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Wholesale and Retail Price Integration for Date Palm in Saudi Arabia

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ABSTRACT

The objective of this work is to investigate vertical price transmission in the dates', Khalas variety, market in Saudi Arabia. Saudi Arabia is considered the third producing country of dates in the world. Several research instruments were used to estimate the asymmetry and co-integration of the monthly wholesale and retail prices of the selected variety of dates during the period 2005-2012. The results showed that the two series of prices were symmetric and co-integrated. Long-run elasticities of price transmission for rising wholesale prices were 0.593 and 0.793 for falling wholesale prices. The study recommended the that it is important for the government to establish market information centers to update the price data and capture the adequate communication and transmission of information for dates in both the wholesale and retail levels.

KEYWORDS KSA, elasticity of price transmission, co-integration, symmetry, stationarity.

INTRODUCTION

Kingdome of Saudi Arabia (KSA) is considered the third country in the world in dates' production, and the first in dates' consumption. There are about 28 million trees, out of which about 22 millions are baring trees. The total acreage of palm trees in Saudi Arabia in 2015 was about 107.3 thousand Hectares. (General Authority for Statistics, 2015) The major producing regions in the Kingdom are Riyadh, Qaseem, Medinah and Eastern Province. While the main demand is for Sukkari, Khalas and Berhi varieties. In this study the wholesale and retail prices of the Khalas variety will be analyzed for price transmission between the two market levels.

In economics where competitive markets prevail, "the law of one price" states that in case of notransaction costs and no trade barriers, identical goods should have identical prices. (Spritzer, 2007). On the other hand, Enke, (1951); Samuelson, (1952); Takayama and Judge, (1972) postulate that price transmission could be achieved if the commodity, after converting its prices to a common currency, is sold on competitive domestic or foreign markets that differ only by transfer costs.

Price transmission was studied from different angles 1) the Law of One Price (Ardeni, 1989). 2) Market integration (Zakari, et.al. 2014; Baquedano and Liefert 2013.Fossati, S. et.al. (No Date). 3) Evaluation of policy reform, (Amikuzuno, J. No.date). 4) Vertical price transmission along the supply chain from the consumer to the producer level (Kharin, et. al. 2014; Vavra, and Goodwin 2005). 5) Horizental price transmission, (Listorti and Esposti. 2012; Jawad and Sayed. 2015). 6) The vertical-derived demand functions direct price elasticity. (Syrovátka, and Lechanová. 2005).

Price transmission could be investigated through vertical price integration which refers to the co-integration of prices in a given market at two price levels, e.g., wholesale and retail levels. (Garcia and Salayo, 2009)

The objective of this work is to investigate vertical price transmission in the dates', Khalas variety, market in Saudi Arabia.

METHODOLOGY

Several quantitative models were used to investigate vertical price transmission, they include simple correlation analysis and regression models upgraded to new econometric approaches such as Autoregressive Distributed Lag model (ADL), the linear Error Correction Model (ECM), the asymmetric/non-linear ECM, the Threshold Vector ECM, the Smooth Transition Co-integration Model, and the Markov-Switching ECM.

In this study monthly time series wholesale and retail prices of the Khalas variety of dates in the Eastern Province of KSA. The Analysis was conducted according to the following steps:

Evaluating the Stationarity of the time series data.

Evaluating the symmetry or asymmetry between the two levels of prices,

Implement the autoregressive distributed lag model (ADL) for evaluating the co-integration between the two levels of prices.

Evaluating of Elasticity of transmission between the two levels of prices.

Stationary Test

A series is said to be, weakly or covariance, stationary if the mean and auto-covariances of the series do not depend on time, otherwise, they are considered non-stationary.

Many economic time series are non-stationary, but we can implement some transformation activities, such as differencing, to make them stationary.

In this study we used the Augmented Dickey-Fuller (ADF) t-statistic to test if the prices are stationary or not. There are three different forms of autoregressive equations to detect stationarity of the time series data:

i) $$\Delta Pt = \emptyset P_{t-1} + \alpha 1 \Delta P_{t-1} + \alpha_2 \Delta P_{t-2} + \cdots + \alpha_p \Delta P_{t-p} + \mu_t \quad (1)$$

Where Δ is the difference operator, P_t is the price of a commodity at time, t. (Dickey and Fuller 1979).

This equation is valid when it does not have intercept (a drift value) or a linear time trend.

To determine the number of augmenting lags (p) we minimize the Schwartz Bayesian information criterion or minimize the Akaike information criterion or lags are dropped until the last lag is statistically significant.

We use the t-statistic associated with the Ordinary Least Squares estimate of ∅. This is called the Dickey-Fuller t-statistic. The Dickey-Fuller t-statistic is skewed to the left with a long, left-hand-tail.

The null hypothesis of the Augmented Dickey-Fuller t-test for this equation is:

Ho: $\emptyset = 0$ (i.e. the data needs to be differenced to make it stationary)

H1 $= \emptyset < 0$ (i.e. the data is stationary and doesn't need to be differenced)

ii) When the time series doesn't have a trend and potentially slow-turning around a non-zero value, we will use the following test equation which has an intercept (α_o) but no time trend:

$$\Delta Pt = \alpha_o + \emptyset P_{t-1} + \alpha_1 \Delta P_{t-1} + \alpha_2 \Delta P_{t-2} + \cdots + \alpha_p \Delta P_{t-p} + \mu_t \quad (2)$$

iii) $\Delta Pt = \alpha 0 + \emptyset Pt\text{-}1 + \gamma t + \alpha 1 \Delta ZPt\text{-}1 + \alpha 2 \Delta Pt\text{-}2 + \cdots + \alpha p \Delta Pt\text{-}p + \mu_t \quad (3)$

This equation is used when the time series has a trend in it (either positive or negative) and is potentially slow-turning around a trend line.

Moreover, the Augmented Dickey-Fuller (ADF) test is used to test for co-integration, in addition to evaluating the stationarity or randomness of the error term of the co-integrating regression of the price series. If the error term is found to be stationary, then it is considered as a white noise (i.e., purely random) and hence, the two prices are considered co-integrated, i.e. the tested price series for co-integration have a long-term relationship. Furthermore, this implies that the prices are trending together towards **Asymmetry between the Two Levels of Prices**

The term "asymmetric" implies "the reaction of the price at one level of the marketing chain to a price change at another level depending on whether the initial change is positive or negative" (Von Cramon-Taubadel 1998).

Vertical Asymmetric Price Transmission (APT) can be of two main types: (a) APT refers to **magnitude** of the price response at a given market level conditional on the direction of change of the price in another market level, and (b) APT refers to the pace of price response at a given market level conditional on the direction of change of the price in another market level. (Frey and Manera, 2007). The **speed** has been largely attributed to the presence of transaction costs, menu costs, inventory management practices, and market power as well (Meyer and von Cramon-Taubadel, 2004).

Asymmetry of time series prices occurs when prices rise more readily than they fall. Ray, et.al. (2006) found in their research that wholesale prices may adjust asymmetrically in the small changes, but symmetrically in the large changes, when retailers face cost of price adjustment, especially when prices changes are small.

There are several models which specify and estimate nonreversible functions, e.g. Tweeten and Quance (1969), Wolffram , 1971 ; Houck , 1977 ; Ward, 1982 ; Kinnucan and Forker , 1987 ; von Cramon - Taubadel and Fahlbusch , 1994 ; Zhang, et al. , 1995 ; Tiffin and Dawson , 2000 ; Goodwin and Harper , 2000 ; Abdulai , 2002 ; Serra and Goodwin , 2003 ; Lass , 2005 ; Ben - Kaabia and Gil , 2007.

Houck (1977) model for asymmetry price transmission is based on segmentation of price variables into only first different increasing and decreasing phases. Ward (1982) added lags to the exogenous variable to Houck's model. Moreover, Boyd and Brorsen used lags to differentiate between magnitude and speed of transmission. Azzam (1999) brings some light to retail's higher responsiveness to farm price increases. He showed that price asymmetry can result from concave spatial demands. Moreover, Azzam found that price transmission is only partial, which means that both farm price increases and decreases are transmitted less than proportionally by retailers.

Gardner (1975) derived different formulas to calculate price transmission elasticities depending on the origin of the price change: demand or supply shifts, Gardner's formulas show that the elasticity of price transmission would be less than one for demand shifts.

In this study Houk's model will be implemented to check for asymmetry between the two level prices.

Co-Integration

Assume we have a time series $\mathbf{Y_t}$ as a function of past values and some random error:

$$Y_t = \Omega Y_{t-1} + \mu_t \quad (4)$$

The $\mathbf{\Omega}$ term dictates how strongly the present value of Y is dependent on the prior value of it, while $\boldsymbol{\mu_t}$ is an Independent and Identical Distributes (IID) random variable. If $|\Omega| = 1$, we say that Y_t is integrated, and the series has a permanent memory such that past shocks to the series cumulate. An integrated series has a mean and variance that depend on time (Bannerjee et al. 1993). If we have an explanatory variable that is also integrated and causally related to Y then we say the two series are co-integrated. Co-integration implies that they maintain an equilibrium. i.e. the two integrated series never drift far apart from each other.

On the other hand, co-integration relationship could be evaluated at the two levels of prices, i.e. wholesale and retail levels, by regressing one price on another price at logarithmic form since the relative error is declining. (Banerjee et.al. 1993).

If P< 05 we reject Ho in and accept Ha

If prices are determined at wholesale level, then:

$$\ln Pr = \alpha_1 + \varepsilon_{RW} \ln Pw \quad (5)$$

Where **Pr** and **Pw** are retail and wholesale prices ε_{RW} is the elasticity of price transmission from **Pw** to **Pr**. When $\varepsilon_{rw} = 1$ implies perfect price transmission, which means that there exists a percentage spread model with mark-up of ($e\alpha^1$ -1); Imperfect price transmission occurs when $0 < \varepsilon_{rw} < 1.$

Alternatively, if prices are determined at retail level then:

$$\ln Pw = \alpha_2 + \varepsilon_{WR} \ln Pr \quad (6)$$

Where ε_{WR} is the elasticity of price transmission from **Pr** to **Pw**. Perfect price Transmission is present if $\varepsilon_{WR} = 1$, it implies a percentage spread model with mark-down of (1- $e\alpha^2$); while imperfect price transmission is $\varepsilon_{WR} > 1$.

Co-integration could be evaluated by different models, assuming that the time series data are stationary.

To test for co-integration, first we implemented the **Autoregressive Distributed Lag (**ADL) test, the test follows the following model specification:

$$\Delta \mu t = \beta \mu_{(t-1)} + \varepsilon_t \quad (7)$$

If $\boldsymbol{\beta}$ in equation (7) is found to be statistically significant (i.e., accept Ha: $\beta \neq 0$ at level of

Significance $\alpha = 5\%$), then the error term of the co-integrating regression is considered random then the prices in the regression model are considered co-integrated and stationary. This means that the two series of prices have a long-run relationship. Otherwise, if β is found to be statistically non-significant (i.e., accept Ho: $\beta = 0$), then the error term is considered non-stationary. This implies that the two prices series have a spurious relationship such that the generated regression parameters are not valid for inference.

The **(ADL)** model will be implemented in the study. This model is generally used when the dependent variable includes lagged values and current and lagged values of one or more explanatory variables.

The **ADL (1,1)** model could be written as:

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \beta_0 X_t + \beta_1 X_{t-1} + \mu_t \quad (8)$$

Where: Y_t and X_t are stationary variables, and μ_t is a white noise.

The test for the null hypothesis of no co-integration for equation 8 will be as follows:

$H_0 = 0$ then no integration

$H_A < 0$ then we have co-integration equilibrium adjustment

RESULTS AND DISCUSSIONS

3.1 Basic Analysis

Monthly wholesale and retail prices for Khalas dates variety were collected from the Ministry of Agriculture in Saudi Arabia publications for the period 2005-2012.

This data show a mild increase during the studied period as shown in Figure 1. The trend equations of the wholesale and retail prices are shown below:

Pw= 10.12+ 0.029 T (9)

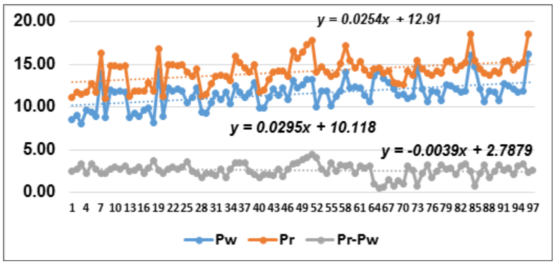
(5.79*[1])**

Pr= 12.91+ 0.025 T (10)

(4.75*)**

Figure 1 Trend Lines for Monthly Khalas Wholesale and Retail Prices in the Eastern Province of Saudi Arabia During 2005-2012

(SAR /Kg)



Where: **Pw** and **Pr** are wholesale and retail prices for Khalas dates, **T**: time in months, figures between brackets are t-values

Figure 1 Trend Lines for Monthly Khalas Wholesale and Retail Prices in the Eastern Province of Saudi Arabia During 2005-2012

(SAR²/Kg)

3.2 Stationary Test of the Wholesale and Retail Prices of Dates

The trend equations bellow for both wholesale prices and retail prices shows that there is positive significant trend, so we used the following test equation which has an intercept term and a time trend to evaluate the stationarity of the data, the equation for the wholesale prices is:

$$\Delta Pw_t = \alpha_0 + \emptyset Pw_{t-1} + T_t + \alpha_t \Delta Pw_{t-1} + \alpha_2 \Delta Pw_{t-2} + \cdots + \alpha_p \Delta Pw_{t-p} + a_t \quad (11)$$

The same equation was evaluated but substituting the Pw by Pr, Annex 1 shows the results for testing the data by using the Augmented Dickey-Fuller t-statistic test. The value of Pw-1 coefficient was -0.693 with t-value -6.807 sig at P<0.001, and the value of Pw-1 coefficient was -0.717 with t-value -7.027 sig at P<0.001. Here we can reject the null hypothesis of a unit root at all common significance levels, i.e. the data is stationary.

Regressing the error terms in the relationship between the wholesale and retail prices of Khalas dates with the lagged error terms emphasized the fact that the price data are stationary as shown in equation 12.

$$\mu_t = 0.0004 - 0.516\, \mu_{t-1} \quad (12)$$

(-5.69)***

The coefficient of the lagged error is found significant since it does not statistically equal zero.

Moreover, Johansen Co-integrated test was used to check for stationarity of the two price series. The objective of the test was to verify if the two variables have a common stochastic drift. The rationale of the test is that any variable that is not unit root process is a stationary I(0) process.

Trace test indicates two co-integrating eigenvalues(s) at the 0.05 level, thus the variables have a common stochastic drift and stationary.

Table 1 Unrestricted Co-integration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.138257	23.90239	15.49471	0.0022
At most 1 *	0.107622	10.36176	3.841466	0.0013
Trace test indicates 2 co-integrating eigenvalues(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

3.2 Asymmetry between the Two Market Levels of Prices

To check the asymmetry in the wholesale and retail prices of dates, the first difference of the natural logs of the retail price is regressed on natural log of the positive changes in wholesale prices and their negative changes. The resulted equation is shown below:

$$LnPr - LnPr1 = 0.012 + 0.592\, LNPw^{+} + 0.793\, LNPW^{-} \quad (13)$$

(11.08***) (12.42***)

The values between brackets are t values, which were significant at P<0.001.

Long-run elasticity of price transmission for rising wholesale prices = **0.593**

Long-run elasticity of price transmission for falling wholesale prices = **0.793**

If $\varepsilon_{FP} = 1$, we have perfect transmission, and thus the mark-up will be $(e\alpha_1 - 1)$. While if $0 < \varepsilon_{PP} < 1$ implies that the transmission between the two prices is not perfect.

3.3 Co-Integration in the Wholesale and Retail Prices

The test for co-integration is implemented to evaluate if the retail and wholesale prices within a market exhibits a meaningful relationship between the two price series.

The co-integration test between the retail price and the wholesale price within a given market is measured by regressing wholesale prices as independent variable and retail prices as dependent variable. Garcia, Y and Salayo, N. (2004).

The elasticity of Price Transmission between dates' wholesale prices and dates' retail prices is estimated at **0.723** as shown in the following equation:

LNPr = 0.88 + 0.723LNPw (14)

(18.76)***

The value between brackets is t value, which were significant at P<0.001. The error term equation is shown in equation 15, where the coefficient of the lagged error tem is statistically non zero, which mean that the two prices series are co-integrated.

µt = 0.0004- 0.516 µt-1 (15)

(-5.69)***

The value between brackets is t value, which was significant at P<0.001.

We implemented the ADL model to investigate the occurrence of co-integration between the wholesale and retail prices as another type of test.

The estimated equation using OLS is:

$$\Delta Pr_t = 2.237 - 0.472\, Pr_{(t-1)} + 0.846Pw - 0.462\, Pw_{(t-1)} \quad (16)$$

(F=175.219***)

(-5.168***)(17.801***) (-5.056***)

(R^2= 0.855)

(DW= 2.04)

All the independent variables were significant at P<0.001, which imply that the two prices were co-integrated.

This result shows that the short run effects of the wholesale prices on retail prices was 0.846 and for the lagged wholesale price was -0.462. If the wholesale prices increased by 5 SARs, then the positive change in retail prices will be 4.23 SARs in the short run, while the long run change in retail prices will be 1.92 SARs. i.e. {0.846+ (-0.462)}*5

CONCLUSIONS:

This study has investigated the relationship between the wholesale and retail prices for dates of Khalas variety in Saudi Arabia. Monthly wholesale and retail prices during the period from 2005 to 2012 were used in the analysis.

The wholesale and retail prices showed slight positive trends during the studies period, while the marketing margins were almost stable.

By using the Augmented Dickey-Fuller (ADF) test, the results showed that the time series data for wholesale and retail prices were symmetric.

The Autoregressive Distributed Lag (ADL) test showed that there is a co-integration between wholesale and retail prices for dates in Saudi Arabia, showing that the retail price is the leading market. These results suggest that market prices move together in the long-term and vary concurrently as part of a single market.

Long-run elasticity of price transmission for rising wholesale prices = 0.593 and for falling wholesale prices = 0.793.

It is important for the government to establish market information centers to update the price data and capture the adequate communication and transmission of information for dates in both the wholesale and retail levels.

Annexes

Table 1 ADF Output for Wholesale Prices of Khalas Variety

Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(KHLASS_PWK)				
Method: Least Squares				
Sample (adjusted): 2 96				
Included observations: 95 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
KHLASS_ PWK(-1)= Ø	-0.693408	0.101872	-6.806676	0.0000
C	8.052738	1.181599	6.815121	0.0000
R-squared	0.332524	Mean dependent var		0.080000
Adjusted R-squared	0.325347	S.D. dependent var		1.846185
S.E. of regression	1.516406	Akaike info criterion		3.691391
Sum squared resid	213.8524	Schwarz criterion		3.745157
Log likelihood	-173.3411	Hannan-Quinn criter.		3.713117
F-statistic	46.33084	Durbin-Watson stat		2.059586
Prob(F-statistic)	0.000000			

Here we can overwhelmingly reject the null hypothesis of a unit root at all common significance levels.

Table 2 ADF Output for Retail Prices of Khalas Variety

Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(PR)				
Method: Least Squares				
Sample (adjusted): 2 96				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PR(-1)= Ø	-0.716701	0.101989	-7.027218	0.0000
C	9.337246	1.354915	6.891388	0.0000
@TREND(1)	0.017562	0.005739	3.059824	0.0029
R-squared	0.349416	Mean dependent var		0.078105
Adjusted R-squared	0.335273	S.D. dependent var		1.713475
S.E. of regression	1.397010	Akaike info criterion		3.537615
Sum squared resid	179.5506	Schwarz criterion		3.618264
Log likelihood	-165.0367	Hannan-Quinn criter.		3.570203
F-statistic	24.70568	Durbin-Watson stat		2.072973
Prob. (F-statistic)	0.000000			

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