Although a vast amount of empirical literature exists on these issues, the findings are generally inconclusive/contradictory. The paradox of efficient markets is that if every investor believed a market was efficient, then the market would not be efficient because no one would analyze securities. In effect, efficient markets depend on market participants who believe the market is inefficient and trade securities in an attempt to outperform the market.

In 1990s, with the easier accessibility to financial data banks and greater computer power, a thorough demonstration of the benefits of trading rules and consequently the possibility of forecasting financial asset returns were studied by many researchers. There has been a growing recognition that the introduction of nonlinearities in the modelling approach could allow one to explain certain price moves that seemed previously random. At the same time, it enabled the testing of new category of models, and particularly non-linear models, to explore the microstructure of financial markets.

Today's financial markets are characterised by a large number of participants, with a different appetite for risk, a different time horizon, different motivations and reactions to unexpected news. It seems therefore unlikely that all these complex interactions could average out in a linear fashion. To model nonlinearity the researchers started using complex techniques like Genetic Algorithms, Fuzzy Logic, Neural Networks, etc. Various performance figures are being quoted to support the usefulness of these new techniques but rarely a comprehensive investigation is available capturing the relationship between asset prices and their determinants.