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CONVENIENCE YIELD: EMPIRICAL EVIDENCES FROM INDIAN CHILLI MARKET

IRFAN UL HAQ
RESEARCH SCHOLAR
DEPARTMENT OF BANKING TECHNOLOGY
PONDICHERRY UNIVERSITY
PUDUCHERRY

DR. K CHANDERASEKHARA RAO
PROFESSOR & HEAD
DEPARTMENT OF BANKING TECHNOLOGY
PONDICHERRY UNIVERSITY
PUDUCHERRY

ABSTRACT

The paper examines the convenience yield to explain the future prices of chilli in Indian markets. The concept of Convenience yield is widely used to explain the market backwardation. We have seen Convenience Yield widely used concept in market backwardation helps in better understanding of Chilli Futures Prices.

JEL CODE

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KEYWORDS

Convenience Yield, Future Prices, Spot Prices.

1. INTRODUCTION

Commodity price determination has long been an important aspect of investigation by academic researchers as well as market players. At the centre of the rationality of commodity pricing (Kaldor -1939) laid the concept of convenience yield and Working (1949) provided the first evidence of the existence of it in U.S. wheat market. He observed that stocks were held even when the inter-temporal spread within Chicago markets were inverted. It is now conventional wisdom that the convenience yield drives a wedge between commodity futures and spot prices (Gibson and Schwartz, 1990; Schwartz, 1997; Chambers and Bailey, 1996, to mention a few). Even though some theories of storage do not agree with this logic (Khoury and Martel, 1989; Brennan et al., 1997), the convenience yield is found to be economically logical and significant, especially when commodity prices are in backwardation (e.g., Considine and Larson, 2001a,b; Milonas and Henker, 2001). Despite various theoretical discussions of convenience yield the empirical evidence regarding the theories is scant (Pindyck (2001), Considine and Larson (2001b), Schwartz (1997), and Pilipovic (1998)).

The paper is organized as follows. The next section briefly introduces the Indian Chilli Futures Market and explains various theoretical relationships among the future and spot Prices. We have also explained the theoretical determination of the convenience yield. Third section forwards data and methodology used to estimate the relationship between Future and Spot Price. The Fourth section provides empirical results of Indian Chilli's Market and last and the fifth section concludes the study.

2. FUTURE PRICE, SPOT PRICE, AND CONVENIENCE YIELD**2.1 THE CHILLI FUTURES MARKET**

Global production of chilli stands at about 20.00 lakh MT to 25.00 lakh MT per annum. India is the largest producer and contributes about 10.00 lakh MT to 12 lakh MT annually followed by China, Nigeria, Peru, Bangladesh, Hungary. Domestically, Andhra contributes 49 % of total production followed by Karnataka (14 %), Orissa (7 %), Maharashtra (5 %), West Bengal (5 %), Rajasthan (5 %) and Tamil Nadu (4 %). The major trading centre in India is Guntur (AP). The future prices in the study have been analysed based on price trends in Guntur Market.

2.2 CONVENIENCE YIELD

The convenience yield, C , refers to a stream of implicit benefits that accrues to the owner of a physical stock but not to the owner of a contract for future delivery. Stockholders earn the convenience yield because stocks on hand allow them to respond more flexibly and efficiently to unexpected supply and demand shocks. Where stocks are held, regular customer demands can be met, and sudden and unexpected increases in demand can be accommodated without disrupting production schedules. The convenience yield may be thought of as a negative price of storage in that it reflects the benefits rather than the cost of stockholding. These benefits are most significant when stocks are scarce. When stocks are abundant, the convenience yield approaches zero because the scarcity value of stocks is minimal. Empirical evidence presented by Working (1949, 1949), Telser (1958), Fama and French (1987, 1988), and Brennan (1991) also suggest that the convenience yield is a decreasing (convex) function of stocks. It declines with increasing stocks but at a decreasing rate; $\frac{\partial C}{\partial X} < 0$ and $\frac{\partial^2 C}{\partial X^2} > 0$, Where X is the amount of stocks held.

If the market is efficient, then there should be no arbitrage profit between Spot and Future Prices. Holding a unit of commodity (chilli in our case) for one period has the return of $(P_{t+1} - P_t) + CY_t$, where P_t is the price of chilli for the current month, and CY_t is the marginal convenience yield net of storage cost. At the same time, assuming that one also takes a short position using the future contract, the return is then the difference between the future price and the next month's spot price, $F_{t+1} - P_{t+1} = F_t - P_{t+1}$, where F_t is the future price. The total return therefore is

$$P_{t+1} - P_t + CY_t + F_t - P_{t+1} = F_t - P_t + CY_t \quad (1)$$

Since the positions are covered, there is no risk involved in the transaction and the total return is non-stochastic. The returns should be the same as the return of a risk-free investment with price P_t . Assuming the risk-free rate of return is r , then the no arbitrage condition would give us the relationship:

$$F_t - P_t + CY_t = rP_t \quad (2)$$

This equation defines the net marginal convenience yield as the difference between the adjusted spot price and the forward price:

$$CY_t = (1+r)P_t - F_t \quad (3)$$

The convenience yield is the benefit of holding the storage commodity. Theoretically, it depends on several factors. For example, after deriving such a relationship, Pindyck (2001) argues, based on his structural model, that the convenience yield depends on the current price level, the price volatility, and the level of storage. A high spot price (relative to the equilibrium price) reflects the imbalance between supply and demand. As the shortage of supply increases, the demand for storage will increase, driving up the value of storage. When market volatility is higher, the demand for storage is higher as well due to the greater need to buffer fluctuations in production and consumption. The amount of storage is also important in determining the marginal value of storage. The lower the

storage level is, the higher the value will be for the marginal storage. A variant of the last argument is that the lower the level is of storage relative to the average storage level, the higher the marginal convenience yield will be.

2.3. THE FUTURE AND SPOT PRICES

The forward and spot prices of a storable commodity are expected to be different, as the forward prices are not usually equal to the expected spot prices. In general, the future or forward price should be less than the expected future spot price. The intuition is that holders of the commodity bear risks by purchasing the commodity at time t. As a reward for bearing risks, investors expect to see the spot prices rise above the current futures or forward prices over the commodity-holding period. Therefore, we can formulate the idea in the following equation:

$$F_t = E_t P_{t+1} - RP_t \tag{4}$$

where E is the expectation operator conditional on information available at time t and RP is the risk premium factor.

The theories of commodity price determination suggest that the risk premium depends on several factors. Pindyck (2001) ties the risk premium to the current spot price of the commodity. Considine and Larson (2001b) suggest the risk premium to be positively related to price volatility. Schwartz (1997) and Pilipovic (1998), in their two/three-factor models, offer that the risk premium should be negatively related to the risk-free rate and positively to the convenience yield. In addition, Schwartz (1997) also recommends that the risk premium should be positively related to the variability in the convenience yield as well as the time-varying interest rate, and the co-variances between the convenience yield and interest rate.

3. DATA AND METHODOLOGY

3.1. DATA

Data on future prices and spot prices have been taken from NCDEX for delivery at Guntur. Daily Closing Prices of the near month contract for last 5 years from 2006-2010 has been used in the study. The risk-free rate of interest (364 days T-Bill) is obtained from the Reserve Bank of India database.

3.2. EMPIRICAL METHODS

We have employed the simple OLS to test the chilli future price specified as follows:

$$FP = \alpha_1 + \alpha_2 SP + \mu \tag{5}$$

$$FP = \beta_1 + \beta_2 SP + \beta_3 CY + e \tag{6}$$

Where FP is the Future Price, SP is Spot Price and CY is the Convenience yield [as defined in equation (3)].

4. EMPIRICAL RESULTS

Fig.1 shows the movement of future and spot prices from 2006 to 2010. In Fig. 2 we see that Convenience Yield is highly varying over a period of time. Table 1 gives the descriptive statistics of the variables. All the variables are stationary at level. Table 2 and 4 show the results of ADF test. Table 5 and 6 shows the regression results before and after Convenience Yield. We see that Convenience Yield is significant (5% level) and both R squared and Adjusted R squared improve after the introduction of Convenience Yield, which means that convenience yield is helpful in explaining the prices of chilli.

5. CONCLUSION

In this paper we have investigated the empirical relationships between a commodity's future price and spot price. We have considered herein chilli market. We first defined and measured the convenience yield and then modelled the relationship between the future and spot prices based on conventional theories. Our findings suggest that the convenience yield behaves largely as economic theories suggest and is explaining the future price.

FIG. 1: MOVEMENT OF CHILLI FUTURE AND SPOT PRICES

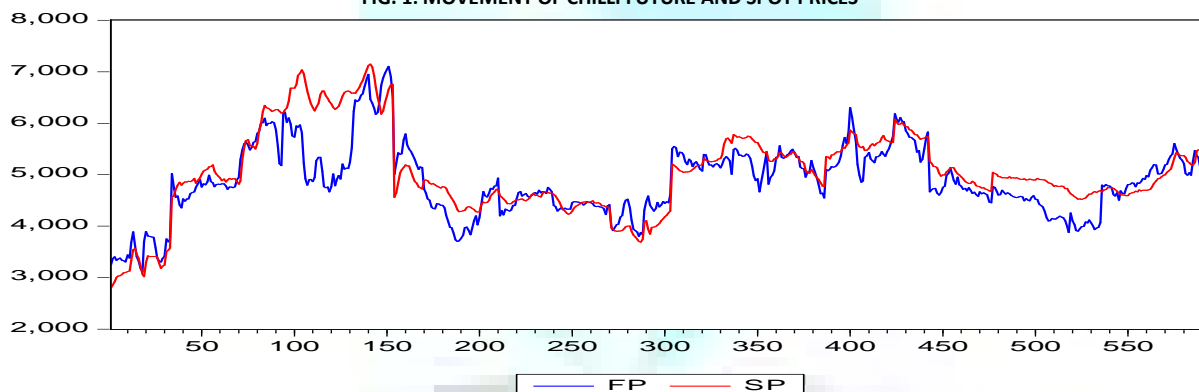


FIG.2: TIME VARYING CONVENIENCE YIELD

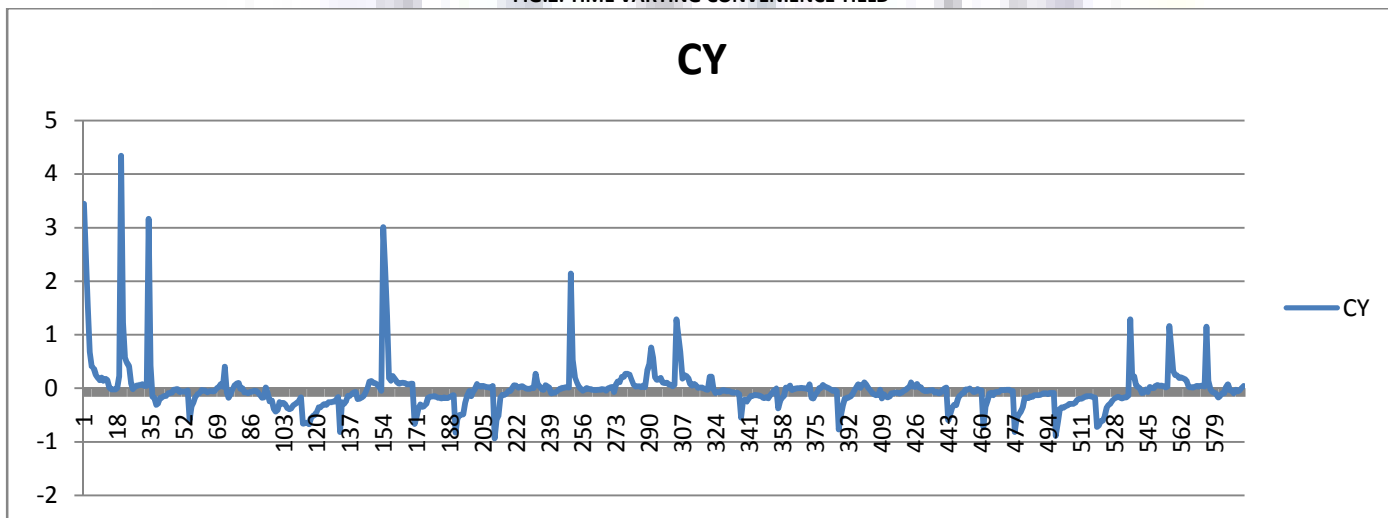


TABLE 1: DESCRIPTIVE STATISTICS

Descriptive	Future Prices	Spot Prices	Convenience yield
Mean	4869.983	5035.052	-0.02448
Median	4804.5	4931.2	-0.04748
Maximum	7109	7148.4	4.339733
Minimum	3109	2802.85	-0.93645
Standard Deviation	701.635	817.1314	0.42727
Kurtosis	0.401783	0.369512	38.51179
Skewness	0.274823	0.099404	5.036249
Observations	596	596	596

TABLE 2: ADF TEST FOR CONVENIENCE YIELD

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.73721	0.0000
Test critical values:	1% level	-3.441185	
	5% level	-2.866212	
	10% level	-2.569317	
*MacKinnon (1996) one-sided p-values.			

TABLE 3: ADF TEST FOR FUTURE PRICE

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.700755	0.0043
Test critical values:	1% level	-3.441129	
	5% level	-2.866187	
	10% level	-2.569304	
*MacKinnon (1996) one-sided p-values.			

TABLE 4: ADF TEST FOR SPOT PRICE

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.985040	0.0369
Test critical values:	1% level	-3.441129	
	5% level	-2.866187	
	10% level	-2.569304	
*MacKinnon (1996) one-sided p-values.			

TABLE 5: REGRESSION RESULTS OF EQUATION (5)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
α_1	2.080274	0.363091	5.729344	0.0000
α_2	0.752024	0.042987	17.49427	0.0000
R-squared	0.752236	Mean dependent var	8.480404	
Adjusted R-squared	0.751819	S.D. dependent var	0.145367	

*Results are corrected for standard errors using Newey & West (1987) HAC Matrix

TABLE 6: : REGRESSION RESULTS EQUATION (6)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
β_1	1.822842	0.369784	4.929477	0.0000
β_2	0.782280	0.043751	17.88017	0.0000
β_3	0.035335	0.016902	2.090529	0.0370
R-squared	0.780149	Mean dependent var	8.480308	
Adjusted R-squared	0.779406	S.D. dependent var	0.145471	

*Results are corrected for standard errors using Newey & West (1987) HAC Matrix

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