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Hossein-Yekani, Seyed-Ali and Bakhshoodeh, Mohammad

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THE IMPORTANCE OF DEVELOPING FUTURE CONTRACTS: A CASE STUDY OF IRAN AGRICULTURAL COMMODITY EXCHANGES

ALI HOSSEINI YEKANI
MOHAMMAD BAKHSHOODEH

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Ali Hosseini Yekani and Mohammad Bakhshoodeh

Respectively, PhD Student and Associate Professor, Department of Agricultural Economics, College of Agriculture, University of Shiraz, Iran.

Abstract:

In addition to interest in establishing local exchanges, there are growing interests in countries without futures markets to use established contracts on existing world exchanges. Cash contracts are dominant in Iran Agricultural Commodity Exchange (IACE), established recently in 2004 but cannot play relevant role of hedge for producers in agricultural markets. This paper attempts to find out either existing future contracts in the exchanges of rest of the world or establishing new future contracts are more relevant for the IACE. In this regard, we utilized the basis risk analysis to study whether or not local physical cash markets in Iran have a strong price relationship to existing futures contracts. The usefulness of making future contracts available at the IACE operators is also investigated using simulation of futures price in a Monte Carlo approach framework. The results showed that the usefulness of the particular foreign future contract (such as Tokyo Grain Exchange) in hedging domestic cash price risks is low. Either, there could be inefficiencies related to the transmission of information to the Iran agricultural markets. Furthermore, using effective risk management tools are needed for such future contracts in the IACE.

Keywords: Basis Risk Analysis, Monte Carlo simulation approach, Future Contract, Iran exchange.

1. Introduction

The price volatility of agricultural commodities is a major source of risk for producers and agribusiness firms. In recent years, there has been an explosion in establishing commodity exchanges and development of new contracts on existing exchanges for hedging producers from market risks. In addition to interest in establishing local exchanges, there is growing interest in countries that have no futures markets to use established contracts on existing world exchanges. In the agricultural commodity area, countries that have a strong price relationship between a particular commodity and the corresponding futures contract use existing contracts extensively for risk management purposes (Figiel et al., 1997). A good example for this is the use of the Chicago Board of Trade (CBOT) soybean futures market by Argentine and Brazilian soybean exporters. The US, Brazil and Argentina all are extensive participants in the world soybean export markets. This creates a linkage between prices in the three countries and this linkage creates hedging possibilities for South American exporters.

Iran Agricultural Commodity Exchange (IACE) has been recently established in 2005 where contracts are made by cash. The commodities traded in IACE include corn (67%), oilseed meals (20%), barley (10%), sugar (1.5%), rice (1%), chickpea (0.4%), lentil, pistachio and saffron (almost 0.1% together). These contracts can not play the role of hedge the producers in agricultural market. Establishing new futures contracts in IACE may have some advantages compared to existing futures contracts in the other exchanges of world. In this context, we are interested to study whether or not local physical cash markets in Iran have a strong price relationship to existing futures contracts.

In absence of strong price correlation, development of a contract based on local needs might be the best way to satisfy local price risk management interests. Some evidences are available for such a claim. For example, the lack of price correlation between Malaysian palm oil markets and the CBOT soybean oil futures contract has supported the development of palm oil futures on the Kuala Lumpur Commodity Exchange (KLCE). Similarly, the establishment of an exchange that would trade coffee futures is being considered in Indonesia as local prices often are moving in divergence to prices traded in coffee futures markets in New York and London.

Many studies have focused on the relationship between the domestic and world prices of main agricultural commodities. Figiel et al. (1997) investigated the impact of government policies on the relationship between Polish and world wheat prices and founded that wheat cash prices in Poland are not closely related to futures prices in Chicago and London. Also, Du (2004) compared the price behavior of the China Zhengzhou Commodity Exchange (CZCE) with that of the Chicago Board of Trade (CBOT) in the US. Results showed that the existing interrelations between the two markets are significant and asymmetric, where CBOT holds a dominant position in the interactions while CZCE is more likely a follower (See Durham and Si, 1999 and Bamba, 2004).

The main purpose of this study is investigating existence the price relationship between Iran physical cash markets and world futures exchanges.

The results of this study will have practical value to Iranian producers considering the use of futures markets. Moreover, this analysis has policy implications with regard to whether or not a futures exchange in Iran is needed.

2. Methodology

In this study, the basis risk analysis is used to investigate the existence of price relationship between the domestic cash markets in Iran and existing futures contracts in the other commodity exchanges.

The basis in a hedging situation is defined as (Figiel *et al*., 1997 and Hull, 2000):

Basis =spot price of commodity to be hedged - futures price of contract used

If the commodity to be hedged and the commodity underlying the futures contract are the same, the basis should be zero at the expiration of the futures contract. Prior to expiration, the basis may be positive or negative. The basis increases when the spot price increases more than the futures price and decline vice versa. Increase in the basis is referred to as a strengthening of the basis and its decline is referred to as a weakening of the basis (Figiel *et al*., 1997 and Hull, 2000).

Basis risk is defined as the fluctuation of basis. If there is a strong price relationship between the physical cash market and the futures market, price changes in the physical cash market will be reflected in the futures market. In practice, the firm has shifted its

risk of declining prices to the futures market; of course the firm has also foregone the opportunity to benefit from price increases. This risk shifting process is one of the primary values of a futures market (Du, 2004, Figiel *et al*., 1997 and Hull, 2000). However, not all of the risk can be shifted as there is never a perfect relationship between cash and futures markets. There is always some residual risk associated with the hedging process. This residual risk (the price risk that can't be shifted to futures markets) is commonly referred to as the basis risk. In other words, the basis risk is the price variation in the physical cash market that can not be explained by futures price variation (Hull, 2000). A low level of variation in the basis implies that there is a strong price relationship between cash and futures markets and viable risk management strategies can be devised. A high level of basis variation indicates that the relationship between the physical cash market and the futures market is not strong and that not enough risk can be shifted to make the hedging operation useful (Hull, 2000).

In order to assess the correlation between cash prices and the corresponding futures prices, the ordinary least square regression is used. In this study to estimate equation (1):

$$s(t) = a + b^* f(t) \qquad (1)$$

where s(t) and f(t) are the spot and futures prices at time t respectively. In this single equation, coefficients are estimated under assumption that the structural relationship described by the equation is invariant over time. Therefore, we applied the Augmented Dickey-Fuller (ADF) statistics for nonstationarity test of s(t) and f(t) series, before estimating the above single regression.

The adjusted R squared of considered regression can be viewed as one way of measuring the residual risk inherent in the basis (Figiel *et al*., 1997). The adjusted R squared in regression (1) indicates the percentage of the variability in cash prices that is explained by the futures prices. The percentage of the cash price changes that is unexplained (1-R squared) is an estimate of the basis risk. The higher the unexplained variability, the lower the value of the adjusted R squared (the higher the basis risk), and the lower the usefulness of the particular foreign futures contract in hedging domestic cash price risks.

In the last section of this study, usefulness of making future contracts available to IACE operators is investigated using simulation of futures price within a Monte Carlo approach framework.

So far, the price simulation is appraised in very studies and in a Monte Carlo framework specially (see Broadie *et al*., 1997, Chuan Duan and Wei, 1999 and Longstaff and Schwartz, 1998). To use this approach in future price simulation, first it is necessary to determine the model of price behavior. The quantity of random disturbance term is calculated using Monte Carlo approach and then the prices are forecasted for future days. According to assumptions about the type of distribution of random disturbance term, researchers usually use different types of price behavior models such as Markov process, Wiener process, Generalized Wiener process and Ito process (Deaton, D.A. and Laroque, G., 1992 and Hull, 2000).

Based on Jarque-Bera Normality test in this study, we use the geometric Brownian motion that is the developed model of Markov process. The discrete-time version of the model is (Hull, 2000):

$$\frac{\Delta S}{S} = \mu \Delta t + \sigma \varepsilon \sqrt{\Delta t} \qquad \textbf{(2)}$$

that is:

$$\Delta S = \mu S \Delta t + \sigma S \varepsilon \sqrt{\Delta t} \qquad \textbf{(3)}$$

ΔS denotes the change in commodity price in a small interval of time (Δt), and ε is a random drawing from a standardized normal distribution (that is a normal distribution with a mean of zero and standard deviation of one). The parameters μ and σ are the mean and standard deviation of daily price changes respectively.

The standard deviation of daily price changes is calculated as (Hull, 2000):

$$\sigma_n^2 = \frac{1}{m} \sum_{i=1}^{m} (u_{n-i} - \bar{u})^2 \qquad \textbf{(4)}$$

$$u_i = \frac{S_i - S_{i-1}}{S_{i-1}} \qquad \textbf{(5)}$$

Where, u_i is the price changes in i^{th} day defined as:

Given prices, the mean and the standard deviation of price changes, it is necessary to know the accurate estimation of Δt. Therefore, we use the inverse of the number of price changes (number of trading days) as the amount of Δt.

In this study, corn is selected as the representative commodity traded in IACE and the other agricultural commodity exchanges of the world, because of high level of traded contracts in IACE (about 67%) and frequently existence in the main agricultural commodity exchanges of the world such as CBOT, EURONEXT and TGE.

Furthermore, the Tokyo Grain Exchange (TGE) historical price data is selected as the world corn futures prices because of having relevant market conditions in Asia and high level of traded commodity.

We used daily historical price data of IACE (spot prices) and TGE (nearby futures prices) corn from this date to September 2005. TGE corn prices are converted to Iranian rials (Rls) equivalent prices. Also, we use daily historical price data of traditional market of corn in Iran (both domestic and foreign corn).

3. Results and discussions:

In order to achieve a suitable perspective of corn market in Iran and Japan, we considered the corn price variation over time. The primary objective of examining variation over time was to gain insight into the degree of Iran price volatility. The basic method was to quantify the spread of minimum and maximum prices and the monthly coefficient of variation.

As is shown in Table 1, there is a great deal of variation observed over time in corn prices in Iran. Where, prices tend to be very volatile especially in traditional markets. Comparing these prices with those in TGE, Iran corn prices exhibit strong monthly fluctuations. For example, during the time period covered, corn price variation as measured by the coefficient of variation ranged from 0.8% to 4.8% in IACE and from 1.1% to 6.3% in Iran traditional foreign corn market while the coefficient of variation over the same period of time is 1.2% to 3% at the TGE.

This price variability over time represents great price risk for those who operate in the Iran corn market. It also indicates a need for using effective risk management tools.

Table 1. Variation over time of daily corn prices in IACE, TGE and traditional markets of Iran (Rls/kg)

	Market	Min	Max	Spread (Max-Min)	Mean	Std. Dev.	CV (%)
OCT 2004	IACE	1445	1580	135	1528.4	34.0	2.2
	TGE	1213	1277	64	1243.0	14.5	1.2
NOV 2004	IACE	1405	1540	135	1436.7	47.1	3.3
	TGE	1152	1231	79	1185.3	18.9	1.6
DEC 2004	IACE	1415	1530	115	1454.6	38.9	2.7
	TGE	1149	1255	106	1193.0	31.2	2.6
JAN 2005	IRAND	1630	1700	70	1661.4	31.6	1.9
	IRANF	1920	2000	80	1973.6	34.1	1.7
	IACE	1446	1680	234	1506.6	62.9	4.2
	TGE	1176	1247	71	1203.9	16.8	1.4
FEB 2005	IRAND	1700	1750	50	1724.2	21.8	1.3
	IRANF	1940	2000	60	1969.2	24.0	1.2
	IACE	1485	1700	215	1585.0	76.6	4.8
	TGE	1123	1289	166	1214.3	32.6	2.7
MAR 2005	IRAND	1720	1730	10	1722.9	4.5	0.3
	IRANF	1940	1990	50	1975.7	22.6	1.1
	IACE	1470	1510	40	1497.9	11.9	0.8
	TGE	1183	1263	80	1219.3	24.8	2.0
APR 2005	IRAND	1670	1800	130	1748.3	56.1	3.2
	IRANF	1720	1970	250	1848.3	116.0	6.3
	IACE	1450	1560	110	1499.2	37.9	2.5
	TGE	1157	1284	127	1213.7	36.7	3.0
MAY 2005	IRAND	1630	1740	110	1695.0	47.2	2.8
	IRANF	1670	1720	50	1702.5	20.5	1.2
	IACE	1395	1535	140	1432.5	59.2	4.1
	TGE	1163	1237	74	1195.3	26.8	2.2
JUN 2005	IRAND	1600	1750	150	1652.2	37.6	2.3
	IRANF	1700	1830	130	1756.7	32.3	1.8
	IACE	1540	1708	168	1616.4	51.7	3.2
	TGE	1136	1250	113	1214.0	25.7	2.1
JUL 2005	IRAND	1660	1760	100	1698.9	33.2	2.0
	IRANF	1750	2050	300	1862.4	95.2	5.1
	IACE	1527	1667	140	1585.6	33.1	2.1
	TGE	1171	1251	80	1202.5	22.9	1.9
AUG 2005	IRAND	1680	1770	90	1728.1	32.6	1.9
	IRANF	1850	2080	230	1985.7	73.3	3.7
	IACE	1500	1630	130	1558.7	31.4	2.0
	TGE	1094	1186	92	1137.5	25.0	2.2

Clearly under such conditions alternatives such as hedging with derivatives that are already available in many countries markets should be examined.

The estimation of the R squared using the regression analysis described in section 2 was performed for the overall considering period. In this way, first we used Dickey-Fuller (DF) statistics for stationarity test of four considering series, because the results of Breusch-Godfrey Serial Correlation LM Test showed that there were not residual serial correlation and no need to use Augmented Dickey-Fuller (ADF) test. The DF test results showed that the price series of IACE and TGE are stationary in level, but the price series of traditional market (both domestic and foreign corn) are I(1) and therefore, their first difference would be stationary.

Then, in addition to the correlations with prices in levels, correlation of lagged prices (in 5 scenarios) was assessed. The results (quantified adjusted R squared) are showed in Table 2. In general, there were poor correlations among the price series examined in this section.

Table 2. Correlation of corn spot prices in Iran regressed against respective TGE nearby futures prices (level and lagged)

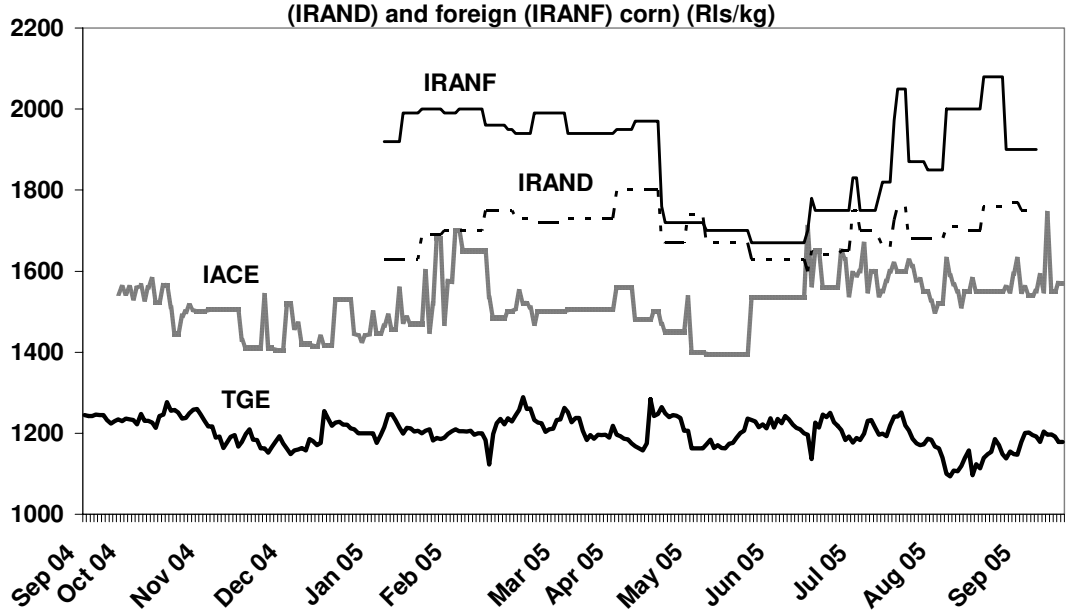
IACE against TGE		IRAND against TGE		IRANF against TGE	
-0.002		-0.006		-0.013	
		IACE against TGE			
1-week	2-week	3-week	4-week	5-week	6-week
-0.006	-0.007	0.000	0.019	0.017	0.035

As shown in Table 2, the lagging process improves the correlation results, especially when prices are lagged more than one month.

After examining the numerical correlations, it is worthwhile to take a more graphical look at the relationship between Iran corn prices and futures prices on the TGE. The prices of IACE, TGE and traditional corn market prices are shown in Figure 1.

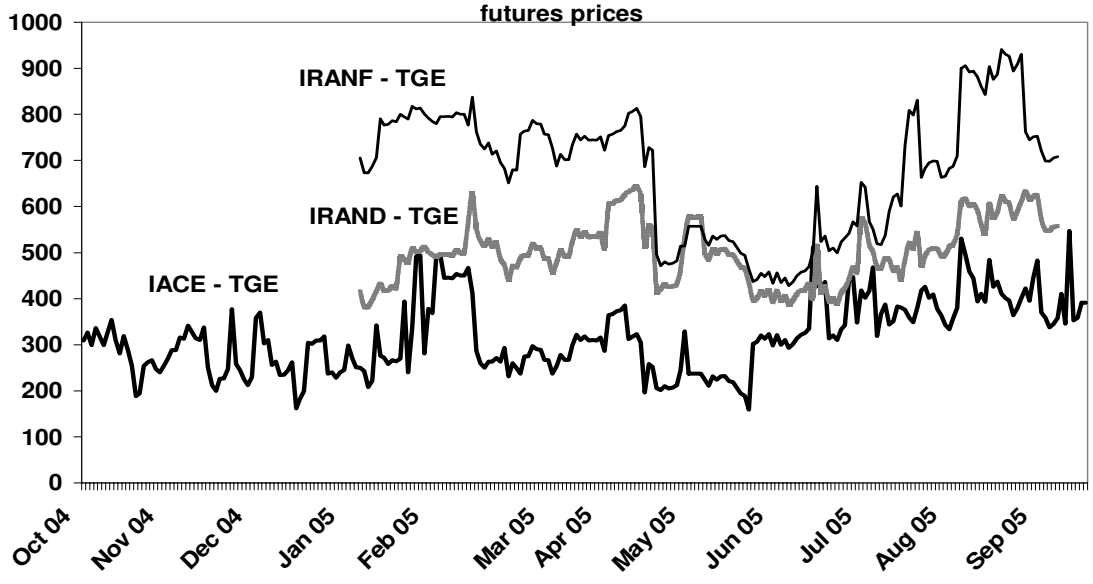
As noted before, when engaged in hedging activities, a commercial firm thinks in terms of residual risk or more commonly a basis risk. This risk is the fluctuation of the price differential between cash and futures prices (basis).

Figure 1. Corn prices in IACE, TGE and Iran traditional market (domestic (IRAND) and foreign (IRANF) corn) (Rls/kg)



In the case of our analysis, the physical cash price is the IACE and traditional corn market prices and the futures price is TGE price. A graphical display of these relationships is shown in Figure 2. This Figure shows visually the strong basis risk of the Iran corn basis using TGE futures prices as a base.

Figure 2. Basis between IACE and Iran traditional market cash and TGE futures prices



In the last part of this study, we investigate the usefulness of making future contracts available of IACE operators, using simulation of futures price in a Monte Carlo approach framework.

To use this approach in future price simulation, first it is necessary to determine the model of price behavior. In order to specify the best model that shows the corn price behavior in IACE, Jarque-Bera statistic is used to test normality of corn price time series. The results show that the null hypothesis based on normal distribution of corn price time series is not rejected in 99% confidence level. Table 3 shows the existence of normal distribution in corn price time series and the results of Jarque-Bera test.

Table 3. The results of normality test of corn price time series in IACE

Statistics	Price (Rls)
Mean	1533.42
Median	1542.50
Maximum	1743.00
Minimum	1395.00
Standard Deviation	70.81
Skewness	0.18
Kurtosis	2.99
Jarque-Bera	0.83
Probability (Confidence Level of Test)	0.66

As is noted in methodology section, according to the results of Jarque-Bera normality test, the geometric Brownian motion model is used to simulate corn future prices in IACE. Six representative days in two periods of time are selected for start simulation in Monte Carlo framework. In the first time period, price simulations are done for the last days of December 2004, January 2005 and February 2005 to the last day of April 2005 and in the second period, price simulations are started in the last days of June, July and August and finished in the last day of September 2005. Simulated in different times, Figures 3-1 to 3-3 exhibit the results of corn price simulations in the time period of Sep 2004-Apr 2005, and Figures 4-1 to 4-3 show similar results whithin SEP 2004-SEP 2005. The lower lines in each of these three figures show the future corn prices at TGE and the upper graph shows the corn prices at IACE in which, the solid section shows the corn cash prices and the dashed section exhibits the corn simulated prices.

Figure 3.1 Corn price simulation (from Jan 2005 onward) (Rls/kg)

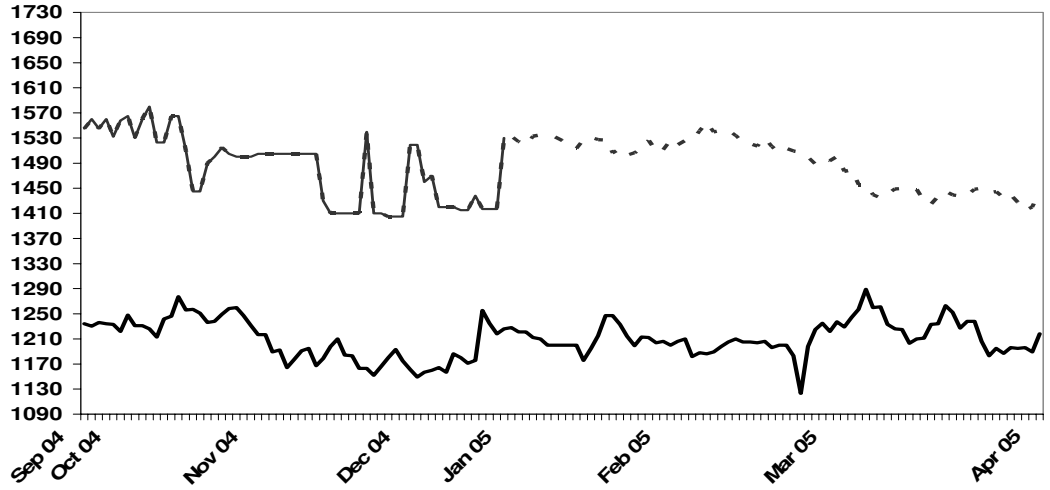


Figure 3.2 Corn price simulation (from Feb 2005 onward) (Rls/kg)

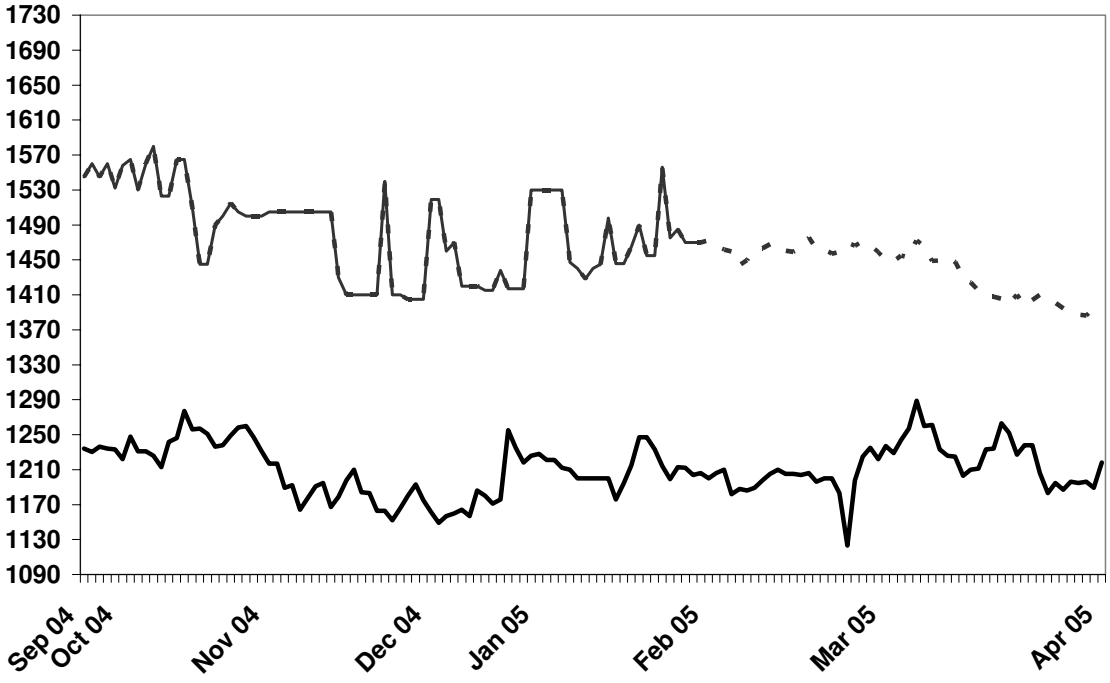


Figure 3.3 Corn price simulation (from Mar 2005 onward) (Rls/kg

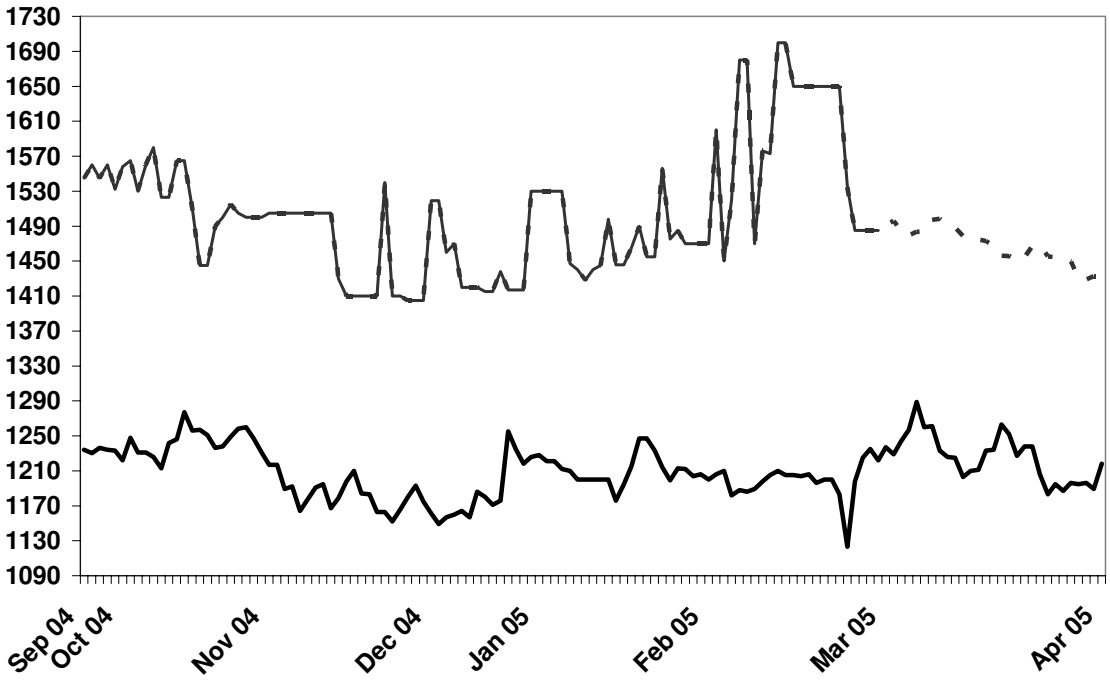


Figure 4.1 Corn price simulation (from Jul 2005 onward) (Rls/kg)

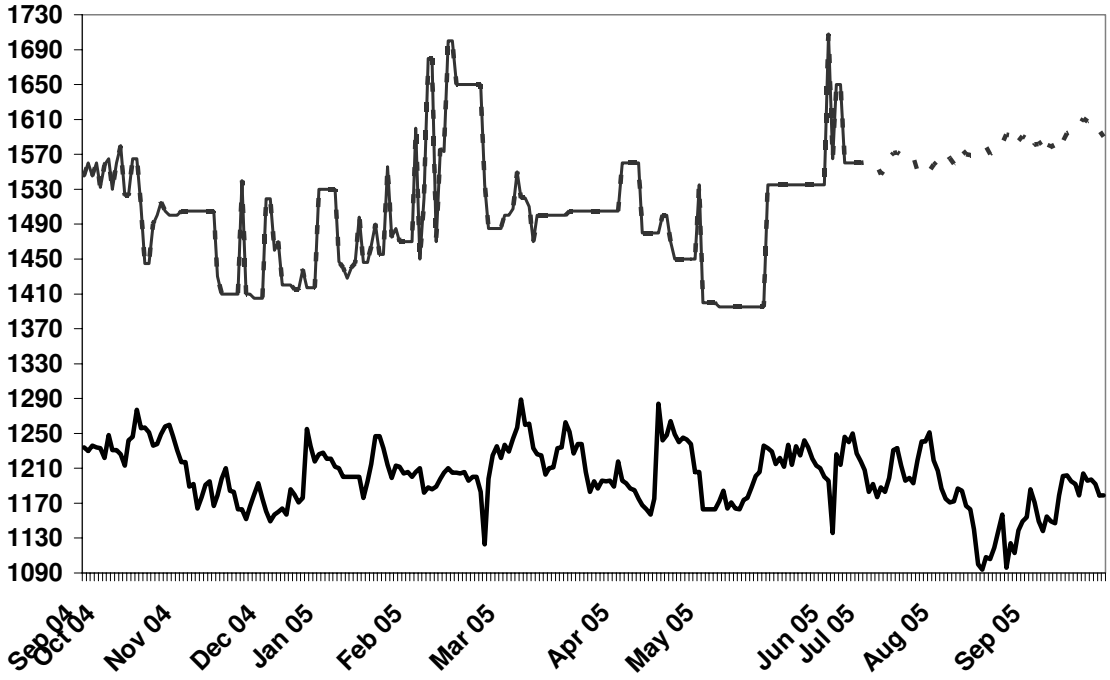


Figure 4.2 Corn price simulation (from Aug 2005 onward) (Rls/kg)

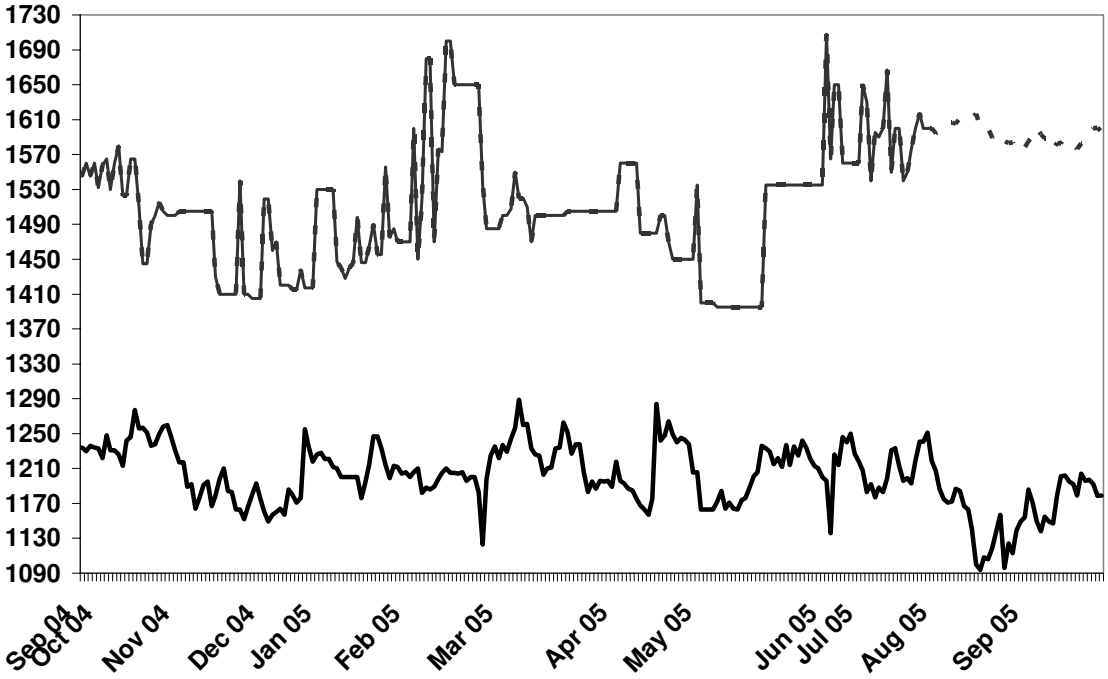
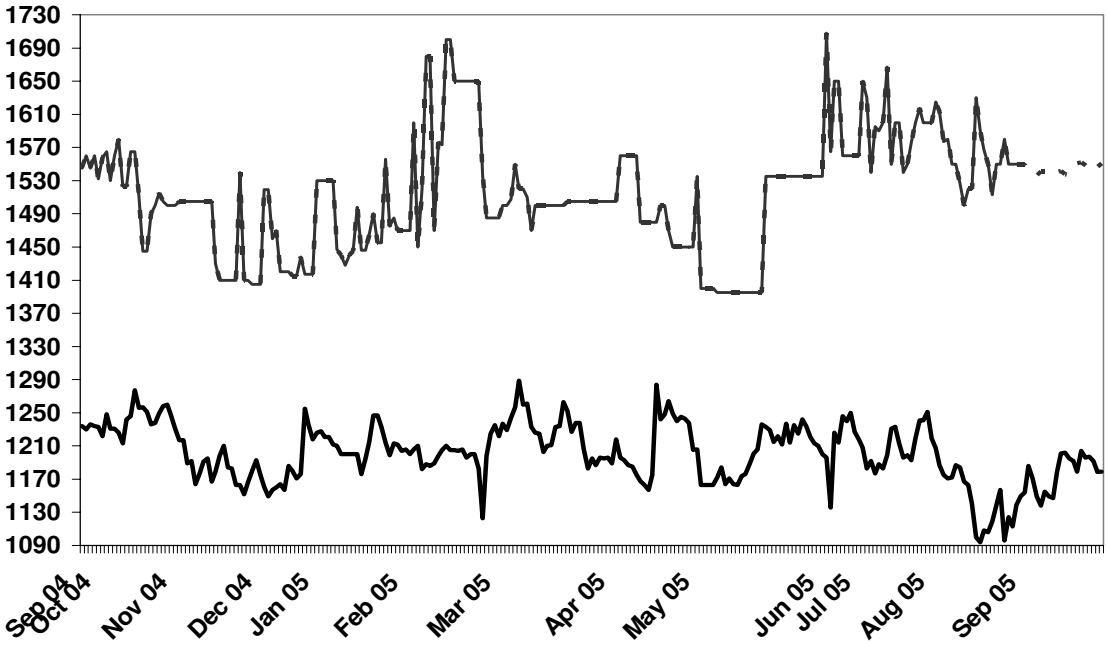


Figure 4.3 Corn price simulation (from Sep 2005 onward) (Rls/kg)



These figures indicate that the corn future prices in IACE (simulated price) and TGE have no correlation in any considered states. Therefore, the existing futures contracts in

the TGE are not a suitable and strong substitution for establishing new futures contract in IACE.

4. Conclusions:

The results of this study showed that, in Iran, prices tend to be very volatile especially in traditional market. Comparing these prices with those at the TGE, Iran corn prices exhibit strong changes in variation from month to month. This price variability over time represents great price risk for those who operate on Iran corn market. It also indicates a need for using effective risk management tools that under such conditions, alternatives such as hedging with derivatives that are already available in many countries should be examined.

In general, there is poor correlation among the Iran spot and TGE futures prices. In other words, there is strong basis risk in the Iran corn basis using TGE futures prices as a base. Therefore, the usefulness degree of the particular foreign futures contract (such as TGE) in hedging domestic cash price risks is low.

The lagging process improves the correlation results, especially when prices are lagged more than one month. This suggests that there could be inefficiencies related to the transmission of information to the Iran corn markets. In other words, it takes up several times for factors readily apparent to those trading at the TGE (as representative market of world) to be fully discounted into the Iran corn market.

According to the results of price simulation in Monte Carlo framework, there is no correlation between the TGE future prices and IACE simulated prices. Therefore, the existing futures contracts in the other agricultural commodity exchanges of world (such as TGE) are not a strong substitution for establishing new futures contract in IACE.

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