An Economical Analysis on Inter-District Integration of Rice Markets in Sri Lanka

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ABSTRACT

This study measures the degree of market integration among the geographically dispersed rice markets in Sri Lanka. It uses the secondary data collected on the retail prices of rice in markets of which located in the districts of Colombo, Kurunegala, Polonnaruwa, Kandy, Nuwaraeliya and Anuradhapura over the period of 1991 to 1996.

Using an empirical model developed based on the theoretical aspects presented by Ravallion (1985) and Timer (1987) the outcome of this analysis show that, Colombo as the focal point of price formation, the rice markets indicated above were highly correlated to each other and integrated both in the short and long term perspectives.

KEY WORDS: Correlation, Integration, Rice markets, Ravallion model, Price formation

INTRODUCTION

Rice is the Staple food in Sri Lanka and is produced in most part of the country. It occupies 34 percent of the total cultivated area. More than 80 000 farm families and 1.8 million farmers are engaged in rice cultivation. This means 6.5 million people are directly or indirectly depend on rice cultivation. Sri Lanka has been able to produce around 95 percent of its total rice requirement. (Central Bank of Sri Lanka 2003).The performance of paddy sector is shown Table1.

Table1 - Performance of paddy sector in Sri Lanka:

Year	Area 000 Hac	Production 000(Mt)	Quantity Import 000 (Mt)
1994	930	2684	58
1995	915	2810	9
1996	744	2061	345
1997	730	2239	306
1998	848	2692	168
1999	896	2851	214
2000	878	2860	15
2001	793	2695	52
2002	852	2859	95
2003	982	3071	35

Source: Central Bank Reports of Sri Lanka

The country's rice production has dropped in year 1996 due to the drought prevailed in the country thus increasing the import. But, it has recovered and reached highest ever output in year 2003.

There are 27 Agricultural districts in which 5 contribute about 52 percent of the rice production. The surplus areas are: Ampara, Kurunegala, Polonnaruwa, Anuradhapura, and Mahaweli '*H*' area. Inter-regional rice trade is thus of great importance due to the presence of few surplus and many deficit regions.

Since the introduction of the open economy in 1977, rice-marketing sector has undergone significant structural changes with other sectors of the economy. As a part of the structural adjustment program the state involvement has been scale down leaving private sector to perform those activities. There is no state organization to oversee activities relating to rice marketing and as a result consumers have to pay higher price for rice while farmers find it difficult to sell their product.

Sri Lanka is attaining to be self sufficient in rice. In order to be self-sufficient market should be efficient. Market integration plays an important role in efficiency. Two trading markets are assumed to be integrated if price changes in one leads to identical price response in other. Associated with market integration is the degree of price transmission, which may have an effect on speed of traders to move food to deficit areas, especially during emergencies such as droughts, floods or pestilence, before the effected people suffer from hunger.

Understanding the degree of market integration is crucial to appropriate formulation of food security program and policies such as emergency stock and trade. Market based policies for poverty elevation and food security, could be more effective if markets integrated. If markets are integrated the effect of policy intervention in one market would be transmitted to other markets. On the other hand if markets were segmented each market would need its own policy or program which is costly. If there is a shortfall and markets are well integrated, importing rice to Colombo port would be sufficient to alleviate food shortage in other markets since price changes due to increase supply in Colombo would be transmitted to other markets and make rice trade to adjust accordingly. Common factors affecting degree of market integration are transportation cost, availability of adequate infrastructure and market information.

Market integration may be defined as a situation in which arbitrage causes prices in different markets to move to gather. In integrated market prices are those where price are determined interdependently. This has generally been assumed to mean that price change in one market will be fully transmitted. Markets that are not integrated may convey inaccurate price information that might distort marketing decision and contribute to inefficient product movement.

The purpose of this research is to analyze empirically the degree of integration among the selected geographically dispersed rice markets in Sri Lanka with the focus on the impact of Colombo prices on other selected markets. If markets are integrated,

emergency food relief program could focus on the major market and be sufficient to alleviate food shortage elsewhere in the country.

METHODS

This section refers to the model used to examine the data, ways and means of collecting data and the analysis.

Conceptual framework

The model developed by Ravallion (1985) was taken as the basis for this study. It assumes a radial distribution of markets where one central (reference) market with price R, is related to n feeder (regional) markets.

$$R = f(P_1 \ldots P_n, X) \quad (1)$$

$$P_i = f_i(R, X_i) \text{ for } i = 1 \ldots n \quad (2)$$

Where there are n regional markets with prices P and R is the reference market price. X_i is a vector for other exogenous variables which might influence price formation in market i, such as seasonal changes and government policy.

The dynamic form of equation 2 with lag l is:

$$p_t = \sum_{j=1}^{l} a_j P_{t-j} + \sum_{j=0}^{l} b_j R_{t-j} + cX_t + e_t \quad \ldots\ldots(3)$$

Empirical model

The Ravallion model modified by Timer (1987) is:

$$P_t = d_0 + (1+d_0) P_{t-1} + d_2 (R_t - R_{t-1}) + (d_3 - d_1) R_{t-1} + d_4 X_{it} + e_{it} \quad (4)$$

Where P_t is the logarithm of the regional market for month t, R_t is the logarithm of the reference market for month t, X_i is a matrix of exogenous seasonal, regional or other variables that might influence, d_i is estimated parameters and e_{it} is random error.

With one lag with out X variables, Timer suggested an "Index of Market Connectedness" (IMC) defined as the ratio of the regional market coefficient $(1+d_0)$ to the reference market coefficient (d_3-d_1).

$$IMC = (1+d_0)/(d_3-d_1) \quad (5)$$

IMC indicates the contribution of the regional market and the reference market past prices on current regional prices. IMC with values of less than one is an indication for short-run integration. d_2 is a measure of the degree to which the price change, in the reference-market is transmitted to the regional market. This parameter measures long run market integration and its value, which is expected to be equal or close to 1.

The difference between these two indicators is that d_2 shows the percentage of the price change in the reference market is transmitted to the regional market price, whereas IMC indicates the relative percentages of the current regional price that are originating from regional market and reference market past prices

Data collection

Monthly retail prices of From 1991 January to 1996 December for market Colombo (COL); Kurunegala (KUR), Polonnoruwa (POL), Kandy (KAN), Nuweraeliya (NUW) and Anuradhapura (ANU) districts published by Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI) were used. Prices were deflated using Colombo Consumer's Price Index (CPI) to eliminate inflation.

Data analysis

Secondary data were undergone following analysis. First Descriptive statistics for each district were taken. Then the correlation analysis was done. The correlation involves estimating the correlation coefficient between market prices of rice of six selected districts.

Next, Multiple regression analysis was done. Ravallion model (equation 4) was estimated for each market with respect to Colombo market and market integration indicators were obtained for each market. In this analysis Colombo market was assumed to be the central market as it is the largest urban centers in the country (higher population density), it has a port (trade center for imports and exports) and it has the highest per capita income, which implies effective demand.

RESULTS AND DISCUSSION

This section summarizes the descriptive statistics of the data and outcome of the empirical analysis.

Descriptive statistics

Descriptive statistic of each district is presented in brief in Table 2 and 3.

Table 2 - Descriptive statistics of rice in selected markets, from January 1991 to April 1996:

Markets	Mean Prices Rs. /Kg	Coefficient. of Variation	Months (n)
COL	1.75	0 .114	72
KUR	1.7	0 .108	72
POL	1.65	0 .127	72
KAN	1.74	0 .128	72
NUW	1.73	0 .119	70
ANU	1.63	0 .137	56

Source; Author

The highest average price of Rs. 1.75 per Kg is observed in Colombo market followed by Kandy market (Rs.1.74 per Kg). Price declines the further the market is from Colombo. Lower mean price is recorded in Anuradhapura.This price pattern implies that Colombo is the focal point of price formation.

For a pair of trading markets, the spatial price differential is not expected to be zero, due to marketing costs of which most important is transport cost.

Table 3 – Average monthly price differentials and coefficient of variance among rice markets, January 1991 to April 1996:

Market Channel	Road Distance (Km)	Mean Price Difference (Rs. /Kg)	Standard Deviation of Price Differential	Coefficient. of Variance
KUR	93	0.046	0.057	0.109
POL	216	0.099	0.065	0.118
KAN	116	0.011	0.081	0.117
NUW	180	0.016	0.078	0.112
ANU	206	0. 14	0.056	0.134

Source; Author

Mean price difference is higher in Anuradhapura (0.14) and Polonnaruwa (0.099) while lower in other districts. The effect of distance on price is evidence as spatial price differential increases with the distance. Larger coefficient of variance indicates that markets may not be integrated. All market pairs have lower coefficient which is closer to 0.1 implies markets are integrated. But, Anuradhapura show low mean price and high mean price differential than polonnaruwa even though it is closely situated to Colombo compare to Polonnaruwa. This may be due to lack of data for some months for Anuradhapura district compare to other district.

Correlation analysis

The correlation analysis reveals that higher correlation among markets which is shown in Table 4.

Table 4 - Rice real price correlation matrix for selected markets, from January 1991 to April 1996:

	COL	KUR	POL	KAN	NUW	ANU
KUR	0. 986					
POL	0. 984	0. 987				
KAN	0. 974	0. 980	0. 981			
NUW	0. 978	0. 975	0. 977	0. 966		
ANU	0. 989	0. 991	0. 988	0. 980	0. 970	
AVG	0.982	0. 983	0. 983	0. 976	0. 973	0. 983

Source; Author

Correlations among the markets indicate statistical significances at probability level of 1percent.Each market pairs has correlation coefficient higher than 0. 9 suggesting that the markets are integrated to each other. Average (AVG) correlation of each market is higher than 0. 9. High correlation suggests the market integration.

Ravallion model application

Empirical results on Ravaliion model application is presented in Table 5. The market pairs are not segmented as reference market coefficients ($d_3 - d_2$) is not zero. This indicates that the central market prices influence prices in the local market.

The value less than one for IMC indicate that there exists short run integration between markets. Short run integration is higher in Kandy – Colombo market channel (0.23). This implies current regional price is originating highly from reference market past prices. While Nuweraeliya – Colombo market channel has lower IMC value (0.87).This implies that current price is originating highly from its own lag prices

Table 4 - Integration of rice markets in Sri Lanka from analysis of real price, January 1991 to April 1996:

Market Channel	Market Integration Indicators	
	Long Run Integration	Short Run Connection
KUR	0.98*	0.58
POL	1.07*	0.38
KAN	1.01*	0.23
NUW	0.93*	0.87
ANU	0.95*	0.32

** Significant at 1 percent probability level*
Source; Author

Long run integration parameters are close to one. That indicates the presence of long run integration among the tradable markets. Comparatively NuweraEliya and Polonnaruwa show less degree of integration while Kandy and Kurunegala show the highest degree of integration with Colombo. Nuweraeliya has lower degree compare to other market may be due to the presence of hilly areas which may increase the transport cost. Next to Nuweraeliya and Polonnaruwa, Anuradhapura and has less degree of integration respectively as they are far away from Colombo. Magnitude of Long integration parameter declines with the distance.

CONCLUSION

Generally, results confirm the importance of Colombo as focal points of inter district rice price formation. It also reveals that markets are highly correlated to each other irrespective of distance and markets are integrated to each other in long run as well as short run perspective.

The effect of distance is evident where magnitudes of model market connection indicators decline with distance from Polnnaruwa – Colombo to Kandy - Colombo market channel. Kandy market has the strong market connection with Colombo as it is the popular city next to Colombo. Nuwereliya market shows slight deviation. This may be due to the hills present in that area which may increase the transport cost. Degree of integration depends on transport infrastructure quality and distance. Market based program and policies are not sufficient to alleviate food shortage in the country.

There is a need to improve the efficiency of food markets through improving, market information and telecommunication. Due to the ethnic war past information on price for most districts are not available.Especially Northern districts were highly restricted from trade due to the war. In future this research can be expanded to other districts if information is available.

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