CHAPTER 2

Conceptual Frame Work of Efficient Market Hypothesis

2.1 Introduction

The efficient market is an important part of modern finance. Even though the empirical results on EMH are mixed, the concept is very sound. It is widely applied in capital markets. The capital market efficiency is associated with cost efficiency, allocative efficiency and information efficiency. The concept of EMH reflects informational efficiency. The theory states that market reflects all information and the prices of security rapidly adjust to the new information may it be historical information, publicly available information or private information. It denies abnormal profits to the traders on the basis of new informational flow. The informational efficiency is a measure of how quickly and accurately the market reacts to new information. Jules Regnault, a French broker demonstrated for the first time the randomness in the security prices in the year 1863. ¹Thereafter, Louis Bachelier, a French mathematician, also presented related work for Ph.D in 1900 as “The Theory of Speculation”. Further, Alfred Cowles in the year 1937 suggested that the professional investors fail to outperform the market. These empirical works were ignored until 1950s. Paul Samuelson took the initiative to circulate Bachelier's work among economists. In 1964 the above quoted works were published as an anthology edited by Paul Cootner. The EMH emerged as a prominent theory in the mid-1960s. In the year 1965, Eugene Fama developed EMH as academic concept and argued for RWH in his dissertation. Samuelson supported EMH and published a proof showing that if the market is efficient,

prices will show random-walk behavior. Eugene Fama published the theory and empirical work related to RWH in the year 1970. Though the market efficiency initially appeared in the beginning of 19th century, Eugene Fama developed the proper theory and called it EMH. Based on the availability of the information, Fama (1965, 1970) classified EMH into weak-form market efficiency, semi-strong form market efficiency and strong form market efficiency.

2.2 Perfect Capital Market

A perfect capital market asserts that the security prices are priced with total efficiency and there is no possibility of arbitrage. Dyckman and Morse (1986) define perfect capital market as: "A securities market is generally defined as informationally efficient if the prices of the securities traded in the market act as though they fully reflect all currently available information and these prices react instantaneously, and in an unbiased fashion to new information." In perfect capital market case, assuming complete markets, perfect rationality of agents and under full information, the equilibrium occurs where the interest rates clear the market, with the supply of funds equal to the demand. This type of equilibrium is called Arrow-Debreu equilibrium. The main difficulty arises with the terms “fully reflect”, ‘available information’ and ‘unbiased manner’ as the actual prices of the securities behave under ideal market conditions. The perfect capital market states that the market or an economy is entirely efficient if it includes equal access to information by all market participants, completely rational economic participants, and no transaction costs. In real world, the perfect market assumptions are hardly true. The basic assumptions of perfect capital market are:

2 http://en.wikipedia.org/wiki/Capital_market_imperfections
1) Perfect competition: All economic agents behave as if they have no market power over prices.

2) Frictionless markets: There are no transaction costs or restrictions on trade. In addition, all assets are perfectly divisible.

3) Homogeneous beliefs: All economic agents have homogeneous prior belief and receive same information function.

4) Individual rationality: All economic agents are rational expectations utility maximizers

The perfect market model is equated as

\[ f_m (p_{t+1}|\Omega_{rm}) = f(p_{t+1}|\Omega_t) \]

Where

\( \Omega_{rm} \) = information set actually used by the market at time \( t \)

\( \Omega_t \) = all relevant information set available at time \( t \)

\( f_m(.) \) = true joint probability of the price vector \( P_{t+1} \) implied by \( F_t \)

\( f(.) \) = joint probability of the price vector \( P_{t+1} \) as assessed by the market

The implications of the perfect capital market is that 1) there are a large number of utility-maximizing agents who participate in the markets independently of each other, 2) all economic agents quickly adjust prices to reflect new information sets upon their arrivals and 3) new information set arrives at the markets at random and independently of any other information sets. The market is said to be informationally efficient if market prices are identical to those prices that would rule in perfect capital markets in which the information under consideration is received by all individuals. By using the above perfect capital markets’ conditions, the analysis of the behavior of prices is relatively straightforward.
But, practically the capital markets are imperfect and the main feature of financial market is that it leads to information asymmetry. Lack of information occurs since the lenders do not have information about the type of borrowers as in real world there are many types which can be categorized as good and bad type of borrowers. The other type of asymmetric information is the moral hazard which arises from the lack of information about the ex-post behavior of the borrower. Another important characteristic that results in imperfection is that the exchange does not happen simultaneously in capital markets.

2.3 Classification of EMH

Fama (165, 1970) formally developed EMH theory and argued that market is informationally efficient and there is no further scope for abnormal profits as prices adjust to the new information rapidly. Further, based on the type of information, EMH is classified as weak-form efficiency, semi-strong form efficiency and strong-form efficiency. All the three forms of EMH explain the relationship between the security prices and various levels of information. The vast amount of literature on EMH preceded the formal development of adequate theoretical statement of information efficiency.

2.3.1 Random Walk Hypothesis (RWH)

RWH is referred to as weak form of market efficiency. It states that it is not possible to predict the futures prices based on past price history. Current prices already includes any information contained in the past price series. Bachelier (1900) uses statistical methods to analyze gambling and later applies them to analyze returns on stocks, bonds, futures, and options. He also recognizes that the Weiner process is the Brownian motion. Osborne (1959), in his paper ‘Brownian Motion in the Stock Market’ found that stock price follows a random walk when
he develops its assumptions using the Brownian motion which is equivalent to the movement of a particle in a fluid. Cootner (1964) edits a volume called “The Random Character of Stock Market Prices” which has become the basis of EMH. The basic assumptions of RWH are:

- Stochasticity: Price moves minimally and independently, and is identically distributed.
- Finite Variance: Volume and variance are finite and not important.
- Price-Value Correlation: Price is related to its fundamental value.
- Unconditional Expectations: Expected return is a time-invariant probability weighted average.
- General Equilibrium: Price equilibrium is obtained when traders mutually agree to trade.
- Informational Efficiency: Traders trade at equilibrium price based on available information.
- Normality: Distribution of price changes is normal with stable mean and finite variance.

The mathematical model of RWH is

\[ f_{(r_{j,t+1} | \mathcal{F}_t)} = f(r_{j,t+1}) \]

Where:

\[ \mathcal{F}_t \] = information set containing historical price series available at time t

\( (r_{j,t+1}) \) = return on security j at time t+1

The implication of RWH is that the information set of price series is important but the sequence on or the pattern of that information is not important for determining the security returns. The price series and patterns will be detected
and eliminated by all traders until it becomes impossible to predict the future course of the series by analyzing its past behavior. The current security prices already reflect all past price series and are themselves the fully revealing market information set or sufficient statistic which can be observed by all traders, both informed and uninformed. The weak form of market efficiency suggests that the current security prices absorb the information in the past prices, and therefore, no one can predict the future price direction based on historical information. Further, it states that charts are of no use in predicting future stock prices because everyone has access to past price information, although some people can get the information in fraction of seconds.

2.3.2 Semi-Strong Form of EMH

Semi-strong form market efficiency states that security prices adjust rapidly to the publicly available information and thereby it denies abnormal profits. The semi-strong form takes the information set a step further and includes all publically available information. In addition to the past prices, the other news such as economic reports, stock split, earnings news, dividend declaration, world news etc. are used to analyse the stock price response. The past studies have investigated the extent to which people can profit by responding on various corporate announcements. There are mixed evidences. Buttom Malkiel wrote “A Random Walk Down Wall Street” and provided the evidences that professionally managed portfolios are beaten the market.

If the markets are efficient in semi-strong form, then an analysis of balance sheet, income statements, corporate announcements and any other publicly available information about a company will not yield any abnormal economic
profits. For example, Ball and Brown (1968) test the semi-strong form EMH by studying the equation used to forecast EPS of each of 261 firms over the period. The forecast was based on the average trend in earnings in the past plus a deviation from this trend caused by the cycle of average corporate profitability for all other stocks. This forecast was then subtracted from the actual earnings reported at the end of the year. Firms with reported EPS greater than the forecast were placed in one group, while those reporting less than forecast were placed in another group. If stock price responds rationally to public information, the study expects the stocks of firms reporting unexpectedly high EPS to show above-average returns, and vice versa. They found that most of the good or bad information contained in earnings reports already anticipated by the market. It was concluded that most of the information contained in earnings reports had already been quite accurately estimated on the basis of fundamental data and that the market adjusts very quickly to reflect new information in the price after receiving it. Thus, market appears to be informationally efficient in the semi-strong form sense, so that abnormal returns cannot simply be made by security analysis net of costs.  

The semi-strong form of the EMH raises serious questions about analysts’ ability to develop useful earnings forecasts. Specifically, this form of the hypothesis holds that analysis of any publicly available information is pointless because all such information is already reflected in stock prices.

2.3.3 Strong Form of EMH

Strong form of EMH says that security prices fully reflect all relevant public and private information. It is the most extreme level of EMH. According to the strong form EMH, even corporate insiders cannot make abnormal profits by

4http://www.cob.unt.edu/firel/Kensinge/Fina5170/Selected%20Readings/MktEfficiency.pdf
exploiting inside information about their company. It is the most satisfying and compelling form of EMH in a theoretical sense, but it suffers from one big drawback in practice. It is difficult to confirm empirically because the empirical evidences fail to support strong-form of market efficiency. Insiders definitely make a profit trading on their knowledge. The insider information gives an unfair advantage that can be used to extract the profits from trading even though, the insider trading is illegal. The exchange specialists can achieve above average returns with this specific order information which they have. The equity analysts always beat the market with their specific portfolio management skills. The Institutional money managers who work for mutual funds, pensions and other types of institutional accounts found earning above the average returns. Management insiders have additional insight into their company’s future and there is evidence that stock exchange specialist cause abnormal patterns of fractional price movements. Fama (1965, 1970, and 1991) categorized the empirical approaches to test markets efficiency differently using his proposed three forms of EMH as guidelines:

1) Tests of Returns Predictability: This group is used to test the weak-form EMH which consists of the tests of independence, tests of trading rules, tests of contrarian strategies, and cross-sectional and time-serial tests of capital asset pricing models.

2) Event Studies: Semi-strong-form EMH is tested under the event studies to see how security prices and returns adjust to the arrivals of public information related to the specific firms’ past earnings performance and the general economic, political, and social conditions and other corporate events.
3) *Tests of Private Information*: The tests in this group are applicable to the strong-form EMH whether investors' possession of private information which is not reflected in security prices can result in abnormal returns.

The empirical evidences are mixed suggesting that capital markets are not informationally efficient in the long run. New information sets that are not yet reflected in stock prices have tremendous opportunities to beat the market.

### 2.4 Implications of EMH

Early evidence on the EMH was quite favorable but, in recent years, especially in modern finance, the deeper analysis of the evidence suggests that the hypothesis may not always be entirely correct.⁵

- A popular technique used to predict stock prices is technical analysis which studies the past stock price data and search for patterns such as trends and regular cycles. Rules for when to buy and sell stocks are then established on the basis of the patterns that emerge. The EMH suggests that technical analysis is a waste of time. The simplest way to understand the use of the random-walk result derived from the EMH that holds that past stock price data cannot help predict changes. Therefore, technical analysis, which relies on such data to produce its forecasts cannot successfully predict changes in stock prices.

- If semi-strong efficiency is true it undermines the work of fundamental analysts whose trading rules cannot be applied to produce abnormal returns because all publicly available information is already reflected in the share price. An analysis of balance sheets, income statements, product line, income statements, product line, etc., does not help.

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announcements of dividend changes or stock splits, or any other public information about a company will not yield abnormal profits.

- A portfolio manager's goal is to outperform a specific benchmark with specific investment ideas. EMH implies that this goal is unachievable. A portfolio manager will not be able to achieve above average returns.
- An investor should thus focus on the minimizing his costs to invest. To achieve a market rate of return, diversification in a numerous amounts of stocks is required, which may not be an option for a smaller investor. As such, an index fund would be the most appropriate investment vehicle, allowing the investor to achieve the market rate of return in a cost effective manner.

2.5 Problems with the EMH

There are many arguments which have been used to question the validity of EMH over decades. Many focus on market anomalies such as the January effect where the price of small-cap stocks will rise abnormally during the first few days of trading in a new year or the existence of long-term successful investors such as Warren Buffet or George Soros, but there are far more anomalous prima-facie problematic at a theoretical level.

2.5.1 Information Asymmetry

One of the assumptions of EMH is that all the market participants have the access to new information and security prices adjust rapidly to the new information flow. But practically, good information is expensive to generate. Empirical studies show that good information tends to be collected by investors and disseminating misinformation by one investor to other investors. Patell & Wolfson (1984)

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suggest that news is incorporated into price within ten minutes despite substantial disparities in investor access to information. The real problem is how the market is able to adjust its prices so accurately and so quickly when there is an information asymmetry.

2.5.2 Investors are not rational

EMH is based on the belief that individuals behave in a rational manner and that all existing information is embedded in the investment process. The investors don’t always behave rationally. The markets undergo fashionable trends, certain industries or stocks will become fads, leading to investor over-confidence or under confidence leading to market bubbles and crashes. It is always difficult to try and make an exact science where human behaviour is involved. The main question is how a market can be efficient when investors make irrational decisions.

2.5.3 Stock market crashes

The theory assumes that all traders in the market have adequate information and all future expectations are precise. The financial crises are the clear examples of shares being over valued by traders and therefore market crash. Over-estimation of the market leads people to take unnecessary risks and they lose the battle.

2.6 Market Anomalies

EMH became controversial especially after the detection of certain anomalies in the capital markets. Some of the main anomalies that have been identified are as follows:\(^7\):

2.6.1 The January Effect

In January, stock returns are inexplicably high and small firms’ stocks do better than large firms’ stock. For the first time, Rozeff and Kinney (1976) found

\(^7\)http://www.er.ethz.ch/teaching/EFFICIENT_MARKET_HYPOTHESIS_Russel-Torbey.pdf accessed on 10/9/2014
higher mean returns in January as compared to other months. They used NYSE stocks for the period 1904-1974 and found that the average return for the month of January was 3.48 percent as compared to only 0.42 percent for the other months. Thereafter, the same evidences are found in Bhardwaj and Brooks (1992) for 1977-1986 and Eleswarapu and Reinganum (1993) for 1961-1990. Numerous studies have shown positive evidence that stock returns are high in January month.

2.6.2 Day of the week Effect

Mondays are historically bad days for the stock market. Wednesdays and Fridays are historically good. Tuesdays and Thursdays have mixed responses. In EMH, this should not happen since the market absorbs all the available information. Researchers discovered the day of the effect in the early 1980s and even today the empirical evidences support this anomaly. A large number of studies have documented the day-of-the-week effect. One of these anomalies is the Monday seasonal effect, French (1980), Gibbons and Hess (1981), Lakonishok and Levi (1982), Gultekin and Gultekin (1983), Smirlock and Starks (1986), Lakonishok and Smidt (1988), Kim (1988), Jaffe et al. (1989), Solnik and Basquest (1990), Dubois and Louvet (1996) Wang, et al. (1997) and Kamara (1997) found that the asset returns are lower or negative on Mondays relative to other days of the week.

2.6.3 Turn-of-the-Calendar Effect

This type of anomaly states that the markets performance is good in the beginning and the end of the month. A large amount of literature shows that a substantial return comes from the last trading day of the month and the first few days of the following month. For the rest of the month, the ups and downs almost break even.
2.6.4 Small Firm Effect

The small firms with low market capitalization tend to outperform larger companies and this is referred to as small firm effect. This market anomaly is a factor used to explain superior returns in the Three Factor Model, created by Gene Fama and Kenneth French. The three factors being the market return, apply to companies with high book-to-market values, and small stock capitalization. The main reason for the small-firm effect is the fact that small firms have more room to grow than large firms do. The small firm effect may be explained by the fact that these firms are riskier and, therefore, have higher returns. Additionally, small firms have lower stock prices and, thus, what would be a small price appreciation for a large firm can, in fact, be huge for a small firm.

2.6.5 P/E Ratio Effect

This market anomaly states that the low price-earnings ratios tend to perform better than stocks with high price-earnings ratios. The low price-earnings ratio effect occurs because stocks with low price-earnings ratios are often undervalued and their prices eventually rise. The P/E ratios are indicators of the investment performance of a security and low P/E stocks have a tendency to outperform high P/E stocks even after adjusting for underlying risks.

2.6.6 Neglected Stocks

It is a market anomaly which states that neglected stocks are also tend to outperform the broad market averages. The neglected-firm effect occurs on stocks that are less liquid (lower trading volume) and tend to have minimal analyst support. The idea here is that as these companies are identified by the investors, the stocks will outperform. The neglected firm effect suggests that the lesser-known companies are able to generate higher returns on their stock shares, because they
are less likely to be analyzed and scrutinized by market analysts. The smaller firms might also exhibit better performance, because of the higher risk/higher reward potential of small, lesser-known stocks, with a higher relative growth percentage.

2.6.7 Announcements and Anomalies

The announcement of information regarding stock splits, earnings, mergers and acquisitions etc. are used to see the stock market performance. The empirical studies show that market uses announcements anomalies to generate excess profits. The stock splits increase the number of shares outstanding and decrease the value of each outstanding share, with a net effect of zero on company's market capitalization. However, before and after a company announces a stock split, the stock price normally rises. The increase in price is known as the stock split effect. The stock splits are often viewed by investors as a signal that the company's stock will continue to rise. Empirical evidence (Ikenberry et al. (1996), Fama (1997) and Desai and Jain (1997)) suggests that the signal is correct. Further, a short-term price drift is observed after announcement. Stock prices react and often continue to move in similar direction. If a positive earnings surprise is announced, the stock price may immediately move higher. Short-term price drift occurs when stock price movements related to the announcement continue long after the announcement. When companies announce a merger or acquisition, the value of the company being acquired tends to rise while the value of the bidding firm tends to fall. Merger arbitrage plays on potential mispricing after the announcement of a merger or acquisition. The bid submitted for an acquisition may not be an accurate reflection of the target firm's intrinsic value; this represents the market anomaly that arbitrageurs aim to exploit. Arbitrageurs

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aim to take advantage of the pattern that bidders usually offer premium rates to purchase target firms.

### 2.6.8 Holiday effect

The tendency for a stock market to gain on the day before a holiday is known as Holiday effect. The holiday effect can be beneficial for traders, who may buy a security in the days leading up to the last trading day and then sell for a higher price on the final day. The unusually good performance of stocks on the day prior to market-closing holiday is observed in the empirical work. Historically, stock prices have advanced disproportionately higher as a percent on pre-holiday trading days than on other days of the year.

Anomalies reflect inefficiency within markets. It is obvious that some kind of seasonal anomalies are persistent in the markets of both advanced and emerging countries. Despite the use of sophisticated information technology and after introducing reforms, the securities markets are not fully efficient. The presence of anomalies indicates stock market inefficiency. Some anomalies occur once and disappear, while others occur repeatedly. History is no predictor of future performance, and therefore, we cannot expect every Monday to be tragic and every January to be great, but there will also be days that will "prove" these anomalies true.