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Spatial integration of the Caspian Sea bony fish market: An application of the seasonal co-integration approach to monthly data

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ABSTRACT

Analysis of spatial integration (co-integration) will make an important contribution to the literature of market structure. The analysis presents an index of spatial markets' efficiency and tests law of one price in the fish markets of Guilan and Mazandaran. The seasonal and monthly nature of price series creates fluctuating market conditions. So this study was done to investigate spatial integration of markets for different types of marine bony fish in Guilan and Mazandaran over a period of 120 months from 2001:1 to 2010:12. Given that the fishing season is from October to late April, all prices of illegal fishing registered in the Iran Fisheries Organization were used for the remaining five months (May to September). The modern approach of analyzing seasonal unit roots and estimating Seasonal Error Correction Model (SECM) was used in the study. Results showed that there has been seasonal co-integration in markets for different types of bony fish and spatial markets obeyed law of one price in both Mazandaran and Guilan. Therefore, this long run seasonal dynamics approach needs to be considered in error correction computations and finally forecasting and policymaking for future situation in the various fish markets. Otherwise, price policy and market planning will fail to achieve appropriate efficiency in terms of spatial markets in the long-term.

1. Introduction

In Iran, marine products are considered as an important source of animal protein. Aquaculture currently has very effective role in supplying food for communities and contributing to national food security. And the Caspian Sea, as the habitat of many types of boney fish such as white fish, carp and mullet has long been an important source of boney fish in the country. In 2010, a total of 16 602 tons of bony fish were caught from the country's northern coastline; 15 063 tons (approximately 91%) consisted of white fish, carp and mullet. In addition, from the total of these catches, more than 90% were caught in Mazandaran (46.5%) and Guilan (43.9%). Furthermore, fish consumption in these provinces is high with about 12 kg per capita (Iranian Fisheries Organization, 2011). Therefore, the Mazandaran coastal market is one of the most important boney fish markets in the country.

Diagram 1, demonstrates that retail prices of white fish, carp, and mullet are subject to constant fluctuation in Mazandaran. The price trend of white fish has been descending between 2004 and 2008 in Mazandaran, while the price trend of carp has been ascending during those years. Also demonstrated in the diagram is that in recent years, the consumer price trend has been ascending. In 2001 to 2002 and 2005 to 2007, the retail price trend of mullet and carp has been in reverse. In 2009 and 2010 fish prices were rising in Mazandaran. This trend has had a steeper slope in the Carp market.

The Guilan market also demonstrated a retail price trend of white fish and mullet that has been quite oscillatory but ascending. In recent years, prices of these two types of fish have increased dramatically. However, the price trend of carp has been more stable. Although, there was a dramatic retail price increase observed in 2009 it was then followed by a perceptible reduction Diagram 2.

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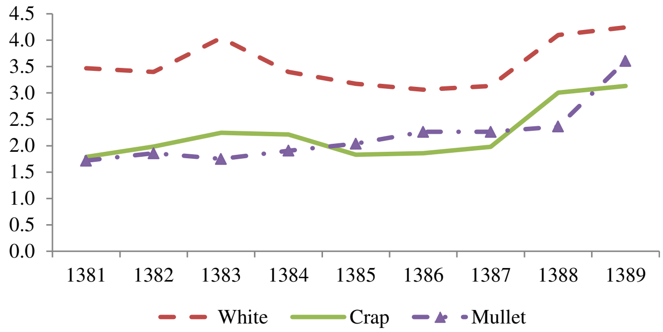

Diagram 1. Retailing price trend of bony fish in Mazandaran.

Questions investigated in this study are as follows:

Given the monthly nature of examined series, will the seasonal nature of data affect spatial co-integration of spatial markets and their integrity?
Will seasonal adjustments to data be appropriately effective in the analysis of spatial markets' Efficiency?
Can the seasonal nature and monthly behavior of data be disregarded for future policy-making governing the market in bony fish?
Finally, will predictions of price efficiency in future market structure result in a diversion, regardless of data on seasonal behavior?

Before investigating the spatial co-integration of markets, it should be explained that according to the monthly nature of data and the probability of seasonal unit roots in existing price series, application of Johansen and Juselius' conventional methods of co-integration (1990) may not present responses that necessarily relate to reality. In fact, in this method, seasonal co-integration of data hasn't been investigated and will be associated with error in predicting future situations and proper policy-making. Another solution is that through these results related to seasonal unit roots and the determination of roots and suitable filters, price series of seasonal adjustments are applied and then the co-integration of modified data is examined by the approach of Johansen and Juselius (1990). However, this approach may lead to wrong inference of economic relationships and could damage seriously valuable information on seasonal efficiency in an economic time series (Ghysels and Perron, 1993; Lee and Siklos, 1997; Feranses and McAleer, 1998; Darne, 2004). Furthermore, increased interest in using unadjusted data and studying seasonal price behavior has increased the need for appropriate methods to analyze data integration with a seasonal nature. These issues have been addressed in the following mentioned pilot studies; Hyllberg et al. (1990), Engle et al. (1993), Joyeux (1992), Cubada (1995). Lee (1992), Kunst and Franses (1998) that developed the Maximum Likelihood approach, which had been used in Johansen's studies (1998). Restrictions were imposed on parameters that related to seasonal abundance in an Error Correction Model (ECM). Finally, by criticism of these restrictions, Johansen and Schaumburg (1999) proposed an approach termed 'Alternative Method of Maximum Likelihood Estimation'. This method offered seasonal (4 months) data; and finally in Darne's study (2004) results were developed into monthly units (12 months).

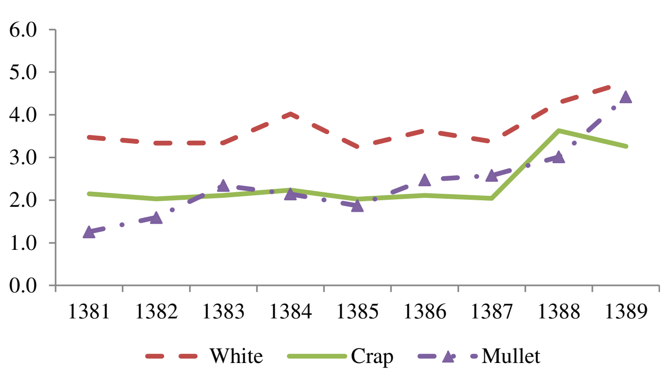

Diagram 2. Price trend of bony fish in Guilan.

Co-integration studies and market integration analyses haven't considered the seasonal nature of data within a country. However, there have been some studies that examined this situation in markets for agricultural products Darne (2004), Fok et al. (2007), Montasser (2011). Given that similar studies conducted in the same country, for the first time, this study examines seasonal co-integration based on monthly data in the boney fish market of Caspian Sea including white fish, mullet and carp.

2. Methodology

At the first step, given that the nature of data examined in this study was monthly (120 months), the existence of non-seasonal and seasonal unit roots was investigated by the Beaulieu and Miron test (1993) (BM test). If X_t is the time series of monthly price, created through an Auto Regressive (AR) process; the following equation can be expressed:

$$\phi(L)X_t = \mu_t + \varepsilon_t \quad (1)$$

In the above equation, $\varphi(L)$ is a polynomial of twelve degree ($\phi(L) = 1 - L^{12}$), L is for lagged operator, and ε_t is white noise. Also, μ_t is defined as $\mu_t = \alpha + \beta t + \sum_{s=1}^{12} \delta_s D_{s,t}$ and consists of intercept (α), linear trend (t), and monthly dummy variables ($D_{s,t}$). Polynomial expression $\varphi(L)$ has twelve featured roots which includes ± 1; $\pm i$; $-1/2(1 \pm \sqrt{3}i)$; $1/2(1 \pm \sqrt{3}i)$; $-1/2(\sqrt{3} \pm i)$; $1/2(\sqrt{3} \pm i)$ (Beaulieu and Miron, 1993). In the BM approach, regression Equation (2) was presented for a hypothesis test of seasonal and non-seasonal unit roots.

$$\left(1 - L^{12}\right)A_t = \alpha + \sum_{s=1}^{11} \delta_s D_{s,t} + \beta t + \sum_{i=1}^{12} \pi_i y_{i,t-1} + \sum_{j=1}^{p} \varphi_j \left(1 - L^{12}\right)A_{t-j} + \varepsilon_t \quad (2)$$

In this equation, $y_{i,t}$ are linear conversions of lags values of A_t which in each of them, one of the unit roots in the considered frequency has been maintained and other unit roots in other frequencies are removed. To test seasonal and non-seasonal unit roots, first this equation is estimated according to ordinary least squares (OLS), and then the significance of π_i parameters is evaluated by statistics of t-test and F-test. In order to test unit roots in zero frequency and π, using the test's one-sided t-statistic, hypotheses of H_{k0}:$\pi_k = 0$ for $k = 1,2$ are separately tested against opposite hypothesis, H_{k1}:$\pi_k < 0$ for $k = 1,2$.

To test compound seasonal unit roots, hypotheses of H_{k0}:$\pi_k = \pi_{k+1} = 0$ for $k = 3,5,7,9,11$ will be examined against opposed hypothesis using F-test statistic i.e., at least a seasonal unit root (H_{k0}:$\pi_k = \pi_{k+1} \neq 0$ for k=3,5,7,9,11). Hypotheses of $\pi_9 = \pi_{10} = 0$, $\pi_7 = \pi_8 = 0$, $\pi_5 = \pi_6 = 0$, $\pi_3 = \pi_4 = 0$, and $\pi_{11} = \pi_{12} = 0$ respectively indicate unit root in $\pm\pi/2$ (4 months), $\mp 2\pi/3$ (3 months), $\pm\pi/3$ (6 months), $\mp 5\pi/6$(2 and a half months), and $\pm\pi/6$ (12 months or annual) frequencies.