



Received: 08 November 2013  
Accepted: 15 July 2014  
Published: 22 August 2014

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Reviewing editor:  
Sergi Jimenez, Universitat Pompeu Fabra, Spain

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## RESEARCH ARTICLE

# The management of price risk in Iranian dates: An application of futures instruments

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**Abstract:** Effective risk management is an important aspect of farming. Risk management involves choosing among alternatives that reduce the financial effects of the uncertainties of weather, yields, prices, government policies, and other factors that can cause wide swings in farm income. To deal with price uncertainty, this paper focuses on futures markets and calculates hedge ratio for dates. A bivariate BEKK GARCH model is used to determine time-varying hedge ratios. The results show that the average BEKK BGARCH hedge ratio for dates is .7. Also in this paper, the hedge ratio, which takes into consideration the producers' risk-averse parameter, is estimated [Extended mean Gini hedge ratio (EMGHR)]. Results of EMGHR recommended that risk-averse producers, who have risky parameter equal to 50, could reduce their price risk to 60% by attending futures markets.

**Keywords:** hedge ratio, BGARCH, EMG hedge ratio, bootstrap, dates

**JEL classifications:** C<sub>1</sub>, C<sub>15</sub>, C<sub>32</sub>, D<sub>4</sub>, D<sub>18</sub>, G<sub>14</sub>

## 1. Introduction

Risks faced by farmers are numerous and varied, and are specific to the country, climate, and local agricultural production systems. These risks and their impacts on farmers are widely researched (World Bank). Price risks occur due to changes in supply and demand, which are beyond the control of producers, but they can be managed using market tools (Ai, 2012). With a tendency toward a decline in government support programs like direct subsidy programs, producers are forced to identify these risks and use private risk management strategies such as future contracts to alleviate losses themselves (Ai, 2012).

## ABOUT THE AUTHOR

Habibeh Sherafatmand is a PhD holder and has graduated in agricultural economics with the rank of first, at Islamic Azad University—Science and Research branch, Tehran. This paper is a derivation from my PhD Thesis. My research interests include applied econometrics, macroeconomics and microeconomics analysis, and different market and consumer demands.

## PUBLIC INTEREST STATEMENT

This paper introduces futures market as an effective tool to deal with dates producer price risks. The present paper applied Bivariate GARCH time series model. Also this paper takes into consideration the risk-averse phenomena of producers (farmers). The estimation sample includes monthly observation from 1990 to 2011. The results show that futures markets could achieve more than 70% price-risk reduction using futures contracts. Results also show that the producers who are 50° of risk-averse parameter are the most to gain from the futures market. So for Iranian dates producers, the development of futures markets is recommended.

Future contracts for agricultural producers generally involve selling commodity futures because producers of the commodity want to lock in a price floor. Simultaneously, speculators and investors looking to lock in a price ceiling are buying the contract. Commodity futures markets thus provide a means to transfer risk between persons holding the physical commodity (hedgers) and investors speculating in the market (Choudhry, 2009).

The purpose of this paper is to answer the following questions:

- Are futures markets effective tools for the management of date price risk?
- What are the optimal hedge ratios for dates?
- Do time-varying hedge ratios perform better than constant hedge ratios?
- How much variation can be reduced by hedging in futures markets compared with a no-hedging position?
- What are the optimal hedge ratios for dates by consideration of risk-averse parameter?

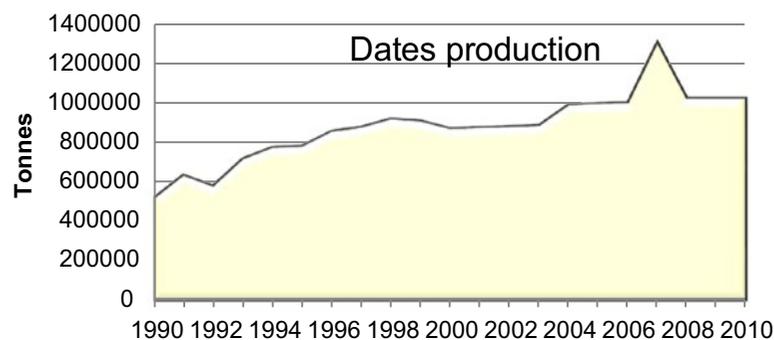
## 2. Market status of Iranians dates and their price volatility

Dates represent a major portion of Iran’s agricultural economy. Figure 1 shows that the production of dates has been relatively stable over the last 20 years, with only a slight increase in 2007. In 2010, Iran’s dates yield was 63,326.4 Hg/Ha. Dates products provide nearly 1.3% of the total agricultural export value. In the years 2008, 2009, and 2010, cash receipts for dates export contributed \$101,783,000, \$55,819,000, and \$134,001,000, respectively.

Trade is an important part of Iran’s dates demand. According to the F.A.O., the amount of dates exported in 2010 was about 106,760 Tons. Iran has ranked as the second and fourth largest dates exporter in the world for the past years. Figure 2 shows that Iran was the third largest dates producer in the world in 2010. Iran’s dates exports fluctuated during 1990–2010. The maximum amount of dates exported occurred in 1996.

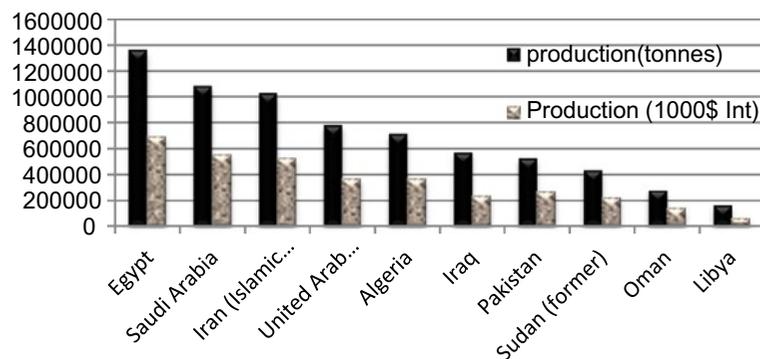
**Figure 1. Dates production during 1990–2010.**

Source: Food and Agriculture Organization (F.A.O.).



**Figure 2. Top dates producers in 2010.**

Source: Food and Agriculture Organization (F.A.O.).



Although dates play an important role in Iran’s country’s exports, its producers always suffer from price fluctuations. As can be seen in Figure 3, producer dates prices were not stable during 1990–2011. The difference between the highest and lowest prices in the past 20 years was almost 3,354.3 Rials/kg, which indicates that the highest dates producer’s price was almost 2.5 times as much as the lowest price; therefore, dates prices have carried risk.

Not only are there fluctuations in producers prices between years but these price fluctuations and variations also exist within a year and during a year (in sample months of a year). Figure 4 shows the producers’ price fluctuations in different months. The Symbol • in Figure 4 indicates the month in which Ramadan occurred.

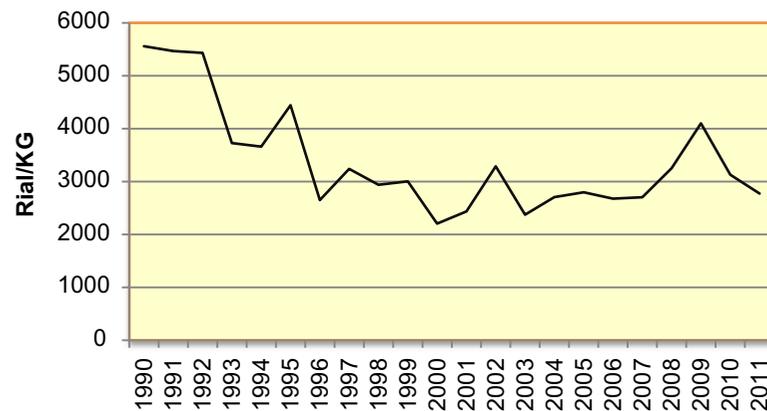
It has been believed that the month of Ramadan is an important factor in the price volatility of dates. The regression below shows that the month of Ramadan has a significant and positive effect on date producer price. (Ramadan is a dummy variable that takes value=1 if it is the month of Ramadan and value=0 otherwise, Standard deviation in parenthesis.)

$$\begin{aligned} \log(PP) = & 13.98 + 0.05 \text{dummy} \\ & (1.17) \quad (0.03) \\ & -0.37 \log(D) + 0.44 \log(I) \\ & (0.1) \quad (0.1) \\ R^2 = & 0.6 \quad D.W = 2 \end{aligned} \tag{1}$$

In the preceding regression, *PP* is dates producer price, *D* is the demand for dates, as it is predictable; the sign of this variable corresponds to the theory. *I* is capital income which has a positive effect on price. (All variables comprise monthly observations over the years 1990:1–2011:12; all of the above data are collected from the statistical office of Central Bank of the I.R of Iran.) Above regression results emphasize the positive effects of the month of Ramadan on date price fluctuation.

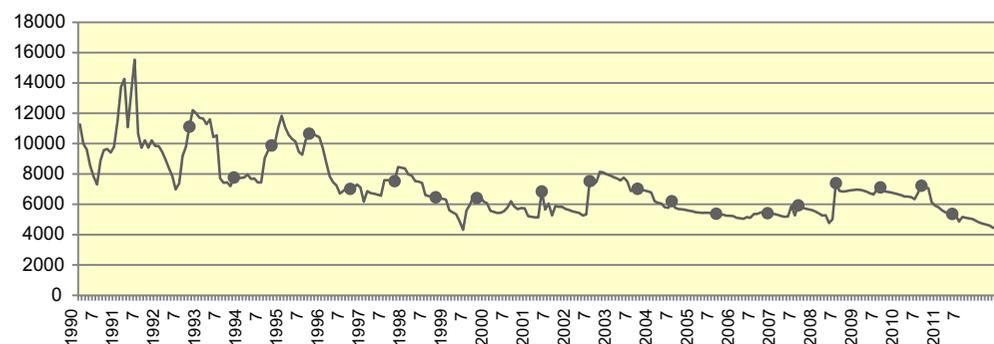
**Figure 3. Iran’s dates producer price during 1990–2011 in constant price 2004 = 100.**

Source: Food and Agriculture Organization (F.A.O.).



**Figure 4. Iran’s dates producer price during 1990:1–2011:12 in constant price 2004 = 100.**

Source: Central Bank of the I.R of Iran.



Dates prices have experienced large fluctuations over the past two decades, however. So, producers can use price risk management tools to deal with the price volatility. In terms of risk management, hedging in futures markets is a very popular tool for managing market risks. The volatility of date prices may cause significant economic losses to producers when the risks are not well managed. These losses could also have a negative impact on exports and cause a further decrease in producer's revenue. The competitive position of the date's market depends on the ability of producers to manage price risks. If this risk is managed properly, dates producers could have a relatively stable revenue. Iran's government can indirectly benefit from dates producers' proactive risk management, because it does not have to subsidize date production with large amounts of money.

So, this paper focuses on the application of futures markets tools to manage the price risk in Iran's date market. In order to determine if futures markets are good instruments for managing price risk or not, hedge ratios will be calculated.

Numerous approaches are available to estimate hedge ratios. Traditionally, an ordinary least squares regression of the spot price on the futures price is run. However, this procedure is inappropriate because it ignores the heteroskedasticity often encountered in price series. Recently, a considerable amount of research has applied the generalized autoregressive conditional heteroscedasticity (GARCH) models proposed by Engle (1982) and Bollerslev (1986, 1990) to estimate time-varying optimal hedge ratios. Pretty GARCH models have been applied to investigate foreign exchange rate futures (Gagnon, Lypny, & McCurdy, 1998; Kroner & Sultan, 1993), interest rate futures (Cecchetti, Cumby, & Figlewski, 1988), asset returns (Hwang & Satchell, 2005; Kasch-Haroutounian & Price, 2001), and commodity futures (Baillie & Myers, 1991; Byström, 2003; Lien, Tse, & Tsui, 2002; Myers, 1991; Soydemir & Petrie, 2003).

Ai (2012) demonstrated optimal hedge ratios using futures contracts for Ontario and Alberta feedlot for live cattle and feeder cattle. Results indicated that time-varying hedge ratios eliminated more risk than constant hedge ratios. da Rocha, Caldarelli, Rocha, and Martines-Filho (2009) determined optimal hedge ratios for soybean farmers in Rondonópolis, using the bivariate GARCH BEKK model. Choudhry (2009) investigated the hedging effectiveness of time-varying hedge ratios in the agricultural commodities futures markets using four different versions of the GARCH models. Results indicated superior performance of the portfolios based on the GARCH-X model-estimated hedge ratio. Kumar, Priyanka, and Ajay (2010) examined hedging effectiveness of futures contract on a financial asset and commodities in Indian markets. Floros and Vougas (2004) estimated hedge ratios, using data on the Greek stock and futures market in 1999–2001, based on the OLS, ECM, VECM, and BGARCH models. They found the ECM and VECM to be superior over the OLS model. The BGARCH model even produced a better result than the ECM and VECM models.

All the above-mentioned studies computed hedge ratios with no regard for the individualism of producers or investors, some studies take into consideration the characteristics of the phenomenon of risk aversion investors, and then the hedge ratios that consider risk-averse parameter are calculated, such as Yitzhaki (1984), Cheung, Kwan, and Yip (1990), Kolb and Okunev (1992), Hodgson and Okunev (1992), Shaffer and DeMaskey (2002, 2004), Shaffer (2003), Ringuest, Graves, and Randy (2004), Shalit and Yitzhaki (2005), and Demirer, Lien, and Shaffer (2005).

### 3. Materials and methods

#### 3.1. Materials

Data on dates prices comprise monthly observations over the years 1990:1–2011:12, namely:

- Producer price in constant price 2004 = 100 in Rials of I.R Iran.
- Total date production in tons.

All the above data were collected from the statistical office of the Central Bank of the I.R of Iran.

### 3.2. Methods

#### 3.2.1. The time-varying hedging rule

Using a mean-variance framework, hedge ratios have been estimated using OLS by regressing the returns from holding a spot contract on returns from holding a futures contract. In a similar context, assuming utility maximization and efficiency in future markets, the conditional optimal one-period ahead hedge ratio,  $b_{t-1}^*$ , at time  $t$  can be derived as:

$$b_{t-1}^* = \frac{\text{Cov} \left( R_t^s, R_t^f | \Psi_{t-1} \right)}{\text{Var} \left( R_t^f | \Psi_{t-1} \right)} \quad (2)$$

where  $R_t^s$  and  $R_t^f$  denote logarithmic of spot and futures prices from  $t-1$  to  $t$ , respectively, and  $\Psi_{t-1}$  is the information set at time  $t-1$ . This ratio is similar to the conventional hedge ratio except that the conditional variance and covariance replace their unconditional counterparts. Because conditional moments can change as the information set is updated, the hedge ratios can also change through time (Bera, Garcia, & Roh, 1997).

A natural and widely used model for estimating model 2 is BGARCH model.

To ensure the condition of a positive definite conditional variance matrix in the optimization process, Engle and Kroner (1995) proposed the BEKK model. This model representation can be observed below in the following Equation.

$$\begin{aligned} \Delta y_t &= \mu + \varepsilon_t \\ \varepsilon_t | \Omega_{t-1} &\sim N(0, H_t) \end{aligned} \quad (3)$$

$$H_t = CC' + \sum_{i=1}^q A_i \varepsilon_{t-i} \varepsilon_{t-i}' A_i' + \sum_{j=1}^p B_j H_{t-j} B_j'$$

where  $y_t = (pp_t, ppf_t)'$  is a  $(2 \times 1)$  vector containing cash and futures prices,  $H_t$  is a  $(2 \times 2)$  conditional covariance matrix,  $C$  is a  $(3 \times 1)$  parameter vector,  $A$  and  $B$  are  $(3 \times 3)$  parameter matrixes, and  $\text{Vech}$  is the column stacking operator that stacks the lower triangular portion of a symmetric matrix.

The diagonal Vech parameterization involves nine conditional variance parameters.

#### 3.2.2. EMG hedge ratio

Since the above-mentioned models take the decision without regarding to the individualism of producers or investors, the results of the above model might be biased. In this study, it is desirable to account for farmers' risk aversion, so hedge ratios that consider a risk-averse parameter are calculated. The K.O. (Kolb & Okunev, 1992) approach is adapted, so an EMGHR (EMGHR) is calculated.

Adopting the notation from K.O. (Kolb & Okunev, 1992), the EMG coefficient for a hedger is given by:

$$\Gamma(v) = -v \text{COV} \left( R_p, (1 - F(R_p))^{v-1} \right) \quad (4)$$

where  $v$  is the risk aversion parameter;  $R_p = R_s + xR_f$  is the return on the market portfolio with  $x$  being the hedge ratio, and  $R_p$  (resp.  $R_f$ ) being the return on the spot (futures) market. Also,  $\text{Cov}(\dots)$  denotes the covariance operator and  $F(\cdot)$  denotes the probability distribution of  $R_p$ . A sample analog is adopted to estimate  $F(\cdot)$ . More precisely, given observation of  $R_{st}$  and  $R_{ft}$  ( $t=1, \dots, T$ ), and given any hedge ratio  $x$ ,  $F(R_{pt})$  is estimated by  $\hat{F}(R_{pt})$ , the rank of  $R_{pt} (= R_{st} + xR_{ft})$  divided by the number of observations.

Similarly, the covariance term in Equation 4 is estimated by the corresponding sample analog. Thus, for empirical implementation purpose, the extended mean-Gini coefficient is rewritten as:

$$S\Gamma(v) = -(v/T) \left\{ \sum_{t=1}^T R_{pt} (1 - \hat{F}(R_{pt}))^{v-1} - \left( \sum_{t=1}^T R_{pt}/T \right) \left( \sum_{t=1}^T (1 - \hat{F}(R_{pt}))^{v-1} \right) \right\} \quad (5)$$

An iterative process is applied to find the minimum of  $S\Gamma(v)$  over the choice of  $x$ . Suppose there is no tie in ranking:  $\hat{F}(R_{pt}) \neq \hat{F}(R_{pt'})$  whenever  $t' \neq t$ , then Equation 5 is differentiable with respect to  $x$  and the optimal hedge ratio satisfies the first-order condition  $\partial S\Gamma(v)/\partial x = 0$ .

Since the hedge ratio is of central interest, replacing EMG by its estimate may not be the most appropriate approach. Alternatively, using Equation 5 to minimize the EMG, the optimal hedge ratio must satisfy the following first-order condition:

$$-\text{cov} \left( R_f, (1 - F(R_p))^{v-1} \right) + \text{cov} \left( R_p, (v-1)(1 - F(R_p))^{v-2} f(R_p) R_f \right) = 0 \quad (6)$$

where  $f(\cdot)$  denotes the probability density function. An estimate for the LHD of Equation 6 is

$$Q(v, x) = \sum_{t=1}^T R_{ft} (1 - \hat{F}(R_{pt}))^{v-1} - \left( \sum_{t=1}^T R_{ft}/T \right) \left( \sum_{t=1}^T (1 - \hat{F}(R_{pt}))^{v-1} \right) \\ + (v-1) \left\{ \sum_{t=1}^T R_{pt} R_{ft} \hat{f}(R_{pt}) (1 - \hat{F}(R_{pt}))^{v-2} - \left( \sum_{t=1}^T R_{pt}/T \right) \right. \\ \left. \times \left( \sum_{t=1}^T R_{pt} \hat{f}(R_{pt}) (1 - \hat{F}(R_{pt}))^{v-2} \right) \right\} = 0 \quad (7)$$

where  $\hat{f}(\cdot)$  denotes the estimate of the density function. For a given  $v$ , the optimal hedge ratio is derived by an iterative process to solve the Equation  $Q(v, x) = 0$  corresponding to the estimate  $\hat{f}(\cdot)$ , which may be assumed to arise from histograms,  $\hat{f}(\cdot)$  is chosen to be the number of observations with the same value divided by the total number of the observations (Lien & Luo, 1993).

## 4. Results

### 4.1. Augmented Dikey-Fuller test and future price forecasting approaches

At first, unit root tests for monthly date's producer prices in constant price 2004=100 were performed. Results of the Augmented Dikey-Fuller test (ADF test) shown in Table 1 indicate that the null hypothesis could be rejected for spot price series at the 5% significance level. The producer price series (PP) and the logarithm of producer price series are stationary.

In the next step, ARCH-LM test was performed on dates spot price. According to AIC and SBC criteria, one lag is accepted for spot price series ( $PP_{-1}$ ), the equation for which is as follows (standard deviation in parenthesis):

**Table 1. Results of unit root test for date's spot producer price**

	ADF
PP	-3.02
log (PP)	-3.05
Critical value	-3.4
	-2.8
	-2.5

Source: Research findings.

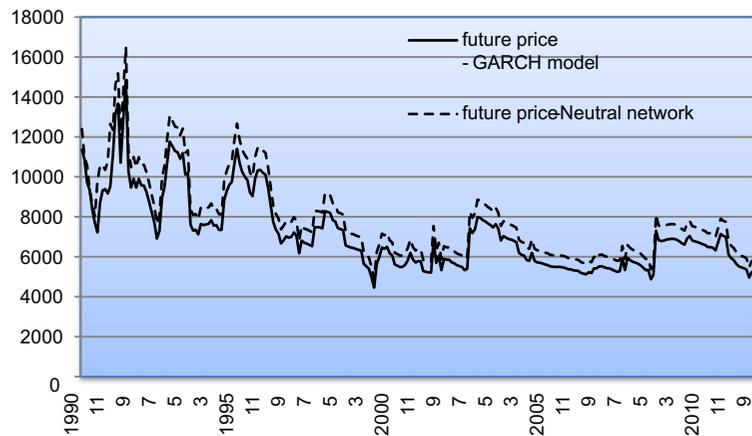
**Table 2. Results of ARCH-LM test for date's spot producer price model**

ARCH test		Probability
F-statistic	38.4	.0
Obs. $R^2$	33.7	.0

Source: Research findings.

**Figure 5. Monthly dates future prices forecasted with different methods.**

Source: Finding research.



$$PP = 422 + 0.93 PP_{-1} \quad (153) \quad (0.02) \quad R^2 = 0.88 \quad D.W = 1.9 \quad (8)$$

where  $PP$  is dates spot price,  $PP_{-1}$  is dates spot price with one lag. Since there are ARCH effects left in residuals, the GARCH approach proved to be appropriate. Table 2 shows that the null hypothesis could be rejected and the ARCH effect is left in residuals. Therefore, the GARCH model is appropriate for use. Results of the best GARCH (1, 1) are as follows (standard deviation in parenthesis):

$$PP = 0.92 PP_{-1} + 457.5 + 0.5 resid_{-1}^2 + 0.25 GARCH_{-1} \quad (0.01) \quad (126) \quad (0.15) \quad (0.13) \quad R^2 = 0.88 \quad D.W = 1.8 \quad (9)$$

After applying the GARCH model, a future price series is forecast (note Equation 9) and also with the artificial neural network (ANN) approach. Figure 5 shows the results of future prices for dates. After forecasting future prices of dates with these two methods, based on the mean absolute percentage error (MAPE) criteria, (MAPE = .0013 in ANN and MAPE = .046 in GARCH approach), the ANN approach for future price series was preferred.

#### 4.2. Determination of hedge ratios

The OLS regression was performed for date's spot and futures prices. In regression,  $\log PP = c + \beta \log PPF$ , The coefficient of  $\beta$  is constant hedge ratio. Figure 6 represents the OLS estimated constant hedge ratio from the minimum variance model.

$$\log(PP) = 0.33 + 0.96 \log(PPF) \quad (0.25) \quad (0.03) \quad R^2 = 0.9 \quad D.W = 1.9 \quad (10)$$

where  $R^2$  represents to what extent the variation of spot returns can be explained by futures returns (Kumar et al., 2010). Combining the optimal hedge ratios and  $R^2$  values, the question of how much

of the dates product should be hedged to maximize the risk reduction can be answered. A date's producer who maintains 96% of his dates hedged could reduce the date's price risk by 90%.

Next, we turn to the estimation of bivariate BEKK GARCH. Table 3 provides the parameter value for the BGARCH-BEKK. The ARCH coefficients are positive and significant, and imply volatility in the log difference of cash price ( $A_{11}$ ) and future price ( $A_{22}$ ). Dates GARCH coefficients ( $B_{11}$ ,  $B_{22}$ ) are significantly positive implying GARCH effect. The covariance parameters indicate a positive and significant interaction between these two prices. The covariance GARCH parameters  $\hat{B}_{11}$  and  $\hat{B}_{22}$ , which account for the conditional covariance between cash and futures prices, are positive and significant, and imply strong interaction between cash and futures prices.

Since the main objective of this study was to determine the time-varying optimal hedge ratios, Figure 6 shows the time-varying optimal hedge ratios for dates from BEKK model. The average of the BGARCH optimal hedge ratios was .7, which was slightly lower than the OLS constant optimal hedge ratio (.96) during 1990–2011. Most of the movement of the time-varying hedge ratios is confined below the constant minimum variance hedge ratio.

**Table 3. Estimation of BGARCH models with diagonal BEKK**

**Model:**  $\log S_t = \hat{\mu}_1 + \varepsilon_{s,t}$   
 $\log F_t = \hat{\mu}_2 + \varepsilon_{f,t}$   
**GARCH**<sub>1</sub> =  $M_{11} + A_{11}^2 * resid_1(-1)^2 + B_{11}^2 * garch_1(-1)$   
**GARCH**<sub>2</sub> =  $M_{22} + A_{22}^2 * resid_2(-1)^2 + B_{22}^2 * garch_2(-1)$   
**COV**<sub>12</sub> =  $A_{11} * A_{22} * resid_1(-1) * resid_2(-1) + B_{11} * B_{22} * cov_{12}(-1)$

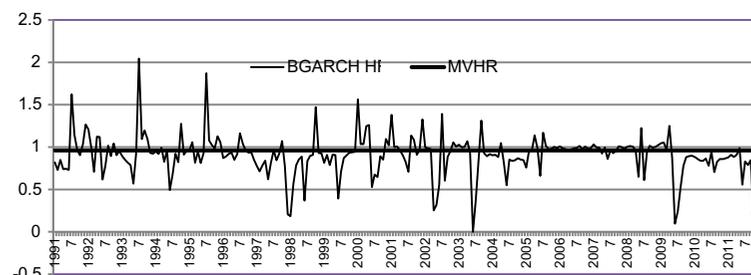
Coefficient	Spot market equation	
$\hat{\mu}_1$	.5 (.14)	$R^2 = .9$ D.W=2
$\log(pp_{-1})$	1.01 (.09)	
$\log(pp_{-2})$	-.07 (.09)	
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$\hat{\mu}_2$	.6 (.14)	$R^2 = .9$ D.W=2
$\log(ppf_{-1})$	.92 (.01)	
<hr/>		
Coefficient	Variance equation coefficient	
$\hat{M}_{11}$	.001 (.0007)	Log likelihood = 614
$\hat{M}_{22}$	.002 (.0006)	
$\hat{A}_{11}$	.42 (.07)	
$\hat{A}_{22}$	.47 (.08)	
$\hat{B}_{11}$	.7 (.11)	
$\hat{B}_{22}$	.6 (.11)	

Source: Research findings.

Notes: Numbers in parenthesis are standard errors,  $m_3$  is sample Skewness,  $m_4$  is sample Kurtosis, J.B is Jarque–Bera normality test, Q(12) is the Box Pierce statistic for 12th order serial correlation in the residuals.

**Figure 6. Optimal hedge ratios from BGARCH model and OLS (time-varying hedge ratios vs. constant hedge ratios).**

Source: Finding research.



Overall, the result of BEKK BGARCH hedge ratio shows that the optimal hedge ratio for dates is time varying and the average hedge ratio is .7. Results also indicate that if producers of dates attend in futures markets, they could reduce their price risk to 70%.

#### 4.3. The effect of risk aversion parameter (estimation of EMGHR)

Table 4 represents the extended mean Gini hedge ratios (EMGHR) for 16 different levels of risk aversion ( $v$ ), ranging from  $v=2$  to  $v=200$  (above  $v=200$ , the hedge ratios stabilize and are thus omitted). As Table 4 shows, the rank-based EMGHR (rank, in Table 4) for dates tends to increase as risk aversion increases for  $V=2-50$ . In  $V=50$ , the rank-based hedge ratio gets its maximum value, which is .6 and it is near the average BEKK BGARCH hedge ratio (.7). Table 4 also shows that after  $V=50$ , the hedge ratio decreases with increasing risk aversion parameter. This is consistent with Lien and Luo (1993). The results also show that the rank-based hedge ratios are larger than the Kernel hedge ratios. The results show that at low levels of risk aversion ( $v=2-10$ ), the EMG and MV hedge ratios derived

**Table 4. EMGHR calculated using both Kernel and rank-based estimator**

V	Estimator	Dates hedge ratios
2	Kernel	.0003
	Rank	.41
	Difference*	.4
3	Kernel	.0004
	Rank	.42
	Difference	.41
4	Kernel	.0005
	Rank	.43
	Difference	.2
5	Kernel	.0008
	Rank	.47
	Difference	.46
6	Kernel	.001
	Rank	.49
	Difference	.48
7	Kernel	.002
	Rank	.51
	Difference	.5
8	Kernel	.002
	Rank	.52
	Difference	.51
9	Kernel	.003
	Rank	.53
	Difference	.52
10	Kernel	.004
	Rank	.54
	Difference	.53
20	Kernel	.02
	Rank	.58
	Difference	.56

(Continued)

**Table 4. (Continued)**

V	Estimator	Dates hedge ratios
50	Kernel	.1
	Rank	.6
	Difference	.5
75	Kernel	.2
	Rank	.59
	Difference	.39
100	Kernel	.3
	Rank	.57
	Difference	.27
120	Kernel	.4
	Rank	.56
	Difference	.16
150	Kernel	.6
	Rank	.53
	Difference	-.07
200	Kernel	.8
	Rank	.49
	Difference	-.3

Source: Research findings.

\*Difference between Kernel and Rank estimators (.4=.41-.0003).

**Table 5. Statistical results to test the null hypothesis**

$$\frac{1}{N} \sum_{i=1}^n (H_i^{\text{kernel}} - H_i^{\text{rank}}) = 0$$

	Dates
t-statistic	5.54
P-value	.00

Source: Research findings.

markedly from each other and at high level of risk aversion ( $V=50$ ), EMGHR and MV hedge ratios are similar. For a high-level risk averse ( $V=200$ ), the EMG strategy provides a 49% elimination of risk.

In general, results of EMGHR show that if dates producers are risk averse (risk-averse parameter is equal to 50), then the maximum amount of risk that can be managed by futures markets is 60%.

There is an issue about whether or not the difference between these rank base and Kernel base hedge ratios are statistically significant. A bootstrap simulation producing 150 hedge ratios from the two methods is conducted. Then, these two simulated series are statistically compared. A paired t-test is used to test the null hypothesis  $\frac{1}{N} \sum_{i=1}^n (H_i^{\text{kernel}} - H_i^{\text{rank}}) = 0$  where  $N=150$ , the number of bootstrap-generated hedge ratios (Shaffer, 2003). The statistical results are presented in Table 5.

Table 5 shows that the rank-based hedge ratios are not equivalent to the Kernel hedge ratios for dates. Results for the minimum variance for the two simulated series show that rank-based hedge ratios have the minimum variance ( $Var=.002$ ) in comparison with Kernel hedge ratios ( $Var=.06$ ), so rank-based hedge ratios were overcome.

## 5. Conclusion

Risk management in agriculture is now an essential tool for farmers to anticipate, avoid, and react to shocks. An efficient risk management system for agriculture will preserve the standard of living of those who depend on farming, strengthen the viability of farm businesses, and provide an environment that supports investment in the farming sector.

Because there are fluctuations in price of Iranian dates, producers will suffer from these fluctuations. In this study, futures market tools are suggested as a mechanism for managing price volatility. Since most previous studies show that hedge ratio as an indicator for future market efficiency is time varying, a BEKK GARCH model is employed to determine the time-varying hedge ratio. Results of BEKK BGARCH model for Iran dates during 1990:1–2011:12 show that hedge ratio is time varying and it permits the hedge ratios to be based on conditional information. Since there was not a big difference in risk reduction between using constant and time-varying hedge ratios, both hedge ratios could achieve more than 70% price risk reduction, and dynamic hedge ratios is appeal.

The results of EMGHR show that the hedge ratio is relatively high and the producers who are 50° of risk-averse parameter are the most to gain from the futures market. So the development of futures markets for dates is proposed and recommended.

### Funding

The authors received no funding for this research.

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### Citation information

Cite this article as: The management of price risk in Iranian dates: An application of futures instruments, H. Sherafatmand & S. Yazdani, *Cogent Economics & Finance* (2014), 2: 946998.

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