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Determination of Agricultural Futures Contracts Specifications: A Case Study of Expiration Interval of Corn Futures Contracts in Iran

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Abstract: Optimal design of agricultural futures contracts specifications has an undeniable role in success or failure of these contracts. This paper investigates the effects of the changing expiration interval on the behavior of the futures prices of the agricultural products, for determining the best length of the averaging period for futures contract's settlement. In this study, the choice of expiration interval of corn futures contracts has been concerned, because of high level of traded spot contracts in Iran Commodity Exchange. By this purpose, first, a cash settlement index has been introduced and identified in order to calculating the futures prices. Next, in order to determining the best expiration interval, a GARCH (1,1) model has been applied to estimate the conditional volatility structure of calculated futures prices, in different scenarios. The results show that increasing the expiration interval leads to decreasing the volatility and increasing the level of corn futures prices. Therefore, the choice of lengthy expiration intervals causes to increasing hedging performance and hence induces corn producers and speculators to contribute in the futures market.

Key words: Futures contracts specifications · Cash settlement index · Expiration interval · GARCH model · Agricultural commodity exchange · Iran

INTRODUCTION

Nowadays emerging and developing the agricultural futures exchanges is known as a customary structural policy for reforming and resolving the agricultural traditional markets problems around the world. The history of utilizing such markets backs to early 1860's [1]. Studies on the history of establishment and evolution of agricultural futures markets all over the world indicate that introducing this kind of markets has been a response to some economic needs and in many cases, has removed some problems and obstacles in the markets of commodities. Perhaps, the traditional market failure and its inefficiency which have led to various forms of difficulties such as increasing price-risk or high fluctuation have been the most important motivations for establishment of these markets in many countries especially in the developing countries [2].

Following this motivation, Iran Commodity Exchange (ICE) has been established in 2005. But all of the contracts are made by cash in this exchange. These contracts can not play the role of hedge the producers in agricultural market and then such a cash market can not have the expected function in resolving the agricultural markets problems [1-4].

Although emerging agricultural futures market in Iran is a major requirement but it should be noticed that most of new futures contracts fail [5]. If we follow the criteria formulated by Silber [6], fifty-eight percent of the introductions have failed. The development and introduction of commodity derivatives is an expensive and time-consuming process, especially when it concerns new derivatives. Insight in the aspects that influence the success and failure of derivatives seems therefore valuable in designing futures contracts. Many studies have focused on this field. For example see Black [7], Brorsen and Fofana [5], Gray [8], Meulenberg and Pennings [9], Pennings and Egelkraut [10] and Pennings and Leuthold [11].

Optimal design of agricultural futures contracts specifications has an undeniable role in success or failure of these contracts. In this study the optimum expiration interval of agricultural futures contracts in Iran as one of the most important specifications of these contracts is considered.

MATERIALS AND METHODS

In this study the choice of expiration interval of corn futures contracts has been concerned, because of high

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level of traded spot contracts in ICE. The daily corn price data of ICE and both domestic and foreign corn price data of traditional market from January 9th 2005 up to March 19th 2007 were used in this study in order to simulation of cash settlement index and futures prices.

Determining the specifications of a futures contract for a feasible commodity starts with identifying a cash settlement index. The cash settlement index should be identified such an actual representation of market prices [12,13]. This index might be a simple or weighted average of cash market prices which involves either single or various markets [14]. The simplicity and minimum variability are two important specifications which should be considered in calculation of cash settlement index in order to increasing the interest and hedging performance of market participants in using the futures contracts [15]. Also increasing the range of sampling cash price data in both market location and time period of these data can be helpful by decreasing the probability of manipulation of this index [14].

After selecting an optimal cash settlement index, the corn futures prices was simulated in different scenarios of expiration intervals utilizing the methodology of Manfredo and Sanders [16].

If the futures price at the end of expiration interval T is equal to average value of the cash index over this interval, then:

$$F_{t,T} = F_{T,T} = \frac{1}{T}\sum_{i=1}^{T} S_i \qquad for \quad t = T$$

Where S_i is the cash index value at the ith day of expiration interval and $F_{t,T}$ is the futures price at any time t for settlement date T.

As in an efficient and rational market the futures price at time t for settlement time T is equal to the expected settlement price, we have:

$$F_{t,T} = E_t\left[\frac{1}{T}\sum_{i=1}^{T} S_i\right] \qquad for\, t \le T$$

In the other hand based on simple arbitrage arguments, the following relationships hold for storable commodities [3]:

$$E_t(S_K) = S_K \qquad for \quad K \le t \quad (known\ past\ present\ values)$$
$$E_t(S_K) = S_t e^{c(K-t)} \qquad for \quad K > t \quad (unknown\ future\ values)$$

Where K-t is the number of storage days and c is a constant value which involves the total daily carry costs (storage, interest and convenience yield).

According to previous relations the futures prices prior to entering the expiration interval (t<1) can be written as:

$$F_{t,T} = S_t \frac{1}{T}\sum_{i=1}^{T} e^{c(i-t)}$$

Also the amounts of futures prices during the expiration interval (1 ≤t≤T) can be calculated as:

$$F_{t,T} = \frac{1}{T}\left[\sum_{i=1}^{t} S_i + \sum_{j=t+1}^{T} S_t e^{c(j-t)}\right]$$

Then the effects of selecting different scenarios of expiration intervals on futures prices behaviors supposing to a conditional variance during time was investigated in a Generalized Autoregressive Conditional Heteroscedasticity framework (GARCH) utilizing this GARCH(1,1) model:

$$F_t = a_0 + a_1 S_t + \beta_1 D_{1t} + \beta_2 D_{2t} + e_t$$
$$s_t^2 = f_0 + f_1 s_{t-1}^2 + \theta e_{t-1}^2 + \psi_1 D_{1t} + \psi_2 D_{2t}$$

In the above conditional mean and variance equations, S_t and F_t are logarithm of spot and futures prices at time t respectively and D_{1t} and D_{2t} are two auxiliary variables to investigate the effect of changing the expiration interval on the futures prices in terms of levels and volatilities.

RESULTS AND DISCUSSION

In this study, four cash index were calculated utilizing the 1, 3 and 5 days moving averages values of corn prices in ICE and traditional market. These indexes including EX, TR, EXTR and MEXTR which are the mean values of corn prices in ICE, corn prices in traditional market, corn prices in both markets and median of corn prices in both markets respectively. Table 1 shows the results of calculating these indexes.

As the levels of corn prices are very different between ICE and traditional market, indexes which are calculated using just one of these markets price data could not be an optimal representative index of corn market of Iran. Then daily EXTR is the best cash settlement index as has the minimum variability among the different moving averages of this index and MEXTR index.

Table 1: The results of calculating four cash settlement indexes

Index	Moving average	Mean value of index	Standard deviation of basis (%)		Mean value of standard deviation of basis
			ICE prices	Traditional market prices	
EX	1 day	1664.02	0	1.76	0.88
	3 days	1663.23	1.18	1.83	1.5
	5 days	1662.40	1.54	2	1.77
TR	1 day	1866.71	1.76	0	0.88
	3 days	1866.09	2.02	1.06	1.54
	5 days	1865.46	2.24	1.5	1.87
EXTR	1 day	1765.37	0.88	0.88	0.88
	3 days	1764.66	1.45	1.27	1.36
	5 days	1763.93	1.77	1.6	1.68
MEXTR	1 day	1806.91	1.44	0.6	1.02
	3 days	1806.31	1.77	1.17	1.47
	5 days	1805.67	2.02	1.55	1.78

Table 2: Expiration interval, Mean value and standard deviation of futures prices in each scenario

	First period	Second period	Third period	Mean Value	Standard deviation (%)
First scenario	2 days	10 days	1 month	1956.76	2.71
Second scenario	2 days	1 month	10 days	1957.09	2.76
Third scenario	10 days	2 days	1 month	1956.93	2.72
Forth scenario	10 days	1 month	2 days	1957.3	2.79
Fifth scenario	1 month	2 days	10 days	1957.39	2.79
Sixth scenario	1 month	10 days	2 days	1957.44	2.81
Spot prices				1798.46	2.62

Having the cash settlement index, corn futures prices were simulated in six different scenarios. In order to making these scenarios, the total considered period of this study (January 9th 2005- March 19th 2007) was divided into three periods of time and different lengths of expiration intervals (2, 10 and 30 days) were applied in each period of time of all scenarios. Table 2 illustrates the summary of simulating futures prices in each scenario.

In order to determining the best expiration interval of corn futures contracts a GARCH(1,1) model was used for investigating the effect of changing the expiration interval on the futures contract conditions. Two binary auxiliary variables - D_1 and D_2 - have been utilized for calculating the impact of selecting the various expiration intervals on the conditional variance and mean value of futures prices. D_1 and D_2 were taken equal to 0 in the cases of two days and ten days expiration intervals respectively and equal to 1 in the rest of cases. The following results were achieved after estimating the GARCH (1,1) model:

•First scenario

$$F_t=2.2575+0.6968S_t+0.0871D_{1t}+0.0637D_{2t}+\varepsilon_t$$
$$(0.0065)\ (0.0009)\ (0.0025)\ (0.0023)$$
$$s_t^2=0.0002+0.6075\,s_{t-1}^2+0.1953\,e_{t-1}^2-0.0001D_{1t}-0.0001D_{2t}$$
$$(0.0001)\ (0.0604)\ (0.0417)\ (0.0001)\ (0.0001)$$

•Second scenario

$$F_t=2.4215+0.6935S_t+0.0187D_{1t}-0.0705D_{2t}+\varepsilon_t$$
$$(0.0392)\ (0.0052)\ (0.0017)\ (0.0016)$$
$$s_t^2=0.6641\,s_{t-1}^2+0.3097\,e_{t-1}^2$$
$$(0.0375)\ (0.0692)$$

•Third scenario

$$F_t=2.2611+0.6963S_t+0.0619D_{1t}+0.0893D_{2t}+\varepsilon_t$$
$$(0.0065)\ (0.0009)\ (0.0023)\ (0.0026)$$
$$s_t^2=0.0002+0.6071\,s_{t-1}^2+0.1946\,e_{t-1}^2-0.0001\,D_{1t}-0.0001D_{2t}$$
$$(0.0001)\ (0.0602)\ (0.0414)\ (0.0001)\ (0.0001)$$

•Fourth scenario

$$F_t=2.3164+0.7075S_t-0.0696D_{1t}+0.0184D_{2t}+\varepsilon_t$$
$$(0.0410)\ (0.0054)\ (0.0016)\ (0.0017)$$
$$s_t^2=0.6337\,s_{t-1}^2+0.3511\,e_{t-1}^2$$
$$(0.0437)\ (0.0852)$$

•Fifth scenario

$$F_t=2.3932+0.7032S_t-0.0274D_{1t}-0.0899D_{2t}+\varepsilon_t$$
$$(0.0434)\ (0.0056)\ (0.0016)\ (0.0019)$$
$$s_t^2=0.6596\,s_{t-1}^2+0.3317\,e_{t-1}^2-0.0001D_{2t}$$
$$(0.0384)\ (0.0756)\ (0.0001)$$

•Sixth scenario

$$F_t=2.1679+0.7323S_t-0.0828D_{1t}-0.0235D_{2t}+\varepsilon_t$$
$$(0.0394)\ (0.0051)\ (0.0019)\ (0.0015)$$
$$s_t^2=0.6435\,s_{t-1}^2+0.3419\,e_{t-1}^2-0.0001D_{1t}$$
$$(0.0458)\ (0.0822)\ (0.0001)$$

According to the results of first, third, fifth and sixth scenarios, increasing the expiration interval causes to decreasing the conditional variances of futures prices while the second and fourth scenarios shows that this increasing has not a clear impact on the conditional variances of futures prices. Also the hypothesis based on positive effect of increasing the expiration interval on the mean value level of futures prices is not rejected in none of these scenarios.

Then it is clear that increasing the expiration interval decreases the variance and increases the mean value of futures prices. Decreasing the variability of futures prices could improve the hedging performance of market participants and regular increasing the mean level of futures prices could improve their speculating interests. Therefore selecting lengthy expiration intervals such as one month expiration interval seems more suitable in the case of corn futures prices in Iran.

CONCLUSIONS

According to the results of this study the best cash settlement index in the case of corn futures contracts is daily EXTR index which is the daily average of corn cash prices in the both ICE and traditional market of Iran. Also the results show that increasing the expiration interval leads to decreasing the volatility and increasing the level of corn futures prices. Therefore, the choice of lengthy expiration intervals causes to increasing hedging performance and hence induces corn producers and speculators to contribute in the futures market [15-18].

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