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A measure of marketing price transmission in the rice market of Taiwan*

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Abstract

The goal of this paper is to test whether changes in the marketing margin between the farm and the retail prices can result in an asymmetric relationship between the farm and the retail prices in the rice market of Taiwan. By separating the transaction cost variation into two regimes, this paper utilizes a two-regime TVECM with the error correction term serving as the threshold variable to create a non-linear threshold model. The empirical results show that when the marketing margin is lower than the threshold value, the market system operates freely and there is feedback between the farm and retail prices. However, when the marketing margin is higher than the threshold value, the government intervenes in the market and the causality between the farm and retail prices no longer exists. The conclusions are as follows. Changes in the marketing margin can cause the asymmetric price transmission between the farm and retail prices in Taiwan's rice markets; therefore, ignoring the effect of the marketing margin could lead to errors in the models. When the marketing margin is higher than the threshold value, the government intervenes in the market and the causality between the two prices is broken.

Key words: *marketing margin, price transmission, price asymmetry, threshold model, TVECM*

JEL classification: *C22, Q13, Q18*

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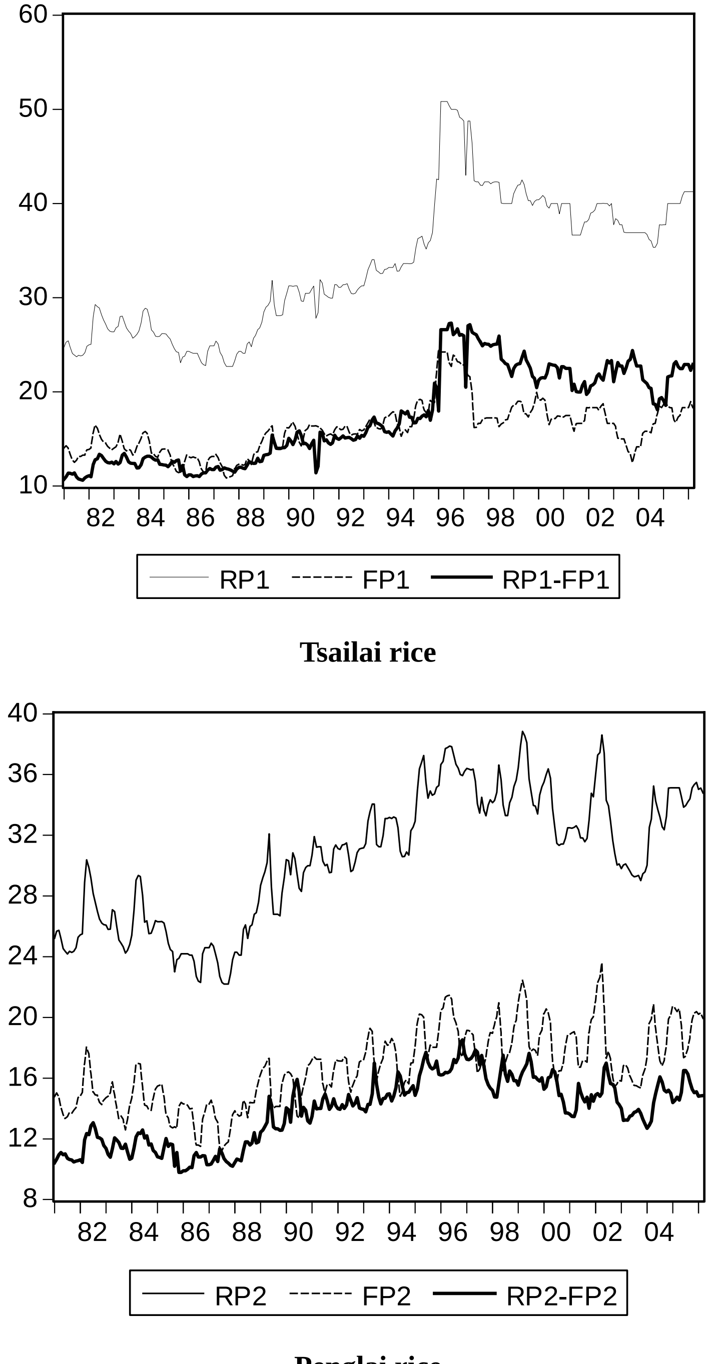
1. Introduction

Rice has long been the most important staple food in Taiwan, as well as one of Taiwan's most important agricultural products. The Taiwanese government has in the past employed a range of measures to maintain the price stability for agricultural products, including the "375 Rent Reduction" in 1949 and the "land to the tiller" policy in 1953. These policies were effective in stimulating large increases in agricultural production, which had two positive consequences: the policies solved problems of food supply and also helped achieve the policy goal of "developing industry through agriculture."

As Taiwan's economy modernized, incomes rose and standards of living improved; the consumption of rice gradually fell as it lost its status as the pre-eminent staple. But the government continued to encourage rice production out of food security considerations, which results in the phenomena that rice consumption is dropping off steeply, while there is currently still excess production in Taiwan. This demonstrates that with government intervention in the agricultural sector, it is often unable to adapt to changes in the actual supply and demand in the market. However, because of the need for food security, it remains necessary for the government to intervene in the rice market. What is vital is that the government has a full understanding of how information is transmitted between the rice producers and retailers and of the effects of changes in the marketing margin. Only with such an understanding is it possible to develop effective long-run policies and short-run adaptive measures.

The two most common varieties of rice available on the Taiwanese market are Tsailai (indica) and Penglai (japonica). Figure 1 shows historical farm and retail price data for both varieties of rice. RP1 is the retail price per kilo (in NTD) for the Tsailai rice, FP1 the farm price per kilo, and RP1-FP1 the difference between the retail and the farm prices. RP2 is the retail price per kilo of the Penglai rice, FP2 the farm price, and RP2-FP2 the difference between the retail and the farm prices. The trends and changes in the retail and farm prices of the two varieties of rice are basically similar.

Figure 1: Farm and retail prices of Tsailai and Penglai rice



Source: The data come from the Council of Agriculture, Executive Yuan, R.O.C.

There is a gap between the farm and market retail prices, which reflects the marketing margin between the farm and the retailer. We can also see that for both varieties of rice, the marketing margin reflected in the price gap appear to be stable, which implies that the farm price and the retail price may be cointegrated in the long-run[3]. Also visible in Figure 1 is the fluctuation in the marketing margin (as measured by price difference) as prices vary. Why might the marketing margin deviate from the long-run equilibrium over the short term? Variation in production costs and changes in the weather and human activities are all causes of short-run asymmetric adjustments in the markets. This fluctuation may cause nonlinear fluctuations and limited cycles in the farm and the retail prices, despite their relatedness. These nonlinear effects may cause more short-run deviations from the equilibrium for the marketing margin, which can in turn, generate asymmetric price adjustments in the rice markets. Because of this, models which do not consider nonlinear relations between variables are certain to produce biased results.

In recent years, empirical analyses of price transmission for agricultural products have attracted attentions among economists. Von Carmon-Taubadel (1998) analyzes vertical price transmission between farm gate and wholesale pig prices in Germany using an error correction model (ECM). To incorporate also effects of the marketing margin into models of price transmission, the author develops the threshold error correction models (TECM). Many studies have been undertaken based on works by Tong (1978) and Balke and Fomby (1997). For example, Obstfeld and Taylor (1997) analyze the 'Law of one Price' within such a framework. Goodwin and Piggott (2001) use a threshold error correction model to quantify the spatial integration in US corn and soybean markets. Ben-Kaabia *et al*. (2002) and Ben-Kaabia and Gil (2007) estimate the price transmission between the vertically related stages of the Spanish lamb market using a threshold model. Meyer (2004) argues that a three-regime threshold vector error correction model (TVECM) is most suitable for analysis of the bi-directional price adjustment in the presence of the marketing margin. These models can account for the effects of the marketing margin in the price transmission analysis even when the transaction cost data are unavailable.

In other applications, Frey and Manera (2007) review the existing empirical literature on the price asymmetries in commodities, providing a way to classify and compare different studies that are highly heterogeneous in terms of econometric models and type of asymmetries and empirical findings. Poghosyan and De Haan (2007) use the TVECM for a fixed rolling window to analyze the dynamics of the transaction cost and to detect any comovements with (policy induced) changes in the financial environment. The methodology is applied on the interest rates from different financial markets in Germany, France, Italy, Belgium, and the Netherlands for the

[3] Von Carmon-Taubadel (1998) and Meyer (2004) accept that the error between two prices over the long run can reflect the marketing margin between markets.

1980-2006 periods, and the finding is that only for some country pairs and financial market segments is there evidence in support of financial integration. Poghosyan and Kuper (2008) estimate a TVECM model for US gasoline and crude oil prices and find evidence for the threshold effect after February 1999. The results indicate that firms adjust prices only if the deviations from the long-run equilibrium between the price of crude oil and gasoline are large enough.

The objective of this paper is to test whether changes in the marketing margin between the farm and the retailer, as measured by the price difference, can cause an asymmetric relationship between the farm and the retail price. For this objective, we establish the following three hypotheses. Hypothesis 1 is that there is a cointegration relationship between the farm and the retail prices. Under the null hypothesis of hypothesis 1, the marketing margin exists and the long-run relationship between the two prices is stable. Hypothesis 2 is that given the established cointegration relationship, there is no threshold relation between the farm and the retail prices. Hypothesis 2 could be examined by the linearity test. When hypothesis 2 is rejected, we could construct the threshold model and divide the model into two regimes. Hypothesis 3 is that the causality between the farm and the retail prices does not vary with the regimes.

The benefit of testing these three hypotheses is that we will be able to calculate a critical level for the marketing margin, which will provide a rational basis for the government to decide when to intervene in the market. Consumers will also be able to judge whether the market price for rice is within reasonable limits. This will help prevent profiteering by businesses in the supply chain, which is against the interests of both the farmers and the consumers.

We employ the farm and retail prices of the two varieties of rice mentioned before to conduct the empirical study. The results show that (1) there is a cointegration relationship between the farm and retail prices; (2) the linearity test rejects hypothesis 2, which indicates that the threshold effect exists; and (3) under the two regimes, the causality test result shows that when the marketing margin is lower than the threshold value, the market system operates freely and there is feedback between the farm and the retail prices. But when the marketing margin is higher than the threshold value, the government intervenes in the market and the causal relationship between the farm and the retail prices no longer exists.

There are four sections in this paper: the first introduces the research, the second presents the model and methods, the third gives the results and their economic implications, and the last section is the conclusion.

2. Model and methods

A TVECM is a Vector AutoRegression (VAR) model with a well-specified longrun relationship and in which regime changes introduce non-linearities. In the linear VECMs even the smallest deviation from the longrun already leads to an adjustment toward the longrun relationship, whereas in the TVECMs the adjustment is assumed to be costly. The adjustment takes place only if the benefits of changing the price exceed the costs or the marketing margin.

In the literature above it is noted that changes in the marketing margin may cause an asymmetric price transmission. In this case, the use of the VAR models or the vector error correction linear models (VECM) would be inappropriate. This paper therefore applies a two-regime TVECM (nonlinear model) based on Von Carmon-Taubadel (1998) and Meyer (2004). The error correction term serves as the threshold variable, separating the transaction cost variation into two regimes to create a non-linear threshold model[4]. In the following, we first briefly introduce the threshold model and then discuss our empirical model.

2.1. Research methodology

The threshold autoregressive model developed by Tong (1978) and Tong and Lim (1980) uses an optimal threshold value to divide the short-run dynamic status of one economic indicator into two regimes. When there are multiple (two) regimes, the threshold model could be transformed as:

$$Z_t = (A_1 + \Phi_1 Z_{t-i}) I(q_{t-d} > \gamma) + (A_2 + \Phi_{2,i} Z_{t-i})(1 - I(q_{t-d} > \gamma)) + \varepsilon, \tag{1}$$

$$Z_t = \begin{bmatrix} g_t \\ i_t \end{bmatrix}_{2\times 1}, A_1 = \begin{bmatrix} \alpha_{10} \\ \beta_{10} \end{bmatrix}_{2\times 1}, A_2 = \begin{bmatrix} \alpha_{20} \\ \beta_{20} \end{bmatrix}_{2\times 1},$$

$$\Phi_1 = \begin{bmatrix} \alpha_{1,11} \dots \alpha_{1,1p}, \alpha_{1,21} \dots \alpha_{1,2p} \\ \beta_{1,11} \dots \beta_{1,1p}, \beta_{1,21} \dots \beta_{1,2p} \end{bmatrix}_{2\times 2p} \quad \Phi_2 = \begin{bmatrix} \alpha_{2,11} \dots \alpha_{2,1p}, \alpha_{2,21} \dots \alpha_{2,2p} \\ \beta_{2,11} \dots \beta_{2,1p}, \beta_{2,21} \dots \beta_{2,2p} \end{bmatrix}_{2\times 2p}$$

where p is the lag length; $q_t - d$ is the threshold variable, and d is the delay parameter; γ is the threshold value; and the error term ε has the properties such that $\varepsilon = (\varepsilon_1^* \ \varepsilon_2^*) \sim iid$, $E(\varepsilon_t|\Omega_{t-1}) = 0$, and $E(\varepsilon_t^2|\Omega_{t-1}) = \sigma^2$ where Ω_{t-1} is the information set in period t-1; $I(\cdot)$ are the indicator functions of regimes, and it is assumed that $I(q_{t-d} > \gamma) = 1$ if there exist regimes and $I(q_{t-d} \leq \gamma) = 0$ otherwise.

4 According to Peel and Taylor (2002), one of the earliest applications of the TVECM (Threshold Vector Error Correction Model), when there is cointegration among the variables, the threshold model has to be revised into the TVECM.

We must examine the existence of the threshold effect in equation (1) before estimating the threshold model. We follow the approach of Tsay (1998) to test the linearity of the model. The null hypothesis is that the model is a linear model—and the alternative hypothesis is that the model is a nonlinear model. Tsay (1998) employs the recursive least squares method (RLS) to obtain the predictive residual of the arranged autoregression (ARR) to build the test statistic based on the standardized predictive residual. For detailed discussion of the Tsay linearity test, please refer to Tsay (1998).

If the null hypothesis is rejected, which indicates that the model is nonlinear, then the next step is to find the values of the two parameters, the delay parameter d and the threshold value γ. Suppose that p, q, and the regimes are known. The threshold variable z_{t-d} determines the appearance of the model in two regimes:

$$y_t = \begin{cases} X_t^{'}\Phi_1 + \Sigma_1^{1/2} a_t & If\ z_{t-d} > \gamma \\ X_t^{'}\Phi_2 + \Sigma_2^{1/2} a_t & If\ z_{t-d} \le \gamma \end{cases}. \tag{2}$$

If γ and d are given, then the above equation can be viewed as having two independent linear regressive models, where Φ_i and Σ are obtained as follows:

$$\hat{\Phi}_i(\gamma,d) = (\sum_t^{(i)} X_t X_t^{'})^{-1}(\sum_t^{(i)} X_t y_t^{'}),\quad \hat{\Sigma}_i(\gamma,d) = \sum_t^{(i)} (y_t - X_t^{'}\hat{\phi}_i^*)(y_t - X_t^{'}\hat{\phi}_i^*)'/(n_i - k) \tag{3}$$

where $\Phi_i^* = \hat{\Phi}_i(\gamma, d)$; n_i denotes the observations in regime i, i=1, 2; and k indicates the dimension of X_t and $k < n$. The residual sum of squares is:

$$S(\gamma,d) = S_1(\gamma,d) + S_2(\gamma,d),\quad S_i(\gamma,d) = trace[(n_i - k)\hat{\Sigma}_i(\gamma,d)], \tag{4}$$

where γ and d are obtained from the following equation:

$$\arg\min_{\gamma,d} S(\gamma,d),\ \ 1 \le d \le d_0\ and\ \gamma \in R_0.$$

After attaining the optimal threshold value (γ) and the delay parameter (d), the best fit threshold model can be built.

2.2. Empirical model

Assume that the long-run relationship between the farm and the retail market prices of rice is expressed by the equation $p_t^R = a + bp_t^F + \varepsilon_t$. p^F is the logarithm of the farm price of rice, p^R the logarithm of the retail price. a represents the price difference, and b the cross elasticity between the two prices. Generally, b >1, meaning that the variation in the retail price will be greater than the variation in the farm price.

According to von Carmon-Taubadel (1998) and Meyer (2004), the error correction term $ECT_t = p_t^R - a + bp_t^F$ reflects the marketing margin between the farm and the retail markets. We therefore take into account a delay d and calculate ECT_{t-d} as the threshold variable in the threshold error correction model. The causal relationship between changes in the farm price Δp^F and the retail price Δp^R is examined in the context of various changes in the marketing margin to understand market responses and the impact of government policies[5]. Unlike Meyer (2004), who uses a delay of one and ECT_{t-1} as his threshold variable, we use a strict statistical method to extract the correct delay d from the data itself, taking into account the particular features of the rice production cycle.

The threshold model is divided into two regimes. In one regime price adjustments are determined by the marketing margin (or rather, transaction cost deviations from the long-run equilibrium) that exceeds the threshold γ (regime 1); in the other, adjustments are determined by the marketing margin below (and equal to) the threshold γ (regime 2). The specification for the 2-regime TVECM is given below:

Regime 1 (high marketing margin)

$$\begin{bmatrix} \Delta p_t^F \\ \Delta p_t^R \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \sum_{i=1}^{k} \begin{bmatrix} \beta_i^{F,F} & \beta_i^{F,R} \\ \beta_i^{R,F} & \beta_i^{R,R} \end{bmatrix} \begin{bmatrix} \Delta p_{t-i}^F \\ \Delta p_{t-i}^R \end{bmatrix} + \begin{bmatrix} \phi_1^F \\ \phi_1^R \end{bmatrix} [ECT_{t-1}] + \begin{bmatrix} \varepsilon_t^F \\ \varepsilon_t^p \end{bmatrix}, if\ ECT_{t\text{-}d} > \gamma \,, \quad (5)$$

Regime 2 (low marketing margin)

$$\begin{bmatrix} \Delta p_t^F \\ \Delta p_t^R \end{bmatrix} = \begin{bmatrix} \alpha_3 \\ \alpha_4 \end{bmatrix} + \sum_{i=1}^{k} \begin{bmatrix} \delta_i^{F,F} & \delta_i^{F,R} \\ \delta_i^{R,F} & \delta_i^{R,R} \end{bmatrix} \begin{bmatrix} \Delta p_{t-i}^F \\ \Delta p_{t-i}^R \end{bmatrix} + \begin{bmatrix} \phi_2^F \\ \phi_2^R \end{bmatrix} [ECT_{t-1}] + \begin{bmatrix} u_t^F \\ u_t^R \end{bmatrix}, if\ ECT_{t\text{-}d} \leq \gamma \,. \quad (6)$$

Following Tsay (1998), we first assess a linear model in order to be certain that the data do contain thresholds, and that a threshold model is the most appropriate. Thus our null hypothesis is a linear VECM model, and the alternative hypothesis is a nonlinear TVECM model.

Finally, we tested for the Granger causality between the two variables in the short-run within regime 1; this tests the effects of the marketing margin on the price transmission from the farm to the retailer. The Granger causality is tested using the *Wald* statistic, which is also known as the strong exogeneity test. The null hypothesis for the causality in regime 1 (regime 2) is H_0:$\beta_i^{F,R} = 0$, $i = 1,..., k$ (H_0:$\delta_i^{F,R} = 0$, $i = 1,..., k$). The null hypothesis states there is no causal relationship between Δp_t^R and Δp_t^F; rejecting this null hypothesis implies that changes in the retail price do affect changes in the farm price. In the other direction, the null hypothesis is

[5] $\Delta p_t = p_t - p_{t-1}$; p_t is the natural logarithm of the price.

H_0:$\beta^{R,F}_i = 0$, $i = 1,..., k$ (H_0:$\delta^{R,F}_i = 0$, $i = 1,..., k$), stating that Δp^F_t does not affect Δp^R_t. Rejecting the null hypothesis implies that changes in the farm price do affect changes in the retail price.

We can use the adjustment coefficients, ϕ^F_1 and ϕ^F_2, on the *ECT*s at different intervals to determine whether the retail price is weakly exogenous with respect to the farm price; ϕ^R_1 and ϕ^R_2 can be used to determine whether the farm price is weakly exogenous with respect to the retail price. This assessment enables us to judge whether corrections emerge in response to short-run imbalances between the farm and the retail prices.

3. Empirical results

The variables in this model are the farm and the retail prices of the Tsailai and the Penglai rice, the two main varieties grown in Taiwan. The data come from the Council of Agriculture, Executive Yuan, R.O.C., and consist of monthly price data from January 1981 to March 2006, a total of 303 observations. Table 1 reports the basic statistics of the returns of logarithmic farm and retail prices. The means of the two variables indicates that the fluctuation of the retail price is larger than that of the farm price. Figure 1 illustrates the time trends of the two prices and it is very obvious that the retail price is higher than the farm price. These two phenomena implies that there is the marketing margin (or transaction cost) between the farm and retail prices. The standard deviations of Table 1 could evaluate the price risk of the rice prices. The numbers in Table 1 indicate that the farm price is riskier than the retail price is, which indicates that the rice market that Taiwanese farmers face is a low-return and high-risk one. The skewness coefficient indicates that the distribution of the farm price is skewed on the left and the distribution of the retail price is skewed on the right. The kurtosis coefficient indicates that the distributions of the four time series are the leptokurtic.

Table 1: The basic statistics of the first-differenced price variables

	FP1	FP2	RP1	RP2
Mean	0.0008	0.0009	0.001	0.001
Std. Dev.	0.037	0.049	0.027	0.027
Skewness	-0.254	-0.718	0.883	0.152
Kurtosis	7.622	4.515	14.05	5.832
Observations	302	302	302	302

Note: Variables are all in natural logarithms. Variable FP1 the farm price per kilo (in NTD) of Tsailai rice, FP2 the farm price per kilo (in NTD) of Penglai rice, RP1 is the retail price per kilo (in NTD) of Tsailai rice, and RP2 is the retail price per kilo of Penglai rice.

Source: Author and the Council of Agriculture, Executive Yuan, R.O.C

When conducting the tests, we first applied two unit root tests: the Augmented Dickey-Fuller and the Phillips-Perron tests, to establish that the variables were not stationary. The unit root tests compare constant and time-trend models. The results are shown in Table 2. They indicate that the four price series are I(1) processes, i.e. the first difference of the four series are stationary. Using these results, we can test for cointegration between the farm and the retail rice prices.

Table 2: Unit root tests

	ADF		PP	
Variable	constant	Constant + trend	constant	Constant + trend
level value				
FP1	-2.094 [14]	-3.059 [14]	-2.223 [7]	-2.990 [6]
FP2	-1.483 [14]	-3.104 [14]	-2.552 [14]	-4.125 [14]***
RP1	-1.225 [0]	-2.503 [14]	-1.315 [0]	-2.092 [14]
RP2	-1.784 [12]	-2.601 [12]	-1.625 [12]	-2.601 [12]
first difference				
FP1	-4.478 [13]***	-4.463 [13]***	-11.76 [13]***	-11.73 [13]***
FP2	-5.509 [13]***	-5.502 [13]***	-14.01 [13]***	-13.97 [13]***
RP1	-15.84 [0]***	-15.81 [0]***	-15.82 [0]***	-15.79 [0]***
RP2	-4.560 [11]***	-4.561 [11]***	-11.59 [11]***	-11.56 [11]***

Notes: Variables are natural logarithms. A maximum of 15 lags were used in the unit root tests. The numbers in brackets [ ] are the appropriate lag lengths selected by AIC. *** indicate significance at the 1 percent level. The critical value for significance at the 1 percent level is -3.45 for both ADF and PP tests. Critical values from MacKinnon (1996).

Source: Author

The Johansen cointegration test (Johansen, 1991; 1995) was applied to determine whether or not there is a stable long-run relationship between the prices of the two different varieties of rice. The results of the unit root tests showed no trend, implying that the I(1) process was not caused by a time trend. We therefore did not consider time trends in the cointegration test. Table 3 shows the results of the cointegration test: the farm and the retail prices are cointegrated for both varieties of rice. For the Tsailai rice, the long-run relationship between the farm and the retail prices is $p^R_{1,t} = 0.142 + 1.505\, p^F_{1,t}$; for the Penglai rice, the relationship is $p^R_{2,t} = 0.055 + 1.144\, p^F_{2,t}$. The parameter value of *a* shows that for both varieties, there exists a fixed mark-up effect; the value of *b* shows that the cross-elasticity between the farm and the retail prices is higher than 1 for both varieties. This implies that variations in the retail price of both varieties of rice are larger than the variations in the farm price. The cross-elasticity is higher for the Tsailai than for the Penglai rice, meaning that the retail price response to changes in the farm price is greater for the Tsailai than for the Penglai rice.

Table 3: Cointegration tests

Null hypothesis	Alternative hypothesis	Statistic	5% critical level
Tsailai rice p = 6			
λ_{trace} tests			
$\tau = 0$	$\tau > 0$	20.01**	15.50
$\tau \leq 0$	$\tau > 1$	2.28	3.84
λ_{max} tests			
$\tau = 0$	$\tau = 1$	17.74**	14.27
$\tau = 1$	$\tau = 2$	2.28	3.84
Penglai rice p = 12			
λ_{trace} tests			
$\tau = 0$	$\tau > 0$	18.14**	15.50
$\tau \leq 0$	$\tau > 1$	2.98	3.84
λ_{max} tests			
$\tau = 0$	$\tau = 1$	15.16**	14.27
$\tau = 1$	$\tau = 2$	2.98	3.84

Notes: The lag length (k) is determined by sequential AIC tests. ** indicate significance at the 5 percent level.

Source: Author

Before defining the nonlinear threshold model, it is necessary to confirm that the variables are not in fact linear. We follow Tsay (1998) in testing for linearity: the error term (ECT_{t-d}), taken to be a measure of the marketing margin is the threshold variable. We first selected the lag period (p) which gave the best fit for the data as measured by the Akaike information criterion (AIC). For the Tsailai rice, p = 6; for the Penglai rice p =12 .

Table 4 shows the results of the test for linearity. The null hypothesis of linearity is rejected for both varieties of rice, so it is necessary to use a TVECM. We also calculated the p-value for rejecting linearity using a Chi-square test. The appropriate delay for the threshold variable (ECT_{t-d}) was found to be 1 (d=1) for the Tsailai rice and 4 (d=4) for the Penglai rice. The threshold variable for the Tsailai rice was therefore ECT_{t-1}; for the Penglai rice it was ECT_{t-4}. The threshold value for the Tsailai rice model is 0.081; therefore when ECT_{t-1} >0.081, the regime relating to the high marketing margin (regime 1) holds. When ECT_{t-1} < 0.081, the marketing margin is low (regime 2). For the Penglai rice, the threshold value was 0.054, regime 1 holds when ECT_{t-4} >0.054.

Table 4: Summary of linearity tests

Tsailai rice p = 6		Penglai rice p = 12	
d=1	*(1.64E-14)*	d=1	(0.23)
d=2	(2.80E-06)	d=2	(0.14)
d=3	(5.09E-10)	d=3	(0.36)
d =4	(5.28E-11)	*d =4*	*(0.03)*
d =5	(5.79E-05)	d =5	(0.64)
d =6	(1.10E-06)	d =6	(0.22)
		d =7	(0.23)
		d =8	(0.37)
		d =9	(0.61)
		d =10	(0.61)
		d =11	(0.10)
		d =12	(0.04)

Notes: The *p* is the lag length for endogenous variables. *d* is the delay for the threshold variable. Values in parentheses ( ) are the *p*-values calculated by the Chi-square test for linearity.

Source: Author

Table 5 shows the results of the causality test. The Chi-square test (on the significance of the *ECT*) of the strong and weak exogeneity showed that when the marketing margin for the Tsailai rice is higher than the threshold value, there is no significant causality between the farm and retail prices; when the marketing margin is lower than the threshold value, there is significant mutual causality between the two prices. For the Penglai rice, the results are similar, except when the marketing margin is high and the retail price is weakly exogenous with respect to the farm price. The economic interpretation of these findings is that when the marketing margin is lower than the threshold value, the market operates freely: there is feedback between the farm and the retail prices. When the marketing margin is higher than the threshold value, there is no significant causal relationship between the two prices. We suggest that the reason for this difference is that the government makes necessary interventions in the market to stabilize the retail price when there is a large rise in the retail price. That rise may originally have been caused by changes in the farm price, but after the government intervention, a causal relationship between the two prices no longer exists. This is consistent with normal practice of the agriculture authorities in Taiwan.

Table 5: TVECM causality tests

Dependent Variable	Null hypothesis	Regime 1	Regime 2
Tsailai rice p=6, d=1		$ECT1_{t-1} > 0.081$	$ECT1_{t-1} \leq 0.081$
$\Delta FP1$	$\Delta RP1 \times\!\rightarrow \Delta FP1$	3.64 (0.72)	*12.19 (0.06)*
	$ECT1 \times\!\rightarrow \Delta FP1$	0.51 (0.47)	*3.38 (0.07)**
$\Delta RP1$	$\Delta FP1 \times\!\rightarrow \Delta RP1$	7.38 (0.29)	*34.95 (0.00)****
	$ECT1 \times\!\rightarrow \Delta RP1$	0.31 (0.58)	*5.09 (0.02)***
Penglai rice p=12, d=4		$ECT2_{t-4} > 0.054$	$ECT2_{t-4} \leq 0.054$
$\Delta FP2$	$\Delta RP2 \times\!\rightarrow \Delta FP2$	9.76 (0.64)	*12.05 (0.44)*
	$ECT2 \times\!\rightarrow \Delta FP2$	*4.45 (0.03)***	*10.38 (0.00)***
$\Delta RP2$	$\Delta FP2 \times\!\rightarrow \Delta RP2$	18.46 (0.10)	*68.28 (0.00)****
	$ECT2 \times\!\rightarrow \Delta RP2$	1.76 (0.18)	*5.06 (0.02)***

Notes: Δ represents the first difference of a variable. $\Delta RP \times\!\rightarrow \Delta FP$ means the first difference of the retail price (lagged) cannot explain the first difference of the farm price; $\Delta FP \times\!\rightarrow \Delta RP$ means the first difference of the farm price (lagged) cannot explain the first difference of the (current) retail price. Parentheses ( ) indicate the Chi-square values. ***, **, and * indicate significance at the 1%, 5% and 10 % levels.

Source: Author

Finally, the difference in the threshold values suggests that there is a difference in the timing of government interventions in the markets for the Tsailai (threshold 0.081) and the Penglai (threshold 0.054) rice. This may be because the long-run cross elasticity for the Tsailai rice is greater than that of the Penglai rice. This means that a higher transaction cost threshold for the intervention is acceptable for the Tsailai rice when the objective is to avoid excessive movements in the retail price of rice.

4. Conclusions

The purpose of this study is to examine the relationship between the farm and the retail prices in the Taiwanese rice market. We established three hypotheses and obtained several important empirical findings. Firstly, there is a long-run cointegration relationship between the farm and the retail prices. Secondly, the marketing margin resulting from this long-run relationship may cause short-run dynamic adjustments between the farm and the retail prices, which results in the *asymmetric* causality.

This implies that the marketing margin is an important factor when analyzing the causality in the farm and the retail markets. Because of this, we constructed a nonlinear threshold model to fully understand the effect of the marketing margin. Thirdly, when the marketing margin is low, the market operates freely; when the marketing margin is high, the government makes necessary interventions in the market to prevent excessive rises in the rice prices. When intervention occurs, the market system no longer operates.

The main advantage of our model is that it is able to analyze the asymmetric price transmission between the price series without the addition of the transaction cost data (e.g. operating costs for intermediary companies). Additionally, the new findings of this paper can allow the government to make appropriate decisions on market interventions and can be used by consumers to determine a reasonable price range for rice, which serves the interests of both farmers and consumers. Finally, employing different empirical models, adopting various rice prices, or including government policies in the model could serve as the possible future research directions for us.

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Mjerenje prijenosa marketinške marže na Tajvanskom tržištu riže

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Sažetak

Cilj ovog rada je provjeriti da li promjene u marketinškoj marži između cijene na farmi i maloprodajne cijene mogu uzrokovati asimetrični odnos između navedenih cijena na tržištu riže u Tajvanu. Razdvajanjem varijacija transakcijskog troška u dva režima, ovaj rad koristi dvorežimski TVECM s parametrom korekcije greške kao prag varijablom za stvaranje nelinearnog modela praga. Empirijski rezultati pokazuju da, kad je marketinška marža niža od vrijednosti praga, tržišni sustav funkcionira slobodno i postoji povratna veza između cijene na farmi i maloprodajne cijene. Međutim, kada je marketinška marža veća od praga vrijednosti, država intervenira na tržištu i uzročna povezanost dviju cijena više ne postoji. Zaključci *su kako slijedi. Promjene u marketinškoj marži mogu uzrokovati asimetrični prijenos cijene između cijene na farmi i cijene na malo na tajvanskom tržištu riže; dakle, ignoriranje učinka marketinške marže može dovesti do greške u modelima. Kada je marketinška marža veća od praga vrijednosti, država intervenira na tržištu i prekida se uzročna veza između navedenih dviju cijena.*

Ključne riječi: *marketing marža, prijenos cijene, asimetričnost cijene, model praga, TVECM*

JEL klasifikacija: *C22, Q13, Q18*

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