行政院國家科學委員會專題研究計畫成果報告

臺灣地區虱目魚生產地與消費地市場間運銷通路之決價效率分析

Pricing Efficiency of Marketing Channels between Production and Consumption Markets with Implications for Taiwan Milkfish

計畫編號：NSC 87-2415-H-005-009
執行期限：86 年 8 月 1 日至 87 年 7 月 31 日
主持人：凌碧鴻　國立中興大學農產運銷學系

一、中文摘要

受到生產季節性、市場供需變化及市場間交易資訊傳遞效率的影響，台灣虱目魚市場價格普遍呈現不穩定性。本研究目的旨在應用 Engle-Granger **兩階段共整合研究法，藉以探討垂直性與水平性相關魚市場間虱目魚價格因果關係，並評估虱目魚魚市場間共整合性與決價效率性。研究結果指出虱目魚生產批發與消費零售價格間具有顯著雙向因果價格共整合關係，但生產批發價格因應於消費零售價格變動表現出較弱的價格感應度，其反應消費零售交易資訊比較不易完整且快速地傳遞到生產批發市場，因而造成生產批發市場相較於消費零售市場呈現較低決價效率。台北為台灣地區最大魚貨批發市場，其虱目魚批發價格具有價格領導特性，無論長期性或短期性而言，對其他水平性相關魚市場虱目魚價格形成均產生較大幅度的影響力。**

關鍵詞：決價效率，價格共整合，
Enger-Granger **共整合研究法，虱目魚**

Abstract

Instability of milkfish price often occurs in Taiwan, due to the factors of the seasonal production, the changes in market demand and supply, and the efficiency of market information transmission between fish markets. The objectives of this study are to analyze the lead-lag relationship of milkfish prices between vertically- and horizontally- related fish markets and to evaluate the performance of market integration and pricing efficiency between milkfish markets. The results shows that the two-way lead-lag cointegrating price relationship between milkfish wholesale and retail prices. Since the fish wholesale market could not completely and quickly assimilate the retail market information, the speed of wholesale price response to retail price changes is relatively slow, inducing the low pricing efficiency. The Taipei fish wholesale market with a largest trading share appears to cause the greatest leadership impact on the price formation of milkfish in the other horizontally-related fish wholesale markets both in the long-run and short-run.

Keywords: Pricing Efficiency, Price Cointegration, Enger-Granger Cointegration Approach, Milkfish

二、緣由與目的

Milkfish (*Chanos chanos*) is the most significant species in the Taiwan traditional aquacultural operation . In 1996, a total of 12 thousand hectares of milkfish farming areas accounted for 34% of finfish aquaculture. About 82% of milkfish production was located in the southwestern region of Taiwan including Kaohsiung (41.9%) and Tainan (39.6%), but the majority of consumption was spatially dispersed in urban cities.[1] Fish wholesale market becomes

the primal channel for milkfish wholesaling from producers to consumers. The fluctuating supply of milkfish has often led to the price instability within a year throughout its market system. Main factors contributed to this state of flux could be the seasonal production, the changes in market demand and supply, and the efficiency of market information transmission between fish markets.

The objective of this study is to analyze the interdependent behavior of lead-lag milkfish price adjustments between vertically-related markets (from production to consumption) and among five major horizontally-related wholesale markets. Moreover, the speed of price adjustment for evaluating the performance of market integration and pricing efficiency in milkfish markets is discussed. Measurement of the causal price linkages among dispersed markets could provide better understanding of the dynamics and efficiency of arbitrage in transmitting the market information and thereby in market pricing in integrated spatially markets.

三、結果與討論

The 110 monthly observations (July 1989 to August 1998) on average wholesale price of milkfish in the production region and average retail price of milkfish in the consumption region in Taiwan are used for the analysis of the pricing efficiency in the vertical market system.[2] In addition, milkfish prices of five major fish wholesale markets (located in the cities of Taipei, Taichung, Chiayi, Changhwa, and Hsinchu) are applied in the horizontal market system.[3]

First, the Dickey-Fuller (DF) test and the Augmented Dickey-Fuller (ADF) test are introduced to test the presence of unit roots in series.[4] & [5] The null hypothesis of the DF test is that β in equation (1) is equal to unity and hence x_t follows a random walk.

$$x_t = \alpha + \beta\, x_{t-1} + \mu_t\ ;\ \mu_t \sim IID\ (0, \sigma_u^2) \qquad (1)$$

By subtracting x_{t-1} from each side, equation (1) can be rewritten as in (2):

$$\begin{aligned} x_t - x_{t-1} &= \alpha + \beta\, x_{t-1} - x_{t-1} + \varepsilon_t \\ \Delta x_t &= \alpha + (\beta - 1) x_{t-1} + \varepsilon_t \\ \Delta x_t &= \alpha + \gamma\, x_{t-1} + \varepsilon_t \end{aligned} \qquad (2)$$

where Δx_t is the first difference of x_t and γ is equal to $(\beta - 1)$. γ will be zero if x_t follows a random walk. On the other hand, γ will be negative and significantly different from zero if x_t is stationary. The ADF test provides a simple generalization of the DF test to allow for the possibility of higher order autoregressions as follows in (3), where n is the large enough number of lagged difference so that the error term, ε_t, is a white noise process.

$$\Delta x_t = \alpha + \gamma\, x_{t-1} + \sum_{i=1}^{n} \gamma_i \Delta x_{t-i} + \varepsilon_t \qquad (3)$$

According to the DF and ADF unit-root tests, the levels of price series for all markets concerned are nonstationary with the presence of a unit root and the null hypothesis is rejected at the 1% level of significance for all price series in their first differences. This indicates that stationarity is attained for all price series after first differencing.

A bivariate cointegration approach using the Engle-Granger two-stage procedure is further applied.[6] The first stage begins with the estimation of parameters of the long-run cointegrating regression on the level of milkfish price series in market i and j by the ordinary least squares as in equation (4):

$$P_t^i = \alpha_1^{ij} + \alpha_2^{ij} P_t^j + \varepsilon_t^{ij} \qquad (4)$$

where α_1^{ij} represents shifting effects such as marketing margins to capture an *ad valorem* markup between two price series in (4); α_2^{ij} represents the relative degree of the price change of P_t^i in market i resulting from the price change of P_t^j in market j ; and ε_t^{ij} represents the residual error terms, deviating from the long-run equilibrium value in time t. If ε_t^{ij} is stationary, the linear combination of two

price series is said to be cointegrated. When price transmissions between spatial markets are performed efficiently, α_2^{ij} will tend to approach unity and follow the Law of One Price.[7]

If the static long-run cointegration regression is valid, the dynamic error correction model (ECM) can take the form of regressing prices series in their first differences as in (5):[8]

$$\Delta P_t^i = \beta_1^{ij} + \beta_2^{ij}\Delta P_t^j + \beta_3^{ij}\hat{\varepsilon}_{t-1}^{ij} + \sum_{l=1}^{q}\phi_l^{ij}\Delta P_{t-l}^j + \sum_{l=1}^{q}\phi_l^{ij}\Delta P_{t-l}^j + \mu_t^{ij} \qquad (5)$$

where $\hat{\varepsilon}_{t-1}^{ij}$ is one period lagged values of the error terms in (5) and is so-called the error correction terms of which coefficients, β_3^{ij}, represents the speed of dynamic price adjustments of the two price series from their long-run cointegrating relationship in the previous period. β_2^{ij} measures the magnitude of the short-run price transmission. $\sum_{k=1}^{p}\gamma_k^{ij}\Delta P_{t-k}^i$ and $\sum_{l=1}^{q}\phi_l^{ij}\Delta P_{t-l}^j$ represent the autoregressive (AR) components of ΔP_t^i and ΔP_t^j, respectively, which are added in (5) in order to ensure that the residual error terms, μ_t^{ij} and μ_t^{ji}, are white noises. Finally, *Empirical Econometric Modelling Using PcGive 9.0 for Windows* is used for the estimation of the study.[9]

(a) The vertical market system

The results shows the two-way lead-lag cointegrating price relationship between wholesale and retail prices of milkfish in Taiwan. Particularly, the retail market could quickly assimilate consuming market signals and lead to more influences on the pricing formation at the wholesale market in the long-run (108% impact) and the short-run (87%) with a higher error correction factor of 25.4%. In contrast, the speed of wholesale response to retail price changes is relatively slow in both long-run (77.2%) and short-run (59.9%). It suggests that the wholesale market structure could be less competitive and thus may induce price stickiness and slow response to retail price changes. Furthermore, any remaining long-run disequilibrium will be eliminated by an error correction factor of only 19.0%.

(b) The horizontal market system

The results obviously show that a one unit change in the milkfish price of Taipei fish wholesale market located in a biggest urban city in Taiwan leads to an relatively higher percentage change in the milkfish prices of other four horizontally-related wholesale markets concerned in the study. The contemporaneous milkfish price change significantly ranges from 101% to 115% in the long-run and from 94% to 107% in the short-run. Such results are in accordance with a priori exception that Taipei fish market having a largest market share of wholesaling trade in average is expected to have the strong impact on the price formation in the other fish market with a relatively small market share.

On the other hand, Taichung, Changhwa and Chiayi as a regional trading bloc such that the symmetric nature of price responses is found among these three markets in the long-run and the degree of price impact from one market to the other market, indicated by α_2^{ij}, tends to approach to one. The results suggest that with the consideration of market places, the coefficients of price transmission between markets are extremely same in alternative direction, leading to the higher degree of price cointegration. In particular, the phenomenon of this price cointegrating relationship can be found between Taichung and Changhwa both in the long-run and short-run. Consequently, their error terms apart from the long-run equilibrium is corrected by a relatively greater factor indicated by β_3^{ij}, 45.0% and 45.8%. It suggests that market information between these two markets can be more dynamic and the speed of dynamic price adjustments between from the long-run equilibrium relationship is the previous period is more rapid, thus also indicating a fast price response in the short-run.

四、計畫成果自評

The objective of this study is achieved. The preliminary result was presented at *The 42nd Austrlain Agricultural and Resource Economics Society Conference*, University of New England, Armidale, New South Wales, Australia.[10]

五、參考文獻

[1] *Fisheries Yearbook Taiwan Area* (1996). Taiwan Fisheries Bureau, Department of Agricultural and Forestry, Provincial Government of Taiwan, Republic of China.

[2] *Taiwan Agricultural Prices & Costs Monthly (1989-1997)*. Department of Agricultural & Forestry, Provincial Government of Taiwan, Republic of China.

[3] *Fisheries Extension Monthly (1989-1997)*. Taiwan Fisheries Bureau, Department of Agricultural and Forestry, Provincial Government of Taiwan, Republic of China.

[4] Dickey, D. A. and Fuller, W. A. (1981). The Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica*, Vol. 49, pp. 1057-1072.

[5] Said, S. E. and Dickey, D. A. (1984). Testing for Unit Root in Autoregressive Moving Average Model of Unknown Order. *Biometrika*, Vol. 33, pp. 661-680.

[6] Engle, R. F. and Granger, C. W. J. (1987). Cointegration and Error Correction: Representation, Estimation and Testing. *Econometrica*, Vol. 49, pp. 251-276.

[7] Ardeni, P.G. (1989) Does the Law of One Price Really Hold for Commodity Prices? *American Journal of Agricultural Economics*, Vol. 71, pp. 661-669.

[8] Banerjee, A., Dolado, J., Galbraith, J. W. and Hendry, D. F. (1993). *Co-intengration, Error Correction, and the Econometric Analysis of Non-stationary Data*, Oxford: Oxford University Press.

[9] Doornik, J. A. and Hendry, D. F. (1996) *Empirical Econometric Modelling Using PcGive 9.0 for Windows.* London, International Thomson Business Press.

[10] Ling, B. H. (1998). Price Cointegration in Spatial Markets: An Application to Milkfish Markets in Taiwan. Paper presented at *The 42nd Austrlain Agricultural and Resource Economics Society Conference*, January 19-21, 1998, The University of New England, Armidale, New South Wales, Australia.