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PRICE DISCOVERY, SPILLOVER AND DESTABILIZATION: A THEORETICAL PERSPECTIVE

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ABSTRACT

The purpose of this paper is to investigate price discovery function, volatility, liquidity spillovers and Destabilization of commodity markets by reviewing the Theoretical models developed over a period of time. It was found that Price discovery exists for the commodities with long run equilibrium between future and spot market. However, the existence of long run equilibrium does not imply efficient future market. Spillover is the change in the conditional variance in one market lead by a change in the conditional variance of another. Also, price destabilization is the volatility in one market caused from trading activity in another. The present study will aid academicians, future researchers, policy makers and other relevant stakeholders in studying the theoretical framework. The price discovery function of future market has always been an area of discussion in financial literature. Some researchers suggest that future markets are more efficient than spot markets and enhance dissemination of information. Trading in future markets improves the depth of the commodity market. There are others who blame future trading for destabilizing spot market. To empirically analyze the relationship between spot and future market it becomes necessary to firstly deliberate upon the concept of price discovery, spillover and destabilization. This chapter focuses on the models for determining future prices and discusses price discovery in future and spot markets, volatility and liquidity spillover between future and spot market and spot market destabilization from trading activity in future markets. This paper comprises of six sections. The first section, focuses on the models for determining future prices. Section 2 elucidates the concept of price discovery while section 3 talks about the spillovers across markets. Section 4 discusses price destabilization and the last section contains a summary of the paper.

Keywords: *Price Discovery, Spillover, Destabilization, Spot Market, Stakeholders.*

Introduction

Models for Determining Future Prices

Future contracts derive their value from the future cash flows of underlying assets. To determine the prices of future contracts the study considers two models; cost of carry model and expectations model. The models operate under the assumption of perfect markets with no transaction costs and no restrictions for free contracting between two parties. According to the cost of carry model, futures prices are dependent on the cash price and carrying cost of the underlying asset until the date of delivery of futures contract. The cost of carry includes storing of the physical goods, costs of transportation to the delivery centres and insurance costs for goods stored. For participants holding financial instrument there is a financial charge on a short term basis that is equal to the repo rate. Thereby the costs of storing, insurance costs, transportation cost and financial cost are carrying charges which reflect the cost of carrying the commodity from one time to another.

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The mathematical relationship between spot and future can be expressed as follows:

$F_{0,t} = S_0 (1+C_{0,t})$

Where $F_{0,t}$ is the future price at t=0 for delivery at time t, S_0 is the spot price at t=0 and $C_{0,t}$ is the cost of carry up to the date of delivery on futures.

In case the relationship does not hold and the future price is less than the spot price of the commodity, including its carrying charges the investor can apply cash and carry arbitrage strategy. Otherwise, reverse cash and carry arbitrage can be used for future price greater than spot price and carrying cost of the commodity.

The cash and carry arbitrage strategy advocates borrowing funds and purchase of spot commodity with those borrowed funds. The trader can then sell the futures contract and carry the commodity to be delivered against the futures contract. The transaction generates arbitrage profit. For reverse cash and carry arbitrage strategy the trader short sells the spot commodity and lends the proceeds. The futures shall then be bought and delivery accepted of the commodity which can be used to cover the short sale.

However, the cost and carry model breaks down for future contracts which cannot be carried. For instance, fruits where cash and future price cannot be linked with the opportunity to carry forward the commodity. In such cases market participants expect that the future prices must be equal to or approximate expected future spot price. In the absence of such approximation profitable speculative strategy could be applied. The speculators would trade in the future contract as long as its prices deviate from the expected future spot price. The idea can be expressed by the following notation:

$F_{0,t} \approx E_0 (S_t)$

Where $E_0 (S_t)$ is the expected spot price at t=0 for time t.

The future prices can diverge from expected future spot price due to risk aversion on the part of speculators. There are three theories on risk aversion which affect divergence of future prices, namely normal backwardation, contango and capital asset pricing model.

According to the theory of normal backwardation the futures market is generally dominated by hedgers holding a short position. The speculators on the other hand gets paid in the form of premium for assuming risk transferred by the hedgers. The premium is the difference between future price and expected future spot price. Conversely, theory of contango holds that hedgers are net long and the price of a futures contract would fall over the life of the contract. The speculators assume long positions and profit from future prices that lie above expected future spot prices.

The Capital asset pricing model on the other hand, advocates that market compensates only for unavoidable risk. So the return of the asset is correlated with the risk which remains after diversification. Also, as future market trading does not require any initial investment the risk free return is zero. According to the model positive betas imply expectations of rising prices and negative betas fall in future prices for a long position in the futures contract. Only zero betas lead to neither rise or fall in future prices. Most of the earlier literature has reported futures contracts with beta near zero (Kolb, 2007).

$$r_{j,t} = \alpha_j + \beta_j r_{m,t} + \varepsilon_{j,t}$$

Where $r_{j,t}$ is the return on asset j in the t^{th} period, $r_{m,t}$ is the return on the market portfolio j in the t^{th} period, α_j is the constant term in the regression, $\varepsilon_{j,t}$ is the residual error for day t.

Concept of Price Discovery

This section deliberates on the concept of price discovery by focusing on two aspects. Firstly, it discusses the relationship between price discovery, market efficiency and market equilibrium. Secondly, on the empirical methodology used to test price discovery and future market efficiency.

- **Relationship between Price Discovery, Market Efficiency and Equilibrium**

To analyze the role of future trading towards better price discovery in agricultural commodities, it is important to understand the meaning of price discovery. There is no exact definition of Price discovery and different researchers have explained the term in accordance of their research subject. The study concentrates on the term price discovery in the context of future market. For Garbade and Silber, 1983, “price discovery refers to the use of futures prices for pricing cash market transactions”. According to Kumar and Pandey, 2011, “it explains the process by which information is absorbed in the market and price converges towards price of underlying asset.” Yang and Leatham, 1999, “In a static sense, price discovery implies the existence of equilibrium prices. In a dynamic

sense, the price discovery process describes how information is produced and transmitted across the markets". From all the above descriptions it is noteworthy that the process of price discovery explains the formation of equilibrium prices in the cash markets with the help of signals provided by the futures market. Yang and Leatham, 1999 and Kumar and Pandey, 2011 use the term, "existence of equilibrium prices" and "converge to price of underlying asset", implying fair prices that reflect demand propensities of all agents.

The next question is, whether or not, market equilibrium implies efficient market? To answer the same it is important to first understand the term "efficient market" and the role played by an efficient market. The future market has been set up to provide price signals for resource allocation. In accordance with these price signals the firms decide on their production investment decision, investors take their financing decision with an underlying assumption that the prices of assets traded in these market fully reflect all available information. This idea of market prices fully reflecting all available information is called "efficient market", Fama (1981). According to Chowdhury (1991), "A futures market is efficient relative to an information set such that only new unanticipated information leads to a price change."

There are contrarian views with regard to whether or not an equilibrium state of market connotes efficient market. According to Farmer and Geanakoplos (2008), equilibrium allocations are always allocatively efficient under the assumption of rational agents, perfect competition and market clearing. However, for Zapata et al. (2005), market efficiency is a function of how fast and how much information is reflected in the prices. The rate at which prices exhibit market information is the rate at which this information is disseminated to market participants. As new information arrives in the market it generates trades and price movements leading the market towards a new equilibrium price. However the transaction price of the order placed may not be equal to the theoretically desirable equilibrium price. With heterogeneous expectations and trading propensities there may be distortions in the process of price discovery (Schreiber and Schwartz, 1986). Thereby even if the markets are in equilibrium, it cannot suggest efficient markets.

Hence, the definition of price discovery in this study is that, "In a static sense price discovery implies the existence of equilibrium prices. In a dynamic sense, the price discovery process describes how information is transmitted across the markets".

- **Empirical methodology for testing Price Discovery and Market Efficiency**

The theoretical economic models suggest that markets with rational agents who utilize all the available information and operate in a market where risk premium is zero and zero speculative returns is held to be efficient market. To test for market efficiency researchers regress the future spot rate, S_{t+1} on future rate, F_t as in equation:

$$S_{t+1} = a + bF_t + e_t$$

The markets would be efficient in the above specification if the constant term is 0 and slope coefficient is equal to1 (Hakkio and Rush, 1989). The problem with the proposition was that the financial series was non stationary and hence the coefficients were biased towards incorrectly rejecting efficiency.

Next, Engle and Granger propagated the Theory of Cointegration in 1987 whereby market efficiency hypothesis required current future price and future spot price of a commodity to be close to each other. Futures market can contribute in the process of price discovery only if there is a close relationship between prices of futures contracts and spot commodities (Garbade and Silber, 1983). Two variables are cointegrated if there linear combination is stationary when they themselves are non-stationary. For instance, suppose time series X and Y are non-stationary and integrated of order 1 such that:

$$X - dY = U$$

If U is stationary and integrated of order 0 the series X and Y are said to be cointegrated of order (1, 1) and cointegrating vector "d". The Engle Granger (1987) test was criticized on the grounds of incapability to handle multiple cointegration. Johansen Cointegration test (1991) was considered an improvement over the Engle and Granger to examine multiple cointegrating vectors. However, cointegration does not imply market efficiency. According to Hakkio and Rush (1989), cointegration is necessary but not sufficient condition for market efficiency. For market efficiency error term should be white noise, i.e. mean 0 and standard deviation equal to 1. Whereas Cointegration examines the residual or error term to be stationary it does not test for white noise or market efficiency.

Spillover Across Markets

This section focuses on the term spillover and understanding volatility and liquidity spillover across markets. According to Engle et al. (1988), “Using meteorological analogies, we suppose that news follows a process like a' heat wave so that a hot day in New York is likely to be followed by another hot day in New York but not typically by a hot day in Tokyo. The alternative analogy is a meteor shower which rains down on the earth as it turns. A meteor shower in New York will almost surely be followed by one in Tokyo”. Thereby, change in situation in one market surely causes a change in situation in another is spillover. According to Gallo and Otranto, 2007, “Spillover is seen as a situation in which a switch in regime of a dominating market leads to a change in regime in the dominated market (with a lag)”. Hence, there is a relationship between the two markets where one is a leader and other follower. The information travels from the leading market to the other market.

The term spillover, interdependence and comovement are at times used interchangeably. However, each term is associated with a different market situation. Interdependence is a situation where one market is dependent on another market. And comovement represents a contemporaneous change in regimes. Whereby spillover neither talks about a dependent relationship amongst firms nor contemporaneous relationship. Spillover is the change in one market situation led by change in another market situation. Thereby in the context of commodity future and spot market, volatility spillover is the change in the volatility in one market caused by a change in volatility in another market of the same underlying asset.

The discussion on spillover is incomplete without any reference to liquidity spillover. Under conditions of severe financial crisis when markets become very volatile agents also face trading drought. Liquidity either reduces or totally disappears. It thereby becomes important to not just study information linkages via volatility, but also trading activity across markets. According to Cespa and Foucault (2011), “liquidity spillover effect is an exogenous change in the illiquidity of one market which affects the illiquidity of another market”. Righi and Vieira, 2014 describe liquidity spillover as the comovement in trading activity, liquidity and commonalities in daily aggregate spreads and depths in various asset markets. Ambrose and Park, 2012 define liquidity shocks as, “short-term decreases in liquidity in one market generating a chain reaction in other markets.” There is no agreement on the definition of liquidity spillover. Thereby going by the meaning of spillover described earlier liquidity spillover can be explained as the change in the liquidity of one market caused by a change in the liquidity of the other market.

Price Destabilization

Future market activities are generally accused of destabilizing the underlying spot market. A market is considered destabilized if there is a deviation from the no-arbitrage condition and the prices move away from market fundamentals thereby distorting efficient price formation, Lombardi and Robays (2011). Kohlhagen (1977), defines speculative destabilization as, “speculation that causes observed time series of the price to be volatile than it would have been in the absence of such an activity.” The speculator as defined by Johnson, 1976, “a man who derives a private profit by creating social woe”. Thereby price destabilization in the context of this study is the volatility in one market caused from trading activity in another.

Summary

The different aspects of the study discussed above have been summarized in this section. Firstly, future prices are determined using cost of carry model and expectations model. The cost of carry model breaks down for commodities which cannot be carried forward and expectations model can be applied in such a situation. Secondly, Price discovery exists for the commodities with long run equilibrium between future and spot market. However, the existence of long run equilibrium does not imply efficient future market. For future market efficiency the error terms must be white noise. Hence, stationarity of the difference between spot and future market concludes cointegration of the series and not efficiency. Thirdly, volatility spillover is the change in the conditional variance in one market lead by a change in the conditional variance of another. Also, liquidity spillover is the change in liquidity in one market lead by a change in liquidity in another. And lastly, price destabilization is the volatility in one market caused from trading activity in another.

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