

Market Microstructure: Rationality as Defined by the Economic Maxims and Rationality as Defined by Fama, Efficient Market Hypotheses and Opportunity to Beat Share Markets

Liza Marwati binti Mohd Yusoff
Department of Finance and Banking
Faculty of Business and Accountancy
University Malaya
50603 Kuala Lumpur

Tel: 603-0192665693 E-mail: marwati@pkrisc.cc.ukm.my

Abstract

This paper reviews the theory of market microstructure rigorously with the objective to relate it to the rationality as defined by the economic maxims and as defined by Fama, efficient market hypotheses and to infer what the theory has to say about the opportunity to beat the stock markets. It was found that the concept of rationality as defined by the economic maxims is inherent in dealer's optimization problem, multiple provider of liquidity and the information based model. While the concept of rationality as defined by Fama is embedded in the later development in information based model that considers private information as another source of risk for non informed investors. Efficient market hypotheses is linked to the dealer's optimization problem and information based model.

Keywords: Market microstructure, Inventory based model, Information based model, Rationality and Abnormal Return.

1. Introduction

The approach taken in writing this paper is to deliver an aerial view of the market microstructure theory without losing sight of its developments. Nevertheless, to commensurate with the title of this paper, the theory was reviewed to attain the following four objectives:

- (1) To examine whether the concept of rationality as defined by the economic maxims (Marschak, 1950) is embedded in the market microstructure theory or not.
- (2) To examine whether the concept of rationality as defined by Fama (1965) is presence in the market microstructure theory is not.
- (3) To examine whether the concept of the Efficient Market Hypothesis theory of Fama (1965, 1970, 1991) exists in the market microstructure theory or not.
- (4) To infer what the theory says regarding the opportunity to beat share market consistently.

At the end of this article, it is believed that better understanding of the followings would be achieved.

- (1) Definition of the market microstructure theory
- (2) The dimensions in trading mechanism
- (3) The basic models in the market microstructure theory
- (4) The paradigms in the base models
- (5) The development of the theory

2. Market microstructure theory and trading mechanism

Microstructure theory focuses on how specific trading mechanisms affect the price formation process (O'Hara, 1995). According to this theory, there are four dimensions in trading mechanism. The four dimensions are players, place where the trading occurs, rules and the operation of a specific mechanism. Players encompass, first, customers who submit orders to buy or sell. Second, brokers who transmit orders not for themselves but for customers. Third, there are dealers who do trade for their own account. In some markets, dealers also facilitate customer orders and so are often known as broker/dealers. Fourth, there are specialists, or market makers that quote prices to buy or sell the asset. Since the market maker generally takes a position in the security while

waiting for an offsetting order to arrive, the market maker also has a dealer function. As for the second dimension of trading mechanism, for share markets, the most common place where trading occurs is the stock exchange. The rules which is the third dimension of trading mechanism dictates what can be traded, who can trade, when and how orders can be submitted, who may see or handle the order, how orders are processed and how price are set. Whereas, there are different operations for different mechanisms, which means the fourth dimension that is the operation of specific mechanisms varies across nations. Thus, the literatures on microstructure theory basically look at how the components of the dimensions mentioned earlier affect the stock price. This microeconomic perspective was gain by the advocate of microstructure theory after being inspired by a research done by Demsetz (1968) who says trading incurs explicit cost from charge levied by a particular market and implicit cost from 'price of immediacy' that occurs because there exist two categories of buyers and sellers. The first categories is immediate buyers and sellers who are willing to trade immediately and the second categories is non immediate buyers and sellers who want to trade but not at the given time, t . The implication is that if number of immediate buyers differ from immediate seller at the given time, t , then either the immediate buyers (sellers) have to wait for non immediate seller (buyers) to arrive, or the immediate buyer (seller) can offer higher (lower) price to induce the non immediate seller (buyer) to trade at the given time, t . Since the spread that is the price concession depends on the numbers of traders, volume could affect the price of immediacy and thus the market price. His work proposes that the behavior of market which governs the behavior of price could be understood by examining the structure and organization of the market, which becomes the central issue in microstructure theory. It was later noticed that similar idea to the research done by Demsetz (1968) had been earlier proposed by Williams (1938) who emphasized that the market price is determined by the marginal opinion. He says:

"Always some would-be buyer will be excluded from ownership because to them the price will seem more than expected dividends can justify. These buyers will stand with cash in hand, waiting for some present owner to change his mind and sell out to them at their price. If this happens, then the quotation will fall to their figure, but if they change their own minds, then the price will rise to whatever they must bid to dislodge stock from the least optimistic present owner."

(pg. 12)

He then concluded that the bid and asked prices reflect the least optimistic owner and the most optimistic non owner respectively.

Market microstructure theory is encompassed of two basics model that is inventory based model and information based model (Dominguez, 1999). Each of the theories is discussed in section 2.1 and section 2.2 respectively. Inventory based model is further divided into another three research paradigms or models which are order arrival and market making, dealer's optimization problem and multiple provider of liquidity. The affiliation of the market microstructure to the rationality as defined by the economic maxims could be seen from the dealer's optimization problem, multiple provider of liquidity and the information based model. While the affiliation to the rationality as defined by Fama (1965) could be seen from the later development in information based model that considers private information as another source of risk for non informed investors that they include as additional risk premium in their required rate of return. Efficient market hypotheses, on the other hand, could be linked to the dealer's optimization problem and information based model. The opportunity to beat share market consistently could also be inferred from the inventory based model.

2.1 Inventory based model

Inventory based model is concerned with the way the nature of order flow and the market-clearing protocol affect the behaviour of price. The inventory model examines the problem faced by the market maker and/or dealer when orders to buy or sell are not always balanced in the selected time period which produce risk or cost for the market maker and/or dealer that require them to take certain actions that later influence their bid ask spread.

2.1.1 The three paradigms in the inventory based model

The assumptions that are shared by all the three paradigms are investors trade for liquidity, and the investors' utilities and risk preference are left unspecified. The term 'trade for liquidity' is however clearly spelled out by Stoll (2003) who shows the term means the traders trade to smooth consumption or to adjust the risk-return profiles of their portfolios. They buy shares if they have excess cash or have become more risk tolerant, and they sell shares if they need cash or have become less risk tolerant.

The first paradigm or model is known as order arrival and market making looks at how nature of order flow determines security prices set by the market maker. The initial effort was set up by Garman (1976) who assumes that the market maker is a monopolist whose roles is to only provides liquidity that is the market maker takes a purely non speculative position or in short, it could be said that the market maker is a risk neutral monopolists in a

world that information asymmetric does not exist. The market maker also is assumed not to be permitted to borrow either shares to bail him out when order of buy require him to sell number of shares more than what he has in his inventory, or money to bail him out when order of sell require him to buy value of shares that is more than the cash he has in his hand, and has never been exposed to the idea of buffering in inventory. Therefore, the uncertainty that is inherent in the order arrival exposed the market maker to the chances of being a failure or bankruptcy that happen when market maker runs out of money to buy shares or runs out of stock to sell. To avoid a sure probability of failure or bankruptcy that is equal to one, the market maker will set a lower price (pay less) when buying shares and set a higher price when selling shares (sell less) to prevent depleting the shares to zero while increasing the cash inventory. These act of the market makers lead to a positive gap between the bid and ask spreads. However, since the market maker is assumed as risk neutral, the gap between the bid and ask price or size of the spread remain constant. Nevertheless, according to Amihud & Mandelson (1980), another assumption in Garman (1976) that says the market maker is allow to set prices only at the beginning of trading is quite unrealistic since in actual market settings prices continually evolve. Hence, a more realistic approach is to relate the changes in dealer's prices to the changes that happen over time in his inventory position. However, they specified that the market maker is exposed to the idea of buffering in inventory which have two implications. First, the market maker will have his own preferred inventory position. Second, the preferred inventory position implies that the inventory position of the market maker is bounded above and below that eliminates the failure or bankruptcy issue. They figured out that the optimal bid and ask prices are monotone decreasing functions of the dealer's inventory position which simply means even though the gap between the bid and ask price or size of spread remain constant, the placement of the spread could change. The explanation is when the dealer's inventory increases (decreases), he will create situation that deter (encourage) sell order that he must fulfill by the act of buying by decreasing (increasing) the bid price but at the same time he encourages (deters) buy order that he must fulfill by the act of selling by decreasing (increasing) the ask price by the same amount.

In the second paradigm or model that is dealer's optimization problem, the risks that the market maker or dealer face is defined in a lot detail compared to the first model. A formal analysis of this dimension of the dealer's problem in one period (two dates) model was undertaken by Stoll (1978) who states that market maker or dealer is a trader who is willing to alter his own portfolio away from desired holdings to fulfill the trading desires of other traders. Hence, unlike the first model, the market maker or dealer share the same risk adverse characteristics inherent in traders, which means the differences between the bid and ask price (size of spread) should no longer be constant to compensate them for taking risk. The market maker or dealer is also free to borrow or lend at risk free rate. The last sentence becomes the basis for Stoll (1978) to state that the market maker's risk of bankruptcy is zero. Nonetheless, similar to the order arrival and market making model, he still assume the market maker or dealer is a monopolist but he added another important assumption that is the market maker has a fix belief about the intrinsic value of the asset. In his model, he considers a two-date (one period) model in which the expected utility of terminal wealth is maximized by the market maker. It is this objective of market maker that requires the rationality as defined by the economic maxims to be upheld. His main point is that the risk-bearing abilities of the monopolist market maker or dealer will influence the size of spreads set by the market maker or dealer. Hence, the difference in the size of spread between markets is due to the difference in the risk-bearing abilities of the market makers or dealers. Even so, his work does not explain how phenomena like differences in size of spreads during the same trading day in the same share. According to him, the risk-bearing abilities is first influenced by the dealer's wealth with greater initial wealth increase the risk bearing abilities and hence reduce the price (size of spread) charged by them and the risk preferences where greater risk aversion reduce the risk bearing abilities and thus increase the price (size of spread) charged by them. Then he said that the risk faced by the market maker, which has inverse relationship with the risk bearing abilities, is first depends on the transaction size; the larger the transaction size, the more it will moves away from the market maker or dealer preference level translating into higher price (size of spread) charge by the market maker or dealer. Second, the characteristics of the share measured by its variance and correlation with other securities also affect the risk faced by the market maker or dealer and thus is translated in the price (size of spread) charge by the market maker or dealer. From his acknowledgment that variance and correlation are the proper measurement of risk for security, which is the brainchild of Markowitz (1952, 1959), it could be implies that the theory of efficient market hypotheses which provide the theory to support that price changes are random which is required to validate the usage of variance and correlation in measuring risk of security, must also be upheld in this model. Lastly, the risk faced by the market maker or dealer also arise from trading with individuals who know more about the share than the dealer, which mean unlike the order arrival and market making model, the asymmetric information exists. To overcome the weakness of this study that use a single period model, Ho & Stoll (1981) employs a finite horizon (T period) dynamic programming approach to characterize the dealer's optimal pricing theory. This time horizon enables them to explain how the size of spread that to them

represent both the risk neutral and the risk adjustment elements is determined by the market maker or dealer. It is in this research that, at last, what determines the risk neutral spread is mentioned. According to them, this risk neutral spread depends on the slopes (or elasticities) of the supply and demand curves, in which greater elasticity reduce the size of risk neutral spread. As for the risk adjustment, it depends on the time horizon, longer time horizon expose the market maker or dealer to higher risk associated with bearing inventory and portfolio risk which lead to increment in the spread size. However, this research has few restriction like the order placed are all market orders, the inventory is liquidated at some known point in the future which means the dealer's prices will exhibit deterministic trend since spreads would be largest in the morning and would narrow steadily throughout the day, there is a fixed true price where intrinsic value is used for the share, and the last restriction is that the order arrival is assumed to possess Poisson distribution that preclude the possibility that some traders know more about the future movement of price which means this model disregards the existence of informed and non informed trader. These restrictions are relaxed by O'Hara and Oldfield (1986) in their research that involve a discrete-time multiperiod framework that differ from Amihud & Mandelson (1980) and Ho & Stoll (1981) who use continuous-time multi period framework. The implication of their model is that the market maker faces a series of mini-auctions during the day, rather than a stream of transactions. As the number of trading rounds becomes arbitrarily large, the trading process approximates that of a continuous double action. In a continuous double auction, securities can be bought or sold at any time during the day, not necessarily at designated periods as in a straight forward auction. At each auction, markets are cleared, prices and inventory levels change, and at the end of the trading day, excess inventory must be liquidated or stored overnight at cost. Bid and ask prices are set so as to maximize the present expected value of trading revenue less inventory storage costs over an infinite horizon of trading days.

Multiple provider of liquidity is the third paradigm or model under the inventory based model that do not share the common belief that the dealer is the sole provider of liquidity in the market held by all the models mentioned before. Cohen, Maier, Schwartz & Whitcomb (1981) say that there is another channel for liquidity to arise besides being provided by the market maker; the limit order. A limit order specifies a price and a quantity at which a trade is to transact. Specifically, limit orders specify a price to sell (buy) above (below) the current bid (ask) price and await the movement of prices to become active. Thus, when the market is rising, the upward price movement triggers limit orders to sell while when the market is falling, the downward movement triggers limit orders to buy which clearly describe not only how limit order provide liquidity to the market but also if the probability for the limit orders to be executed over the next trading period is one, then it would be better for the trader to use the limit order since it provides better price to the traders. Unfortunately, according to them, even though the market bid or ask price depends on the last previous market bid or ask and hence is a Markov process, the probability is always less than one since there is a jump in the change of market order price due to the existence of transaction cost that prohibit traders to trade continuously. Hence, traders will submit limit order when the size of the spread is large which shows that there is a large gap between the volume of shares the market maker has and the volume of market order placed. It is this limit orders by the traders that provide liquidity which will move the disparity between the volume of shares the market maker has and the volume of market order placed to become closer and eventually reduce the size of the spread. When the size of the spread is small, traders will submit market order since it is guaranteed to be executed and this create demand for liquidity that is translated into bigger size of spread. In short, it could be concluded that the size of spread depends on the behaviour of traders. It is however, important to note that even though the size of the spread is large, in a thin market, limit execution will still remain low describing larger size of spread as a characteristic of thinner markets. Next, a research done by Ho & Stoll (1983) using one period model includes not only limit orders, but also includes two market makers that could trade directly with the public or between them in an interdealer market. They highlighted that even though the interdealer market means that a dealer can lay off an unwanted position by trading at another dealer's quote, this trading would not occur when there are only two market makers. The reason is the trading between them could be easily done only if one of them feels they are carrying excess inventory, and abiding the law of supply is willing to offer a lower ask price while the other one who feel they are short of inventory and abiding to the law of demand is willing to offer a higher bid price. However, Ho & Stoll (1983) assumes that the objectives of dealers is to maximize their utility, there is perfect information regarding each dealer's inventory and wealth positions, and each dealer is aware that they are monopolists on their side of the market. Similar to the dealer's optimization problem model suggested by Stoll (1978), it is the assumption that dealers maximize their utility that relates this model of Ho & Stoll (1983) to the rationality as defined by the economic maxims. The implications of the assumptions made by them are first, the dealers with better position to buy (sell) will quotes the lowest bid price (the highest ask price) he can and second, the prices quoted by each of them can not improve the utility any of the two traders and they therefore would rather waits to cross their position against a market order. Hence, the market spread is then essentially the monopoly

spread, with the size of the spread depends on the inventory positions of the dealer on each side of the market. This research, nevertheless, inspired ones to think that whenever the number of market makers is more than two in perfectly competitive market, the law of demand and supply will be abided by the market makers. Thus, at first, those market makers whose inventory is not at their preferred level will narrow the size of their spread while the dealer that trade with them which logically should be the dealer who offer the best price either the highest bid or the lowest ask will then be less willing to do the same type of trade with other dealer and thus widen their spread. In this case, the spread reflects factors relating to the supply of liquidity.

Generally, one simple implication of the inventory based model is if a dealer is in long (short) inventory, he will prefer to sell (buy). Thus, this inventory effect should cause the security price to be mean reverting. Researches along this line had been done by Madhavan & Smidt (1991) who found little evidence of inventory effects in equity markets, Manaster & Mann (1992) who found little inventory effects in future markets and Lyons (1993) who found evidence of inventory effects in foreign exchange markets but little evidence of inventory effects in equity or future markets.

Eventhough under dealer's optimization problem which is one of the inventory based model states that asymmetric information create additional risk to the market dealer and is later charge as cost that is reflected in the bid ask spread, it does not clearly explain the reason and the working mechanism on how this risk is translated into their prices. This weakness is overcome by the information based model. Note however that the remark that asymmetric information cost is reflected in the bid ask spread implies that *theoretically*, strong form of efficient market hypotheses is irrefutable.

2.2 Information based model

The information based model is inbred by a short paper written by Bagehot (1971). Bagehot is actually a pseudonym used by Jack Treynor who differentiated the notion trading gain from the market gain and states there are three players in the market that is a market maker, informed investors who possess private information that could affect an asset's value and non informed investors who do not possess the private information.

The definition of private information is given by Fama (1970) as any information that any investor or groups have monopolistic access. Fama (1970, 1991) then listed the possible parties that could have the monopolistic access to information as corporate insider (Scholes, 1969) who sometimes have monopolistic access to information about their firms, security analysis (Lloye-Davis & Canes, 1978; Stickel, 1985 & Liu, Smith & Syed, 1990) and professional portfolio management (Jensen 1968, 1969; Ippolito 1989) since they operate in the securities markets every day and have wide-ranging contacts and associations in both the business and financial communities, and NYSE specialists (Neiderhoffer & Osborne, 1966). Specialists are the only person who have access to the list of unexecuted buy and sell limit orders which consists important information about the likely future behavior of prices that could be used as a basis of a profitable trading rule to generate monopoly profit. When the specialist is asked for a quote, he gives the prices and can give the quantities of the highest buy limit and lowest sell limit orders on his book, but he is prevented by law from divulging the book's full contents leaving them the opportunity to create monopolistic profit which had been quoted by Neiderhoffer & Osborne (1966).

"It should not be assumed that these transactions undertaken by the specialist, and in which he is involved as buyer or seller in 24 per cent of all market volume, are necessarily a burden to him. Typically, the specialist sells above his last purchase on 83 percent of all his sales, and buys below his last sale on 81 percent of all his purchases."

Neiderhoffer & Osborne (1966, pg. 908)

Recent paper written by Julan & Shang (2004) added another two parties in the list of possible parties who have monopolistic access to firms' information. First, it is the temporary insiders or constructive insiders that include outside auditors, lawyers, investment bankers and so on that are temporarily retained by the corporation but have access to material non-public information. Second, it is anyone who possesses material non-public information regarding a tender offer from an insider that come to be known as the misappropriation theory in the parlance of insider trading jargon.

According to Bagehot (1971), market gain means when the market goes up (down), in general most investors will gain (loss) while trading gains is the difference between the market return and the trading cost which includes information cost. In a setting where private information exists, this information creates cost to the market maker who is assumed not to possess the private information but must always quote prices to buy and sell. Hence, the market maker transferred the information cost to the other investors known as non informed investors. Thus, the non informed investors will on average lose relatively to the market over time. The reason is the market maker who must always quote the bid and ask price realizes that he will lose when dealing with the informed investors who will buy (sell) when they know the current ask (bid) price is too low (high). Therefore, the market maker is aware

that he is always on the losing part when dealing with these informed investors. Hence, the market maker will offset losses that lose with gain derived from the non informed investors. However, Bagehot (1971) does not really explicitly show how this cost will influence the size and placement of the spread.

The effort was first, however, made by Copeland & Galai (1983) using a static one trade framework. In addition, they assume that there is a single risk neutral market maker, the market maker has unlimited capital, the possibility for the market maker to be bankrupted is none and the market maker face a short time horizon that provide a convenient way to specify how information per se without inventory-carrying effects affects prices. Additional assumptions made in their model are share price is exogenous to the market, the informed investors trade with the objective to maximize gain while the non informed investors trade for liquidity. It is further assumed that traders are chosen to trade probabilistically, and that once selected, a trader may trade at most one unit of the asset; if a trader desires to trade further, he must return to the pool of traders and wait to be selected again to trade. Hence, the probability of the existence of informed investors in the population of investors is denoted by π_1 while it is $(1 - \pi_1)$ for the non informed investors. The probability of the non informed investors will buy, sell, do not buy or sell is denoted by π_{BL} , π_{SL} and π_{NL} respectively. The expected loss of the market maker from trading with informed investors is $(P - P_A) + (P_B - P)$ while the expected gain of the market maker from trading with non informed investors is $\pi_{BL}(P_A - P) + \pi_{SL}(P - P_B) + \pi_{NL}(0)$ where P_A denotes ask price P_B denotes bid price and P denotes the true value of an asset. Since the market maker does not know whether an order comes from the informed or non informed investors, he weights his expected gains and losses by the probability of informed and uninformed trading. In short, the objective function of a market dealer is to maximize $-\pi_1 [(P - P_A) + (P_B - P)] + (1 - \pi_1) [\pi_{BL}(P_A - P) + \pi_{SL}(P - P_B) + \pi_{NL}(0)]$ which implies that the placement and size of bid and ask price is a function of a market maker's maximization problem. In addition, the elaboration thus far also shows that as long as there is positive probability of the existence of informed investors who possess private information, the bid ask spread will always be larger than zero even though other factors affecting the bid ask spread like risk aversion, market power of the market maker and the inventory effects that are mentioned in the inventory based model do not exist which will also hold even if there is more than one market maker in the share market that are competing against each other since the only adjustment that has to be made to the above equation is equaling the profit of market maker to zero. The last assumption that traders are chosen to trade probabilistically, and that once selected, a trader may trade at most one unit of the asset; if a trader desires to trade further, he must return to the pool of traders and wait to be selected again to trade is required to commensurate with the efficient market theory that says the equilibrium price reflects all the past information, publicly available information and private information. The reason is to attain the strong form of market efficiency at the equilibrium, informed investors must be compensated in terms of higher profit for seeking the private information and informed traders profit from trading if prices are not at full-information levels, and so any informed trader will prefer to trade as much and as often as possible. Since such behavior would quickly indicate the information of the informed, the market maker would quickly or instantly adjust prices to reflect this information leaving minute profit to the informed investors that might discourage the informed investors from gathering the private information leading to only, at most, semi strong market efficiency.

Note also that the informed investors could only gain from the private information that guide them to take either buying or selling position if the direction of subsequent price movement in the market is in the same direction with the earlier position taken by the informed investors. This requirement is fulfilled by the action taken by the market makers. Before elaborating the mechanism that guide the mentioned action taken by the market maker it is important to highlight that the difference between the mechanism that led to equilibrium price that reflect the strongest form of informational efficiency mentioned by Fama (1965) and the information based model of market microstructure theory is that in the latter, market makers who set bid and ask price exist in the market setting. Hence to achieve equilibrium, this bid or ask price of a share must eventually (the word eventually is here to reemphasize that it is a gradual process) reflect the intrinsic value of a share after incorporating private information that indicates low value (high value) held by the informed investors in order to ensure the act of selling (buying) by them will stop when the bid price (ask price) is equal to the new value. Nevertheless, the important conclusion from the information based model is the theory of efficient market hypotheses prevails. The same elaboration also justifies the act of Fama (1970) to state the inexistence of cost as a sufficient but not necessarily condition to attain informational efficiency in share market. Thus, the implicit assumption in the model of Copeland & Galai (1983) that the market maker has a fixed belief regarding the true value of an asset is rather absurd since it does not only mean the impossibility of achieving the equilibrium but also the market maker even though is aware of the existence of informed investors who know better the true price of an asset, he does not protect himself by adjusting his beliefs about the value of the share, conditional on the type of trade that occurs. To be more precise, Copeland & Galai (1983) missed the fact that the trade itself could reveal the underlying information and so affect the behaviour of prices. Glosten & Milgrom (1985) highlights that the predominance of informed traders on one side

of the market that is either on buying or selling will eventually lead the market maker to learn their information and assimilates it in his new belief regarding the asset true price that causes his price to change until it converge to the expected value of the asset that commensurate with the given information, echoing the concept in efficient market hypotheses theory. This is the point where market microstructure theory starts focusing on how the market maker learns information from the order flow and assimilates it into his price. Even though there are various models trying to capture this new focus by using different market setting, they all rely on the Bayesian learning model, a published work in 1764, named after Bayes, the person who discovers the learning model and was a minister in United Kingdom. His work was published in 1764. The usefulness of this theorem in the financial market especially in share market is undeniable as Jacob Bernoulli (1713) states that unlike games of chance where priori probability theory is a complete substitute for information, information is never complete in the share markets. Bayes actually made an advance in statistics by demonstrating how better-informed decisions could be made by mathematically blending new information into old information that show the theorem actually focuses on the frequent occasions when people have sound intuitive judgments about the probability of some event and want to understand how to alter those judgments as actual events unfold. Therefore, the primary application of the theorem in share markets under the information microstructure literature is in the usage of new information that is type of trade order whether it is a buy or a sell in determining the expected value of a share conditional on sell order (buy order) that become the bid (ask) price set by the market maker. When the market maker intend to set his buying price (bid price) which becomes the selling price of the investors, the probability of high (low) value is determined by the probability of selling (selling) done by investors conditional on high (low) value. Then the sum of the high value times the probability of high value and the low value times the probability of low value becomes the bid price set by the market maker. To set his selling price (ask price) which becomes the buying price of the investors, the probability of high (low) value is determined by the probability of buying (buying) done by investors conditional on high (low) value. Similar to setting his bid price, the market maker will then take the sum of the high value times probability of high value and low value times probability of low value as his ask price.

Thus far, it has been shown that information based model substantiates that informational efficiency stock markets is attainable. Interestingly, though, there is a more recent model in information based model that requires investors to be rational as defined by the economic maxims and as defined by Fama (1965). This recent model was developed by Easley & O'Hara (2004) that relates information cost that exists due to asymmetric information between informed investors and non informed investors, to the cost of capital. According to them, information structure that is the relative degree of private information to public information in information content of a company affects the cost of capital of the company's share. They explained that investors who realize that they might engage trading with informed traders that expose them to additional risk will require higher rate of share return by including additional premium known as information risk translated as higher cost of capital for the issuer. The higher rate of share return is required because diversify cannot eliminate the additional risk arise from adverse selection, that has to be borne by investors lack of private information. Not to hold any share is not a way to solve this problem since higher utility of investors who do not possess private information could be achieved by holding some risky assets. Additional risk borne by investors when trading with informed investors had actually been mentioned by Kindleberger (1978). He pointed that informed investors initially exaggerate the upswings and the falls that trap the noninformed investors to buy high and sell low which later cause them to be victims of euphoria. The act of exaggerating the upswings and the falls by informed investors has been confirmed by a research done by Julan & Shang (2004). Their research found that countries with more prevalent insider trading have more volatile stock markets, even after controlling the underlying fundamentals that is volatility of real output and of monetary and fiscal policies and maturity of the market. The maturity of the market need to be controlled since it may be reasonable to expect a young market to be more volatile than a long established and highly liquid one since the average experience and skill of the investors and of the market regulators may improve with market maturity. In their model, Easley & O'Hara (2004) assumed that the distribution of payoffs from a share is normal and all investors have CARA utility which parallel to the assumptions made by Markowitz (1952, 1958) that justify the suggested idea proposed by Markowitz (1952, 1958) that mean-variance is the proper objective function of investors to be applied in their model. The usage of variance implies that the distribution of the payoffs of a security must be normal which could only be true if the payoffs of the security are independently distributed or random which is theoretically back up by the efficient market hypotheses which emphasizes that investors are rational as defined by Fama (1965). Therefore, information model of market microstructure theory concludes that the theory of efficient market hypotheses prevails and of this reason, the later model development in information model of market microstructure theory assumes efficient market hypotheses prevails.

On the opportunity to beat the market, it is possible according to the informational based model of market microstructure since the price adjustment is not instantaneous echoing the idea of Alexander (1961):

“These facts are believed to generate trends rather than instantaneous jumps because most of those trading in speculative markets have imperfect knowledge of these facts, and the future trend of prices will result from a gradual spread of awareness of these facts throughout the market. Those who gain mastery of critical information earlier than others will, accordingly, have an opportunity to profit from that early knowledge”.

(pg. 71).

As it was mentioned earlier, bid and ask price is conditional expected value. Hence, the price at each point reflects all publicly available information but not necessarily all private information. The implication is informed traders earn a return to their information and prices at equilibrium are only semi strong efficient until prices adjust completely to the private information. The nature of the adjustment time is mentioned by O’Hara (1995):

“In both microstructure paradigms, prices eventually converge to new-information values, but, since this adjustment takes place in the limit, the actual adjustment time can be infinite.”

(pg. 153).

The last seven sentences in the quotes rise the opportunity to even beat the market consistently. Notice however that this opportunity may be impeded by the fact that under market microstructure theory, the market maker is categorized as non informed investor which contradicts with what is mentioned in Fama (1970) where he used the result of research done by Niederhoffer & Osborne (1966) as evidence. Nonetheless, Madhavan (2000) highlighted that examination on the relationship between changes in market maker inventory levels and subsequent price rises done to determine whether market maker might have better information than the average trader or not in NYSE shows that the correlation is negative, suggesting that market maker do not possess information superior to that of the average trader. Madhavan (2000) added that additional evidences come from studies showing market makers earn less per round trip trade than the quoted spread. This means that market maker purchases tend to be followed by declines in the ask prices while sales are followed by increases in bid prices, the opposite of what one would expect if market makers were informed. Hence, Madhavan (2000) concluded that the maintain assumption seems to be reasonable reopening the possibility of consistently beating the market.

In another research done along the informational model of market microstructure theory that looks at the distribution of order arrival of informed and uninformed traders by Easley, Engle, O’Hara & Wu (2000) found that the distribution of order arrival of both informed and uninformed traders are time varying. They also stated that uninformed traders tend to move in herd but to avoid informed traders. The fact that uninformed traders move in herd opens the possibility of beating the market for reasons mentioned in Behavioral Finance. This opportunity is augmented by their finding that shows the surge in trading activities is caused mainly by the arrival of uninformed traders which mean investors do not have to be superior traders as defined by Fama (1970) to have the opportunity to beat the market consistently.

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