International Journal of Development and Sustainability
ISSN: 2186-8662 – www.isdsnet.com/ijds
Volume 5 Number 6 (2016): Pages 267-277
ISDS Article ID: IJDS16111001

Price instability and the spatial price relationship of rice in some selected rice markets of Bangladesh

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Abstract

The achievement and successful implementation of agricultural price policy necessitates a study on spatial price relationships. The main focus of this study was to examine the price behavior incorporating price instability and market interdependency of rice price by using time series data from 1974-75 to 2010-11. During the whole period, area instability was observed to be higher relative to production, price and yield instability. Higher price instability influenced area instability and higher area and yield instability influenced production instability. The results of empirical evaluation of spatial price linkage through correlation coefficients and cointegration among regional selected markets of Bangladesh using wholesale price of rice indicated that these markets were well integrated. That means, information about price changes were fully and instantaneously delivered to the other markets in Bangladesh.

Keywords: Instability, Spatial price, Rice, Bangladesh

Cite this article as: Rahman, M.M., Karim, M.S., Raha, S.K., Barua, S. and Farid, M.S. (2016), "Price instability and the spatial price relationship of rice in some selected rice markets of Bangladesh", *International Journal of Development and Sustainability*, Vol. 5 No. 6, pp. 267-277.

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1. Introduction

Rice is the staple food in Bangladesh, accounting for about 35 percent of household expenditure. About 80 percent of the agricultural production originates in the crop sector alone in Bangladesh of which rice contributes about 82 percent (www.tech2daybd.wordpress.com).Total rice production in Bangladesh was about 9.77 million tonnes in the year 1971 when the country's population was only about 70.88 million. However, the country produced about 32.35 million tonnes to feed her 150 million people in 2010. These signify that rice production growth was much faster than population growth. This augmented rice production has been achievable largely due to the adoption of modern rice varieties on roughly 66% of the rice land which contributes to about 73% of the country's total rice production (BBS, 2010). That is why the rice price acting an important role in Bangladesh economy. Price instability leads to income uncertainty of the producers. This insecurity impedes investment in agriculture follow-on in slow growth of agricultural output. On the other hand, any single market does not stand alone as a determiner of either price or quantity and the actions of buyers and sellers in a particular market. Price signals and substitution possibilities in other allied markets influence commodity markets in a great extent (George, 1984). In general, the degree of interrelationships between price movements in two markets is called market integration. In an integrated market, price of a homogeneous commodity at different spatially separated locations should tend to move together indicating efficient spread of price information and inter-linkages of markets. An interlinked commodity market price movement in one location should be highly correlated with price movement in other locations. Thus, the degree of inter-relationships between price movements in two markets or market integration is important for agricultural crops. By examining the price volatility faced by farmers, local level planning should be made and implemented for providing maximum price benefit to the farmers. Consumers also will be benefited from well-planned commodity markets.

In the context of agricultural production, instability is one of the important decision parameters in development dynamics, because price and yield instability or uncertainty affects area allocation of farmers to crop production enterprise. Such information of stability will help the farmers in building proper production and investment decisions and to the financing institutions in judging the reimbursement and risk ability of the farmers (Gangwar and George, 1971). And the assessment of market integration is helpful in the formation of appropriate policies for increasing the efficiency of marketing process. For spatially detached regional food markets, as exist in many Asian countries, the character and degree of market integration in the context of food market liberalization is of vital significance. Merely knowing that markets are integrated is not enough. It is necessary to know the extent of spatial market integration within the context of market integration. A marketing system is spatially integrated when price in each individual market respond not only their own supply and demand but also the demand-supply forces in all other markets. In short, a local scarcity in an integrated system is less prejudicial to local consumers because integration induces the arrival of products from other locations. Very quickly it increases supply and decreases the price. Consequently, local price in an integrated system could be more stable than those in a nonintegrated system. Spatial arbitrage by the intermediaries generates these results (Blyn, 1973). Market integration signifies the extent to which price movements in one market are related to those in other markets. In a competitive market structure, price in spatially separated markets are expected to move in unison in response to stimuli from changing demand, supply and other economic force. This is more imperative when the market structure of a commodity is purely competitive. Therefore it is important to know about the market integration. Thus, the study was undertaken to analyze the extent and nature of instability in price, area, yield and production of coarse rice and to examine the spatial price relationship of rice prices in some selected rice markets of Bangladesh.

2. Methodology

The present study was made on the basis of secondary data on prices and available quantity of rice in Bangladesh for the period of 37 years (1974-75 to 20010-11, as the latest data available in Bangladesh Bureau of Statistics (BBS, 2010) and Department of Agricultural Marketing (2014). Earlier to eighties, agricultural sector was vastly subsidized by the Government. Taking out of subsidies and handing over fertilizer and irrigation utensils marketing to private sector started from the eighties. Simultaneously open market economy and privatization policy also began from the same period. Considering these economic phenomena, this period was considered relevant for policy purposes. According to the objective, the entire data were divided into four sub-periods (Period I: 1974-75 to 1980-81, Period II: 1981-82 to 1990-1991, Period III: 1991-92 to 2000-01, Period IV: 2001-02 to 2010-11). The instability index of price, area, production and yield of different varieties of rice was constructed based on regression residuals which were obtained from the fitted exponential function.

$$\text{Instability measure (I)} = = \frac{1}{\log \bar{Y}} \sqrt{\frac{\sum_{i=1}^{n}(Y_t - \hat{Y}_t)^2}{n-2} \times 100} \qquad \text{(Parthasarathy, 1984)}$$

Figure 1. Visual map showing the geographical location of different rice markets

In the case of measuring spatial price relationship, monthly price data were used. For studying the spatial price relationships of rice, twelve district level markets had been selected in which six markets had been selected from districts (Dinajpur, Rangpur, Naogaon, Bogra, Sherpur, Comilla) which were surplus in rice production and six had been from deficit districts (Kushtia, Sylhet, Khulna, Dhaka, Noakhali, Chittagong) (Figure 1). Apparent per capita consumption was used instead of normative per capita consumption for measuring rice surplus/deficit area in district level. To analyze the inter-market relationship of rice prices among selected markets in Bangladesh and to test the market integration between these markets, correlation coefficient and cointegration method were used. For testing stationarity (or nonstationarity), widely popular the unit root test (Gujarati, 2003), Dickey-Fuller (DF) test (Dickey and Fuller, 1979), the Augmented Dickey-Fuller (ADF) and Engle-Granger (EG) test (Ramakumar, 1998) were used. Finally, the Microsoft Excel 2007 Enterprise and SPSS 20.0 programs were applied for data entry and analysis.

3. Result and discussion

3.1. Instability in price, area, yield and production

The instability index of price, area, yield and production of rice, was constructed based on regression residuals obtained from the fitted exponential function. The results of estimated instability measures of price, area, yield and production of rice in Bangladesh over the period I, II, III, IV and total period (1974-75 to 2010-11) are presented in Figure 2. During the whole period, area instability was observed to be higher relative to production, price and yield instability.

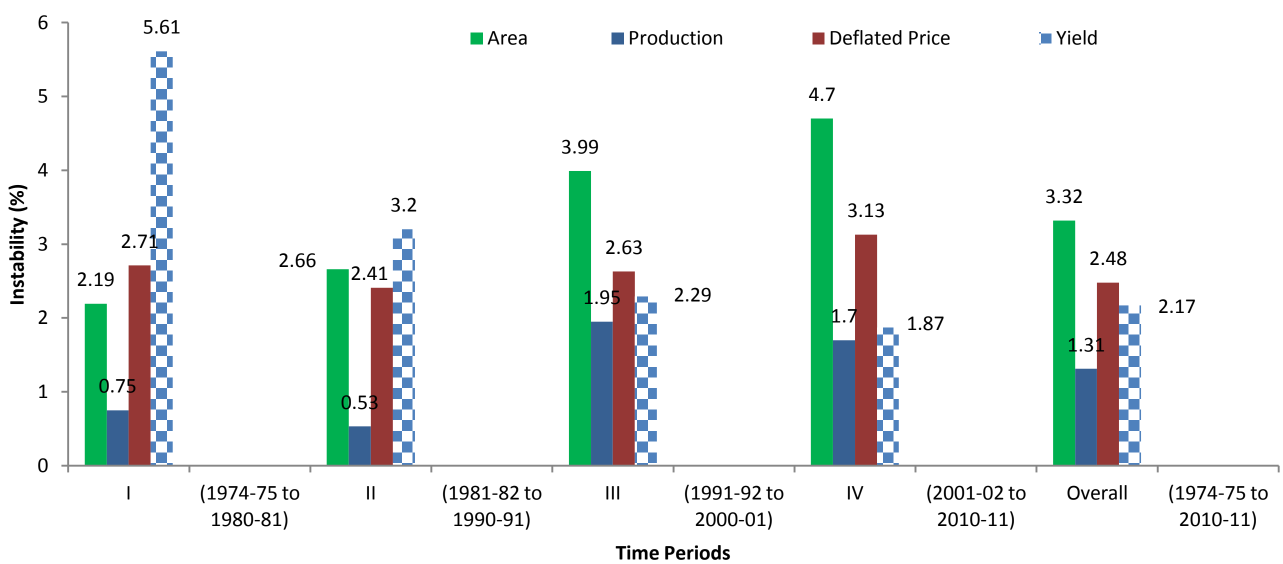

Figure 2. Instability in price, area, yield and production in different periods

Price instability was found to be higher relative to yield and production instability during the periods III and IV. But yield instability in period I was observed to be the highest among all types of instability. Yield instability had been increased in period I because of the sharp increase in the cost of fertilizers and other agrochemicals that accompanied the oil crises of the 1970s. But after the introduction of new HYV rice seed in the latter periods, the yield was in increasing trend and thus the yield instability had found in decreasing trend. Periodic analysis showed that the magnitude of price, yield and production instability of rice declined during the second period relative to the first. Area instability was found to be lower in period I, relative to other periods. Area instability increased during the latter period. Price variability was found to be high and increasing trend and thus there is a need for price stabilization of rice. Area instability was also found to be high. It arose mainly from the population pressure, industrialization of agricultural land etc.

3.2. Spatial price relationship of rice in different markets

3.2.1. Integration by cointegration method

To avoid the problem of spurious correlation between time series variables especially price variable, cointegration method was used which was developed by Engle and Granger (1987) for making firm decisions on market integration. The valuable contribution of the concepts of unit root, cointegration, is to force to find out if the regression residual are stationary (Gujarati, 2003). As Granger (1977), notes, “A test for cointegration can be thought of as a pre-test to avoid spurious regression situations.”

Before testing for cointegrationit is necessary to test whether data series were stationary or nonstationary. The test of market integration is straight forward if the price series are stationary in nature. Conventional methods then can be used. But, if the data series are nonstationary then one has to proceed for cointegration test for which the stationarity of the variables need to check first. To examine whether bivariate cointegration exists between different price series, Engle-Granger test had been applied. To test the bivariate price series of stationarity, the Augmented Dickey Fuller (ADF) test had been carried out. Initially, test had been performed on price series in levels, which implied testing a null hypothesis of nonstationarity against alternative of stationarity.

3.2.2. Unit root and cointegration test of rice price

To test the stationarity of the data, the DF and ADF tests for rice wholesale prices data for surplus districts markets(Dinajpur, Rangpur, Naogaon, Bogra, Sherpur, Comilla) and deficit districts markets (Kushtia, Sylhet, Khulna, Dhaka, Noakhali) were performed over 1990 to 2011 periods. In case of serial correlation, ADF test was applied and that could be brought into being from the Durbin Watson statistic. Table 1 revealed the expected tau (τ) statistics of the regression coefficients of one period lagged price, DW, and decision. The tau (τ) statistics judges against absolute values signify that all the rice price series data were nonstationary, i.e., contain unit roots.

Table 1. Unit root test (test of stationarity/nonstationarity) for the prices of rice

Market	**Method used**	**Condition used**	**Intercept** β_1	**Coefficient of** P_{t-1} δ	**Coefficient of** ΔP_{t-1} α_1	**Coefficient of** ΔP_{t-2} α_2	**Coefficient of trend (t)** β_2	**d-value**	**Decision**
Dhaka	DF	Without constant		0.33 -0.527				2.001	Nonstationary
		With constant	21.383	-0.061 (-0.980)				1.989	
		With constant & trend	25.829	-0.233 (-2.284)			0.216 -2.116	1.966	
Chittagong	DF	Without constant		0.048 -0.771				1.839	Nonstationary
		With constant	15.821	-0.043 (-0.694)				1.83	
		With constant & trend	21.97	-0.22 (-2.106)			0.219 -2.098	1.812	
	ADF	1 lagged difference with trend	23.534	-0.245 (-2.329)	0.094 -1.52		0.239 -2.284	2.027	
Comilla	DF	Without constant		0.032 -0.524				1.767	Nonstationary
		With constant	23.057	-0.063 (-1.026)				1.755	
		With constant & trend	28.493	-0.231 (-2.315)			0.213 -2.131	1.734	
	ADF	1 lagged difference with trend	31.255	-0.267 (-2.667)	-0.136 -2.196		0.242 -2.429	2.026	
Khulna	DF	Without constant		0.015 -0.249				2.2	Nonstationary
		With constant	31.353	-0.082 (-1.325)				2.181	
		With constant & trend	37.033	-0.289 (-2.825)			0.258 -2.525	2.141	

Market	Method used	Condition used	Intercept β_1	Coefficient of P_{t-1} δ	Coefficient of ΔP_{t-1} α_1	Coefficient of ΔP_{t-2} α_2	Coefficient of trend (t) β_2	d-value	Decision
	ADF	1 lagged difference with trend	33.119	-0.27 (-2.6)	-0.077 (-1.234)		0.25 -2.424	1.996	
Sherpur	DF	Without constant		0.011 -0.172				2.146	Nonstationary
		With constant	35.611	-0.089 (-1.452)				2.125	
		With constant & trend	42.381	-0.302 (-2.966)			0.265 -2.606	2.082	
Bogra	DF	Without constant		0.018 -0.285				2.183	Nonstationary
		With constant	29.88	-0.081 (-1.308)				2.165	
		With constant & trend	38.673	-0.302 (-2.842)			0.27 -2.546	2.124	
	ADF	1 lagged difference with trend	35.571	-0.285 (-2.644)	-0.066 (-1.065)		0.261 -2.439	1.994	
Rangpur	DF	Without constant		0.011 -0.185				2.388	Nonstationary
		With constant	37.883	-0.088 (-1.422)				2.36	
		With constant & trend	41.536	-0.304 (-3.071)			0.275 -2.771	2.307	
	ADF	1 lagged difference with trend	32.912	-0.253 (-2.532)	-0.171 (-2.779)		0.241 -2.439	1.979	
Dinajpur	DF	Without constant		0.4 -0.65				1.86	Nonstationary
		With constant	16.911	-0.048 (-0.780)				1.852	
		With	19.901	-0.237			0.231	1.832	

Market	Method used	Condition used	Intercept β_1	Coefficient of P_{t-1} δ	Coefficient of ΔP_{t-1} α_1	Coefficient of ΔP_{t-2} α_2	Coefficient of trend (t) β_2	d-value	Decision
		constant & trend		(-2.217)			-2.158		
	ADF	1 lagged difference with trend	21.266	-0.258 (-2.391)	0.087 -1.397		0.245 -2.429	2.007	
Kushtia	DF	Without constant		0.01 -0.166				2.253	Nonstationary
		With constant	29.496	-0.085 (-1.372)				2.236	
		With constant & trend	33.298	-0.286 (-2.731)			0.248 -2.369	2.198	
	ADF	1 lagged difference with trend	29.431	-0.256 (-2.414)	-0.115 (-1.861)		0.228 -2.17	1.973	
Noagaon	DF	Without constant		0.03 -0.483				2.144	Nonstationary
		With constant	22.186	-0.062 (-1.008)				2.13	
		With constant & trend	26.969	-0.261 (-2.476)			0.244 -2.317	2.1	
	ADF	1 lagged difference with trend	24.9	-0.25 (-2.343)	-0.054 (-0.864)		0.24 -2.264	1.993	
Sylhet	DF	Without constant		0.23 -0.373				1.888	Nonstationary
		With constant	25.491	-0.07 (-1.140)				1.875	
		With constant & trend	31.156	-0.275 (-2.616)			0.252 -2.393	1.846	
	ADF	1 lagged difference with trend	32.738	-0.3 (-2.818)	0.08 -1.291		0.273 -2.579	1.994	
ak hal	DF	Without		0.034				1.79	nst ati

Market	Method used	Condition used	Intercept β_1	Coefficient of P_{t-1} δ	Coefficient of ΔP_{t-1} α_1	Coefficient of ΔP_{t-2} α_2	Coefficient of trend (t) β_2	d-value	Decision
		constant		-0.557					
		With constant	20.376	-0.057 (-0.927)				1.779	
		With constant & trend	27.177	-0.244 (-2.349)			0.231 -2.227	1.758	
	ADF	1 lagged difference with trend	30.414	-0.274 (-2.625)	0.125 -2.028		0.251 -2.415	2.015	

Note: Figure within parenthesis shows t-values of the regression coefficient.

Dickey-Fuller Critical values at 1% and 5% are: Without a constant: -2.66 and -1.95 respectively; with a constant: -3.75 and -3.00 respectively; with a constant and trend: -4.38 and -3.60 respectively (Gujarati, 2003).

The next step was to examine whether bivariate cointegration exists among different districts rice prices. The researcher's aim was to find out which market's price influences others. It is normally assumed that Dhaka is the reference market and it influences other markets prices. As there might be unlike mishmashes of the chosen twelve wholesale markets, all combinations in a system of bivariate relationships were tried (where preferred reference market was the Dhaka wholesale market). Thus, total eleven combinations of cointegration regression estimated and the final result are presented in Table 2. The Engle-Granger (EG) tests of residual of error term confirmed the stationarity of the residual series. Thus DF and ADF of unit root equation indicated that the price of rice series are nonstationary, EG results of residual equation indicated that the residual series (which are linear combination of rice price series) are stationary at level I(0). Thus the findings indicated that, yet the original price series being nonstationary and their linear combination being I(0), the series were cointegrated (at 1% and 5% level of significance).

Since the absolute values of the estimated tau (τ) values exceeds any of these critical τ values, the concluding statement would be that the estimated U_t is stationary that means it does not have any unit root and price are individually nonstationary but cointegrated. From Table 2, it was observed that when rice was traded from Dhaka to Chittagong then the prices of Dhaka influenced the prices of Chittagong and vice-versa. For example, when rice traded from Sherpur to Dhaka then on average 1 unit changes in the prices of Sherpur would change the price of Dhaka by 0.981 unit when others factor remain the same. As mentioned earlier, surplus districts were Dinajpur, Rangpur, Naogaon, Bogra, Sherpur, Comilla and deficit districts were Kushtia, Sylhet, Khulna, Dhaka, Noakhali in rice production, so when price changed in these surplus areas then automatically prices would change for the other districts.

Table 2. Spatial price relationships between different markets for coarse rice from January 1990 to December 2011

Markets	Cointegrating Regression	Cointegration Test	Decision
		Engel-Granger	
Dhaka-Chittagong	P_{Dhaka}= - 46.415 + 1.024 $P_{Chittagong}$ R^2= 0.884 (16.84)	ΔU_t= -0.635 U_{t-1}^{**} (-2.11)	Cointegrated
Dhaka-Comilla	P_{Dhaka}= - 25.742 + 1.019 $P_{Comilla}$ R^2= 0.781 (15.27)	ΔU_t= -0.601 U_{t-1}^{**} (-2.23)	Cointegrated
Dhaka-Khulna	P_{Dhaka}= 49.142 + 0.987 P_{Khulna} R^2= 0.893 (18.36)	ΔU_t= -0.568 U_{t-1}^{***} (-3.72)	Cointegrated
Dhaka-Sherpur	P_{Dhaka}= 38.981+ 0.981 $P_{Sherpur}$ R^2= 0.981 (20.13)	ΔU_t= -0.781 U_{t-1}^{***} (-3.98)	Cointegrated
Dhaka-Bogra	P_{Dhaka}= 6.946 + 1.012 P_{Bogra} R^2= 0.920 (16.25)	ΔU_t= -0.685 U_{t-1}^{***} (-2.93)	Cointegrated
Dhaka-Sylhet	P_{Dhaka}= 56.822 + 0.973 P_{Sylhet} R^2= 0.933 (14.39)	ΔU_t= -0.436 U_{t-1}^{**} (-1.98)	Cointegrated
Dhaka-Noakhali	P_{Dhaka}= - 31.847 + 1.018 $P_{Noakhali}$ R^2= 0.983 (18.11)	ΔU_t= -0.721 U_{t-1}^{***} (-2.96)	Cointegrated
Dhaka-Rangpur	P_{Dhaka}= 97.392 + 0.969 $P_{Rangpur}$ R^2= 0.798 (17.96)	ΔU_t= -0.596 U_{t-1}^{***} (-2.76)	Cointegrated
Dhaka-Dinajpur	P_{Dhaka}= 110.437 + 0.954 $P_{Dinajpur}$ R^2= 0.982 (9.93)	ΔU_t= -0.790 U_{t-1}^{***} (-4.16)	Cointegrated
Dhaka-Kushtia	P_{Dhaka}= 100.77 + 0.964 $P_{Kushtia}$ R^2= 0.985 (22.68)	ΔU_t= -0.485 U_{t-1}^{**} (-2.19)	Cointegrated
Dhaka-Noagaon	P_{Dhaka}= 66.676 + 0.984 $P_{Noagaon}$ R^2= 0.976 (19.38)	ΔU_t= -0.768 U_{t-1}^{***} (-4.08)	Cointegrated

Note: Figure within parenthesis shows t-values of the regression coefficient.

Tau (τ) values (without constant) at 1% and 5% level of significance are -2.55 and -1.95 respectively in the equation.

**** indicates 1% level of significance.*

*** indicates 5% level of significance.*

4. Conclusion

In an economy like Bangladesh where agriculture is a leading sector, both an increase and fall in prices of agricultural commodities have influential consequences on production, trade and level of employment and income. Agricultural price stabilization means reduction in price fluctuations and regulations of price movements within a certain range. It does not imply constant prices or an unchanging price level. In the industrial sector, output can be adjusted according to price variation but in agricultural sector, farmers cannot reduce production even when price fell. This is due to rigidity on account of asset fixity and committed resources. Falling prices affect farmers' income adversely. The markets of rice across the location were integrated as the market price information in regional markets was transferred to other markets. It reveals that, price analysis and development of policies at the comprehensive level is valid and will be significant for policy execution. In case of glowing integration of the markets, national price policy should be mounted rather than regional price policy. On the basis of market price integration measurement and applying price adjustment procedure in one market to other market, government should facilitate and encourage inter-regional movement of commodities by road and communication development and procurement of rice should be undertaken on the basis of market price situation, not by the pre-targeted amount by the Government.

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