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ELUCIDATING THE DYNAMICS OF MISPRICING IN FUTURES CONTRACTS: A REVIEW

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ABSTRACT

The objective of this review paper is to provide a comprehensive synthesis of previous studies regarding the mispricing in futures contracts. On the basis of pertinent literature, it has been revealed that mispricing leads to pricing inefficiency and arbitrage opportunities for traders in the derivatives market. The paper emphasizes on the dimensions of mispricing such as theoretical framework, price discovery, volatility and pricing efficiency in the index futures and single stock futures. The present paper highlights the issues in mispricing in futures contract.

Keywords: Mispricing, Index futures, Single Stock Futures, Price discovery, arbitrage.

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1. INTRODUCTION

Rapid financial innovations including the derivatives drive the improvements in the financial system and markets. Pricing has always been a major concern for investors, hedgers, arbitrageurs and academicians. The need for derivatives market emerged because they act as a cushion against the uncertainties cropping up from fluctuation in the price of the asset. Derivatives are immensely used as a tool in risk management. The temporal relation between underlying asset and index futures is of widespread importance for a number of reasons such as market efficiency, volatility and arbitrage.

Initially, the popularity and use of derivatives was confined to developed markets but now it has gained due attention in other developing markets as well. Derivatives trading in India commenced in June 12, 2000 with trading in stock index futures. Subsequently, stock futures were introduced on November 9, 2001. India is one of the most vibrant financial markets for exchange traded equity derivatives in the world. In 2017, the National Stock Exchange of India (NSE) ranked second among the top 10 global stock exchanges for the volume traded in single stock futures (IOMA, 2017). According to SEBI, the derivative market comprising futures and options (F&O) has grown exponentially over the last 15 years. The notional F&O turnover in FY05 was 1.5 times the cash market turnover. By FY17, it became 15.6 times the cash market turnover (SEBI, 2017).

Though futures market has been one of the most significant developments in the derivative segment, yet it has not gained much attention among the market participants. Therefore, it continues to be an object of interest that intrigues academicians and researchers. The rationale behind the introduction and use of futures contracts is hedging as it serves as a tool for reducing risk associated with unfavorable changes in the future. The significance of the future contracts depend on the close relationship between the price of a futures contract and the underlying security established by cost of carry model. Cornell and French (1983) adopted an arbitrage argument to develop the cost of carry model for stock index future. Any discrepancy between theoretical futures price and actual price amounts to mispricing which gives rise to arbitrage opportunity in the futures market. Attaining fairly valued equity futures is heavily dependent on execution of active arbitrage striving to exploit mispricing (Slivika *et al*., 2011). The arbitrage

opportunities tend to disappear quickly as and when the opportunity becomes widely known and a large number of investors act on it. Ultimately, the futures price approaches to the spot price and the trend of convergence is due to the presence of arbitrageurs.

Theoretically, arbitrage requires no capital and entails no risk but in reality various frictions are associated with it, which causes inefficiencies to persist in the market (Shleifer & Vishny 1997). According to the law of one price and the efficient market hypothesis, two portfolios with the same payoffs should be priced similarly and if it doesn't happen, it gives rise to arbitrage opportunity. In order to benefit from this opportunity arbitrageurs involve themselves in buying the cheaper position and sells (short) the higher priced one simultaneously in the cash market as well as futures market. This trade enables the arbitrageurs to capture the initial difference as a riskless profit. In the real world, arbitrage is a trade (Figlewski 2016). In practice, the existence of transaction cost and various other limits to arbitrage makes the trade more costly and risky than the theoretical framework. Arbitrage plays a crucial role in the analysis of the securities market. The violation of spot futures parity relationship causes arbitrageurs to trade simultaneously in both the spot and futures market and benefit from the arbitrage opportunity. As the number of futures contracts has grown and the number of participants have increased, there arises a need to examine the pricing errors useful to enhance the portfolio returns.

The outline of this paper is as follows: Section 2 states the objectives and methodology of the study. Section 3 reviews the relevant literature and discusses the issues pertaining to price discovery. Section 4 discusses the issues relating to mispricing and arbitrage opportunities in international context. Section 5 reports the results and discussion.

2. OBJECTIVES AND METHODOLOGY

The present paper is an effort on the part of the researcher to delve deeper in the concept of mispricing in futures market and understand the dynamics pertaining to arbitrage opportunities. The primary objective of this paper is to provide an in-depth understanding of the mispricing as it has important implications such as the degree of market efficiency, price discovery, liquidity, risk free arbitrage profits and volatility. The aim of this paper is to provide a systematic review

on the subject of mispricing in futures contracts in order to analyse the advances of the literature on the topic and identify emerging research questions to investigate.

The secondary data pertaining to closing prices of futures contract and risk free rate of interest has been used in the past studies. Various research papers and reports are retrieved from national as well as international journals. The papers were assessed on the basis of their relevance. Further, the references of the identified papers were also used to find out more relevant papers. In general, largely all relevant studies pertaining to market efficiency, arbitrage and price discovery have been studied to have an insight into the literature.

3. THEORETICAL PINNING IN FUTURES CONTRACTS

A review of past literature is presented below according to the nature of their findings. The theoretical relationship between spot and futures price can be explained by the cost of carry model. It is quite common and successful method that has been used extensively in the literature. According to this, prices of futures are expected to mimic the price movements in the underlying asset. Cornell and French (1983) worked on the dynamics of operations of futures contract. The paper explains the relationship between the spot price and futures prices using the cost of carry model. In the Nikkie futures market, cost of carry model was reasonably accurate in predicting the futures prices (Bailey, 1989). Bhaumik (1997) found that the stock prices closely represent a random variable, thereby justifying the introduction of stock index future at Bombay Stock Exchange.

According to the cost of carry model, the theoretical fair price of a futures contract should be equal to price of underlying adjusted for cost of carrying it for the remaining life of the contract. It can be denoted with the following equation.

$$F(t,T) = S(t)e^{(r-d)(T-t)} \quad (1)$$

Where, F(t,T) is the futures price at time t for a contract that matures at time T,

S(t) is the value of underlying stock price at time t,

r is the risk-free interest rate ,

d is the continuously compounded dividend yield between t and T.

For the purpose of computing the theoretical price of futures contract, the interest cost and dividend paid on the underlying is taken into consideration. If the actual futures price is less than the theoretical price, then buying the futures contract and selling the underlying asset yields risk free arbitrage opportunity. On the other hand, if the futures are overvalued that is the actual price is greater than the theoretical price then a risk free profit is made by buying the underlying and opening a short position in the futures market.

Following Mackinlay and Ramaswamy (1988), the mispricing of the futures contract is defined as:

$X_{t,T} = (F_{t,T} - F^{*}_{t,T})/ S_t$

Where, $F_{t,T}$ is the actual futures price at t of the futures contract maturing at T;

$F^{*}_{t,T}$ is the theoretical price computed by Cost of carry model; and

S_t is the price of the underlying

"Mispricing is computed as the difference between actual futures price and the theoretical price calculated via cost of carry model" (Yadav and Pope,1993, p. 923). The fair value deviations are normalized with the prevailing spot price to make the inferences more meaningful. The fair value pricing of futures resulting from arbitrage is also important to investors, regulators and exchanges striving for increased foreign capital and expanding domestic markets (Maniar *et al*., 2010).

Although cost of carry model has been widely used in the literature, it has faced challenges and criticism for pricing of futures contracts. The alternative models to cost of carry model are Hemler and Longstaff (1991) and Hsu and Wang (2004). Hemer and Longstaff (1991) developed a closed form general equilibrium model of stock index futures price taking into consideration the stochastic interest rate and volatility. On the other hand, Hsu and Wang (2004) argued that since the capital markets are not perfect, it is imperative to take into account the price expectation and partial arbitrage to develop the pricing model for index futures. Manu (2015) compared the pricing performance of both the alternative models and found that Hsu and Wang provided better pricing performance than Hemler and Longstaff. Thereby, suggesting that the degree of market imperfection influences pricing errors more than stochastic interest rates and volatility.

Despite the challenges, cost of carry model is quite a successful method that serves as the benchmark model for pricing of index futures. In various financial markets, the compliance of cost of carry model has been analysed and deemed fit to be used as primary approach for computing the price of futures contracts both theoretically and practically. Figlewsky (1984) in the US, Yadav and Pope (1990) in the stock market of UK, Bailey (1989) in the Japenese markets, Fassas (2010) in the Greece stock market, Nandan *et al*., (2014) in Indian futures market and Verdasco (2015) in Spanish market confirmed the compliance of cost of carry model for pricing of index futures.

3.1 PRICE DISCOVERY

One of the important functions of the futures market is the price discovery which in turn helps in improving the efficiency of the market. There exists a long run relationship between spot and future market (Mukthar *et al*.,2011). There are contrary views on the direction of causality between spot market and futures market. Application of cointegration analysis and error correction models helps to figure out the short run and long run deviations from equilibrium which accounts for price discovery and efficiency respectively. Garbade and Silber (1983) found that futures market had stronger lead effect than spot market. Empirical evidence by Kawaller *et al.,* (1987) & Schroeder and Goodwin (1991) & So and Tse (2004) indicate that price discovery occurs more significantly in the futures market as against the cash market. Futures market dominate over spot market and explain the variation in spot market (Pati *et al.,* 2010; Debasish, 2009). The reason attributed for the futures market leading the cash market is the lower trading cost associated with the futures market (Fleming *et al*.,1996).

However, on the other hand, Mukherjee and Mishra (2006) have found contrary evidence that spot market serves as dominant market and is stronger in transmitting information than cash market. Similar results that underlying index prices lead the futures price and the price discovery for a large part occurs in the spot market have been concluded in the Taiwanese and Turkish market (Roope & Zurbruegg 2002 ; Kasman & Kasman, 2008 and Alan *et al*., 2015). In the Malaysian stock market, the cash market reflects to the new information faster than the futures market. Choudhary and Bajaj (2013) found that there is a bi-directional information flows or feedback between the spot and futures markets in case of selected 30 securities and both the

markets play an important role in price discovery. Besides this it was also observed that in case of 12 securities the futures market lead the cash market whereas in 19 securities spot market lead the futures market. Therefore, there exist mixed views as to whether spot market leads the futures market or vice versa.

Modest and Sundaresan (1983) and Cornell and French (1983) explained the significance of tax related timing option in the futures contract. However, various explanations such as timing option, investor's pessimistic expectations and lack of familiarity with futures market did not sufficiently explain the magnitude of discount observed in stock index futures. Figlewski (1984) concluded that such discounts represented a state of disequilibrium - a transitory phenomenon occurred because of unfamiliarity and apprehensions associated with the new markets. Futures discounts cannot persist indefinitely and diminishes soon as the market slowly reached to the equilibrium level.

Since the futures market perform the function of price discovery and risk management, it necessitates the need to study the factors affecting mispricing series giving rise to arbitrage opportunities. Nuruzzaman (2011) identified various factors under PEST analysis that have a bearing on furures market. It took into account the Political, Economic, Socio-cultural and Technological environment that influence any industry. It was concluded that advanced internet trading system, improved education, entry of foreign investment firms and balanced political conditions have contributed in the growth and development of the Indian futures market. Brailsford and Hodgson (1997) examined the mispricing in stock index futures pricing in Australian market and found that there are number of factors affecting mispricing series such as time to maturity, unexpected treading volume and the volatility of futures prices. A large part of mispricing occurs due to the presence of transaction cost but additional factors such as anticipated volatility and time to maturity also contribute (Andreau and Pierides, 2008). Twite (1998) in his study found that the discrepancy between the futures price and theoretical price could be explained by the existence of transaction cost. Figlewski (1984) found that significant mispricing was a transitory phenomenon due to noise and will disappear as the market matures. The study did not observe an equilibrium differential which factors such as tax timing option would cause, rather the deviations from theoretical price relation would diminish by the close of

the following day. Lim (1992) studied the price behavior of Nikkie futures contract and found that the arbitrage opportunities are very limited because of the low level of trading volume. Increase in trading volume causes increase in voltality and negative shocks increase the volatility in futures more than the positive shocks (Pati and Rajib, 2010).The magnitude of the arbitrage will be limited if the trading volume is not large enough.

4. MISPRICING & ARBITRAGE OPPORTUNITIES IN INTERNATIONAL CONTEXT

The pricing efficiency of futures market has been examined in various financial markets. Pricing of futures has been investigated globally. The cost of carry model has been widely used as the basis of extensive empirical research. Initially the equity futures were introduced in the US market in 1982 and then subsequently in other financial markets also. Significant deviation of theoretical futures price via cost of carry model from the actual futures price has been documented by MacKinlay and Ramaswamy (1988) for US data and Yadav and Pope (1990) for UK data. MacKinlay and Ramaswamy (1988) examined the intraday behavior of S&P 500 futures and index quotes and the relative variability of futures and spot markets. After examining the spot futures arbitrage, the study reported that magnitude of mispricing is positively related with time to maturity and the mispricing series is path dependent. Consistent with these results, Yadav and Pope (1994) found significant positive relationships between mispricing and time to maturity. Butterworth and Holmes (2010) compared the pricing efficiency of FTSE 100 and FTSE mid 250 index future contracts in the UK market and found FTSE mid 250 to be an improvement over FTSE 100 contracts in terms of pricing efficiency.

Particularly, in the Indian context, post introduction of index futures and stock futures in June 12, 2000 and November 9, 2001 respectively, scenario and trend of mispricing has been explored as it has important implications for arbitrageurs in the Indian futures market. Arora and Kumar (2013), Bhat and Suresh (2014) and Kapoor (2016) showed that their exists bi-directional relationship between spot and futures market in India. Nandan *et al*., (2014), Vipul (2005), Misra *et al*., (2006), Naidu *et al*.,(2017) and Shankar *et al*.,(2015) found significant underpricing in the futures and sizeable arbitrage opportunities for the traders and arbitrageurs.

From the foregoing discussion it is quite evident that the mispricing in futures has been examined globally. The pricing index futures and stock futures has been based on the widely used cost of carry model. The magnitude of mispricing and arbitrage opportunities are more in the emerging markets as compared to the developed markets. Studies with respect to the Indian context are fewer in context, thereby offering a great direction for future research.

5. RESULTS AND DISCUSSION

The purpose of the futures contracts is to provide an effective mechanism for the management of price risk by offering a market for investors to hedge and trade risk thereby operating the function of price discovery and market efficiency. Prices of futures contracts are expected to closely follow the prices of their underlying security. Any deviation between the two gives rise to riskless arbitrage opportunities to the market players.

On the basis of foregoing analysis of existing literature, the following broad inferences can be drawn. First, cost of carry model is considered as the primary approach and serves as the benchmark method for the pricing of index futures. Bailey (1989) found it to be accurate in predicting the futures prices. Second, there have been instances of persistent mispricing in the index futures in the stock markets of US, UK, Australia, India and Germany. Any mispricing in the price of index indicates the inefficiency in the market. Third, as per the empirical literature, there exists mixed evidence whether the spot market leads the futures market or vice versa. Garbade and Silber 1983; Kawaller *et al.,* 1987; Fleming *et al.,* 1996 and Pati *et al*., 2010, concluded that futures market lead the spot market. On the contrary, Kasman & Kasman (2008) and Alan *et al.,* 2015 indicated that cash market reflects to the new information faster than the futures market. Fourth, a large part of the mispricing is due to the transaction cost and the trading restrictions such as short selling but other factors such as volatility and time to maturity also contribute.

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