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ORIGINAL ARTICLE

Surveying the Informational Efficiency of Corn in Exchange Market

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ABSTRACT
One of the issues in the field of economy in recent decades has been rapidly expanding was economy information. In today's world of information and trading, market efficiency is the core. Efficient market is one where the market price is an unbiased estimate of the true value of the investment and Implicit in this derivation are several key concepts Market efficiency does not require that the market price be equal to true value at every point in time. All it requires is that errors in the market price be unbiased, i.e., that prices can be greater than or less than true value, as long as these deviations are random. In this paper market efficiency of corn futures market in the presence of co-integration relationship between time series, under the assumption of risk neutrality market participants, and the error correction model and the assumption of risk by using ARCH-M models and GARCH-M is evaluated are assessed. The results suggest that a potential future market for corn on weekly and monthly prices is inefficiency.
Keywords: Market efficiency, Corn, GARCH M,Iran

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INTRODUCTION

One of the theories that have been proposed in the field of investment and finance is capital market theory. The market efficiency refers to this problem that to what extent the market price determination has been successful. Successful market means that prices are consistently reflect the new information and information is related to Collection of data and information relating to the companies that are traded on the stock prices is important. So a market can be called efficient market that has enough efficient to process information, or prices fully reflect market information [5]. Informational efficiency is achieved when prices fully reflect available information on financial products available. If investors cannot reach the market informational efficiency with an unusual and extraordinary gain access to specific information. Different levels of efficiency can be classified into the following three levels:

Weak-form efficiency

Prices of the securities instantly and fully reflect all information of the past prices. This means future price movements cannot be predicted by using past prices. It is simply to say that, past data on stock prices are of no use in predicting future stock price changes. Everything is random. In this kind of market, should simply use a "buy-and-hold" strategy.

Semi-strong efficiency

Asset prices fully reflect all of the publicly available information. Therefore, only investors with additional inside information could have advantage on the market. Any price anomalies are quickly found out and the stock market adjusts.

Strong-form efficiency

Asset prices fully reflect all of the public and inside information available. Therefore, no one can have advantage on the market in predicting prices since there is no data that would provide any additional value to the investors. *The purpose of this paper is to answer the following questions*:

- Is there strong form efficiency in corn futures markets?

- Is there weak form efficiency in corn futures markets?

Numerous studies are available to determine market efficiency. Gopal and Sudhir [9] pointed of inefficiency of some commodity market .Pravakar and Rajiv [11] found no evidence supporting future market leads to higher inflation rather results suggested the efficiency of commodity futures market. Gurbandani and D.N, [6] tested the market efficiency of agricultural commodities traded on National Commodity Derivative Exchange of India and pointed out that Indian agricultural commodity market is efficient in week form of efficient market hypothesis. Ranajit and Asima [10] studied the efficiency of Indian commodity market in terms of price formation of agricultural commodities traded on commodity exchanges. By applying cointegration analysis and GARCH model on agricultural commodities they confirmed the cointegration between commodity futures and commodity spot market indices. Brajesh and Pandy [2] investigated the short run and long run market efficiency of Indian commodity futures market. They had tested four agricultural and even nonagricultural commodities for market efficiency and unbiasedness. The result confirmed the long run efficiency of commodity futures prices and inefficiency of futures prices in short run. Kaurand Anjum [7] shows the growth in commodity futures market along with identification of problems that are affecting the performance of agricultural commodity futures in India .

MATERIALS AND METHODS

Material

Data on corn prices comprise monthly and observations over the years 2007:7-2012:12, namely:

- Monthly /weekly corn price in exchange market in constant price 2004=100 in Rials of I.R Iran
- CPI

All of the above data were collected from the statistical office of exchange commodity of the I.R of Iran.

Methods

In this paper, the estimation problems associated with non stationary data are addressed by using co-integration techniques and error correction models. Initially, co-integration techniques are used to test for market efficiency in agricultural commodity futures markets while allowing for a constant risk premia. This follows the approach of Beck (1) , who similarly tested for efficiency in various commodities futures markets. If spot and futures prices are both non stationary and require differencing to make hem stationary, then in general most linear combination of the two series will also be non stationary. However, there may exist a co integrating vector, which makes a specific linear combination of the two series stationary. For example if $u_t = S_t - \alpha - \delta F_{t-1}$ is a stationary series, α and δ is the co integrating terms and the regression $S_t = \alpha + \delta F_{t-1} + u_t$ is the co integrating or equilibrium regression.

It implies that S_t and F_t cannot move too far apart from each other despite the fact that they are both non stationary. Co integration between the two series is a necessary but not a sufficient condition for market efficiency. Spot and futures prices are determined by the same fundamentals and so efficiency implies that they cannot move too far apart. However, cointegration does not rule out short run market inefficiencies, whereby past information can improve future market forecasts of future spot prices. A time series model of a cointegrated series can be written in an error correction form. Such a transformation renders the series stationary, and allows for normal hypothesis testing. The error correction model is as bellow:

$$\Delta S_t = -\rho u_{t-1} + \beta \Delta F_{t-1} + \sum_{i=2}^{m} \beta_i \Delta F_{t-1} + \sum_{j=1}^{k} \psi_j \Delta S_{t-j} + v_t \qquad (1)$$

Where Δ is defined as the change or difference in a variable from one period to the next, u_t is the error correction term, and v_t is a stationary series. Cointegration implies $\rho \rangle 0$ because spot price changes respond to deviations from the long run equilibrium equation $S_t = \alpha + \delta F_{t-1} + u_t$. Market efficiency implies that $\rho = 1,\ \rho\delta = \beta \neq 0 \ and \ \beta_i = \psi_i = 0$. The coefficient β for the current change in the futures price is non zero because new information, which also affects the futures price, affects the future change in the spot price. The additional restrictions that $\rho\delta = \beta,\ \rho = 1, and \ \beta_i = \psi_i = 0$ can be seen by rewriting equation 1, as shown below, where $S_{t-1} - \alpha - \delta F_{t-2}$ is substitute for u_{t-1}

$$S_t = (1-\rho)S_{t-1} + \beta F_{t-1} + (\rho\delta - \beta)F_{t-2} + \rho\alpha + \sum_{i=2}^{m} \beta_i \Delta F_{t-1} + \sum_{j=1}^{k} \psi_j \Delta S_{t-j} + v_t \qquad (2)$$

If the above restrictions did not hold then past future and spot prices would contain relevant information not completely incorporated in to current future prices, which could be used to predict S_t. The efficient markets hypothesis states that all past information should already be incorporated in to the current futures price, and therefore it should have no effect on the future spot price.Beck (1) shows that efficiency

tests based on equation 1 and the above restrictions allow for the existence of a constant risk premium. This is because unlike $S_t = \alpha + \delta F_{t-1} + u_t$, such tests do not impose the assumption that $\alpha = 0 \; and \; \delta = 1$. Thus if it is assumed that risk premia are constant and not time varying in nature, the two hypothesis of unbiasedness and efficiency can be tested for separately. Beck (1) performs such tests on various commodities futures markets. The unbiasedness hypothesis is examined using an error correction model as in equation 1 and testing the restrictions that $\beta = 1, \; \rho = 1, \; and \; \beta_i = \psi_i = 0$. The less restrictive market efficiency hypothesis tests the restrictions that $\delta = \beta, \; \rho = 1, \; and \; \beta_i = \psi_i = 0$. Beck (1) rejects the null hypothesis of unbiasedness, but cannot reject the null hypothesis of market efficiency at the 5% significance level for corn futures prices at a two month forecast horizon .The assumption that $\alpha = 0 \; and \; \delta = 1$, can be tested using the Johansen multivariate cointegration procedure. This approach estimates Likelihood Ratio tests for restrictions on the parameters of the cointegrating regression. The Engle Granger two step cointegrationprocedure cannot be used to test these restrictions, as the test procedure does not have all defined limiting distributions. If the hypothesis that $\alpha = 0 \; and \; \delta = 1$ cannot be rejected, long run market efficiency and unbiasedness may be inferred. In this case equation $u_t = S_t - \alpha - \delta F_{t-1}$ reduced to

$$u_t = S_t - \delta F_{t-1} \qquad (3)$$

The error correction model can now be estimated with a constant term as in below

$$\Delta S_t = \lambda - \rho u_{t-1} + \beta \Delta F_{t-1} + \sum_{i=2}^{m} \beta_i \Delta F_{t-1} + \sum_{j=1}^{k} \psi_j \Delta S_{t-j} + v_t \qquad (4)$$

The market efficiency hypothesis can now be analyzed by testing the restrictions that $\beta = 1, \; \rho = 1, \; and \; \beta_i = \psi_i = 0$. In this context any short run market in efficiencies cannot be due to long run market bias, and the two concepts of unbiasedness and market efficiency may be regarded as synonymous.

Finally, the above efficiency tests are also estimated using GARCH-M and ARCH-M models to take in to account a possibly short run time varying risk premia. Commodity prices have exhibited extensive volatility over the sample period analyzed. ARCH models provide a useful way to parameterize the time varying conditional variances observed in commodity market variables. In this case equation 3 can be written as 4 to include ARCH terms and the time varying risk premia term h_t, which is the conditional standard deviation of the change in spot prices. This was the approach taken by Engle, Lilien and Robins (4), when modeling the term structure of interest rate, and by Domowitz and Hakkio (3), who use this model to test for time varying risk premia within foreign exchange markets. Short hedgers, such as producers, sell futures contracts at a price below the expected future spot price to avoid price risk. The difference between the two prices, the risk premium, compensates purchasers of futures contracts for bearing the spot price risk. An increase in spot price risk, as measured by the conditional variance of spot prices, should increase the risk premium in the futures market.

$$\Delta S_t = \lambda - \rho u_{t-1} + \beta \Delta F_{t-1} + \sum_{i=1}^{q} \beta_i \Delta F_{t-1} + \sum_{j=1}^{k} \psi_j \Delta S_{t-j} + \theta h_t^2 + v_t$$

where $v_t = h_t . e_t$ and $h_t^2 = w + \sum_{i=1}^{q} \alpha_i v_{t-i}^2 + \sum_{j=1}^{p} \gamma_j h_{t-j}^2$ where $e_t \; \square \; IN(0,1)$.(5)

RESULTS

Since all price data used in this study are monthly or weekly time series, so at first the stationary of time series should investigated. Based on the results of stationary, all the variables are non stationary in level but they all are stationary in one difference. To test the long-term relationship between the spot and future prices of corn in the exchange of goods in the monthly and weekly time horizon –monthly from 2004:7 till 2012:12 and weekly from 2007:1st week of 7 till 2012:4th week of 12- it is used Johansen System Co integration Test and the Phillips-Ouliaris Single-Equation Co integration Test .

Table 1. Results of Johansen test for prices of corn in the exchange of goods

variable	Lag	α	δ	Trace Statistic $K=0$	Trace Statistic $K \leq 1$	Eigen value statistic $K=0$	Eigen value statistic $K=1$	result
Monthly:2004:7-2012:12								
corn price (BCP)	7	97.7 73.4	0.94 0.04	32.9 [20.26]	1.67 [9.16]	31.22 [15.89]	1.67 [9.16]	Existence of one cointegration vector

growth rate of corn price (DLBCP)	10	0.001 0.006 0.008	-0.24 0.22 0.17	23.01 [20.26] [20.26]	7.72 [9.16] [9.16]	15.28 [15.89] [15.89]	7.72 [9.16] [9.16]	Existence of one cointegration vector
Weekly:2007 1st week in 7-2012 4th week in 12								
corn price (BCPW)	9	-244.1 200.6	1.13 0.1	43.26 [20.26]	12.07 [9.16]	31.19 [15.89]	12.07 [9.16]	Existence of two cointegration vector
growth rate of corn price (DLBCPW)	12	-0.0007 0.003 0.003	0.73 0.14 0.1	77.99 [20.26] [20.26]	37.8 [9.16] [9.16]	40.18 [15.89] [15.89]	37.8 [9.16] [9.16]	Existence of two cointegration vector

Note: The numbers in parentheses represent the standard deviation of the numbers in brackets indicate the critical values of the test. Cointegration vector based on the spot price variable (St) is normal. * At 90% was confirmed.

Results of Johanson and the Phillips-Ouliaris Single-Equation Co integration tests showed the presence of normal convergence vectors between spot prices and futures. In other words, in the long term future and spot prices are closely related. Note that the convergence relationship does not mean causal relationship. Also, although the long-term prices associated with each other, but it can not necessarily conclude that this relationship reflects the market efficiency in the long term. Convergence means that variables move in time with each other.Holt (8) to assess the long-term relationship used hypotheses of $\alpha = 0, \delta = 1$ on the coefficients of the normal vector of Johansen cointegration test.What accept the long-term relationship of market efficiency is not rejecting oh this hypothesis. However, not rejecting of this hypothesis is for three reasons, however, represents a long-term market performance efficiency and lack of bias. To test this hypothesis, the constraint imposed on the connection method used Johansen co-integration test. Given the likelihood ratio test statistic has a chi-square distribution (χ^2), the approval or disapproval of the hypotheses to be tested.

In this case there are three hypotheses: One $\alpha = 0$, Another $\delta = 1$, And third $\alpha = 0, \delta = 1$. Hypotheses are simultaneously. Johansen test results on the convergence equation coefficients (α, δ) in the table below shows that the hypothesis $\alpha = 0, \delta = 1$ is rejected for all variables in the level of 99%. Although the long-term relationship exists between the spot price and futures, but this relationship has not been stable enough and does not indicate the efficiency and lack of bias in the stock market and traditional goods. Hence it can be concluded that corn in stock market in the time horizon monthly and weekly does not have long run efficiency or strong form efficiency.

Table 2. The results of the Johansen cointegration equations with constraints on corn prices

variable	α	δ	$\alpha = 0$		$\delta = 1$		$\alpha = 0, \delta = 1$	
			χ^2	Prob	χ^2	Prob	χ^2	Prob
Monthly:2004:7-2012:12								
corn price (BCP)	97.7	0.94	1.78	0.18	29.5	0.0	31.2	0.0
growth rate of corn price (DLBCP)	0.001	-0.24	0.03	0.85	2.12	0.14	2.6	0.27
Weekly:2007 1st week in 7-2012 4th week in 12								
corn price (BCPW)	-244.1	1.13	0.93	0.33	18.7	0.0	30.5	0.0
growth rate of corn price (DLBCPW)	-0.0007	0.73	0.047	0.8	2.29	0.12	2.3	0.3

Note: Cointegration vector is based on the spot price variable (S_t) is normal. * At 95% was confirmed.

Due to the approval of inefficiency in the long run, to test the efficiency or inefficiency in short run an error correction model by taking part a fix component is in the following equation estimates:

$$\Delta S_t = \lambda - \rho u_{t-1} + \beta \Delta F_{t-1} + \sum_{i=2}^{m} \beta_i \Delta F_{t-1} + \sum_{j=1}^{k} \psi_j \Delta S_{t-j} + v_t \quad (6)$$

Now we can test the hypothesis of market efficiency by imposing constraints of $\rho = 1, \beta = 1$ and $\beta_i = \psi_i = 0$. If it is confirmed, inefficiencies in short-term cannot cause bias in long run and the two concept of unbiased and efficiency in short-term will be synonymous with each other. The hypothesis test of $\rho = 1, \beta = 1$ and $\beta_i = \psi_i = 0$ from error correction model in the table below shows the performance of short-term market efficiency have been rejected. Low rate of adjustment and also the rejection of hypothesis of a single variable coefficient of future price with one lag (ΔF_{t-1}) are the reasons for inefficiency in the short term. However, there may be a risk or market interventions cause of this inefficiency.

Table 3 - Results of the estimation error correction model between spot and futures of monthly and weekly prices in Commodity Exchange.

	monthly corn	**weekly corn**
	BCP	BCPW
parameter	{7}	{9}
λ	5.01 (30.9)	-0.11 (9.33)
ρ	-0.41** (0.2)	-0.17*** (0.04)
β	-0.098 (0.08)	0.06** (0.03)
β_2	0.38*** (0.157)	-
β_3	0.49*** (0.15)	-
β_4	0.42*** (0.15)	-
β_7	0.4*** (0.01)	-
ψ_1	-0.37** (0.19)	0.32*** (0.06)
ψ_2	-	0.33*** (0.065)
ψ_3	-	0.14** (0.067)
ψ_4	-	-0.408*** (0.066)
ψ_5	-0.27*** (0.12)	-0.17*** (0.069)
ψ_6	-	0.21***

		(0.06)
ψ_7	-	0.13** (0.063)
ψ_8	-	-0.11** (0.06)
F	11.9***	14.03***
R^2	0.69	0.51
R^2_{Adj}	0.63	0.47
$H_0 : \beta = 1$	-11.26***	29.17***
$H_0 : \rho = -1$	2.88***	20.9***
$F\ test$	22.6***	138.3***

Description: The inside {} indicate the number of optimal intervals and standard deviation are reported in parentheses. * Indicates rejection of the null hypothesis at the 10% level, ** indicates rejection of the null hypothesis at 5%, *** indicate that the null hypothesis is rejected at the 1% level.
The only significant parameters have been reported. T-statistics are reported for each hypothesis $\rho = -1$ and $\beta = 1$. F test statistic for the hypothesis $\rho = -1, \beta = 1$ that all parameters simultaneously is equal to zero.

CONCLUSION

The assumption is that if market has poor efficiency, then market participants will acquire surplus profit or benefit. Market efficiency is an important criterion for the development of markets and development of risk management tools and guidance for assessing the performance of current scholarships and legally regulated market. Fama (5), the following conditions for the efficient market stated:
A) There are no transaction costs.
B) All information is available free of charge to all participants in the market.
C) To use all the current information for current prices and distribution agreement for future prices.
Although the long-term relationship exists between the spot price and futures, but this relationship has not been stable enough and does not indicate the efficiency and lack of bias in the stock market and traditional goods. Hence it can be concluded that corn stock market in monthly and weekly time horizon does not have long period of efficiency. The rejection of this hypothesis could be of costs of transport or risks or both.

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