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Spatial Co-integration and Speed of Adjustment among Rice Markets in Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. Author MCR designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MSR, MARS and MAI managed the analyses of the study, the literature searches and contributed significantly to improve the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The structure of co-integration, the pace of adjustment, and the causal markets are investigated using horizontal price integration among five main rice markets in Bangladesh. The null hypotheses were tested using Johansen and Juselius co-integration test and vector error correction model. In Bangladesh, wholesale price volatility in the rice sector has been rising over time. The findings of the study revealed that the rice markets in Bangladesh are perfectly cointegrated. The leading rice markets are Chattagram and Rajshahi, while Khulna is the price taker, which adjusts prices with all other rice markets. Any price shock in the Chattagram and Rajshahi markets takes one to two months for other markets to adjust. The findings also illustrate the value of steering policy efforts in Bangladesh rice markets toward reducing price instability and improving pricing efficiency.

Keywords: Price instability; market integration; long-run elasticity; vector error correction model; Bangladesh.

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1. INTRODUCTION

Bangladesh's most important food crop is rice [1,2,3,4,5,6]. Rice cultivation takes up more than three-quarters of the country's overall cropped area. It is also accounting for more than 83 percent of the total cereal food supply [7]. Agriculture in Bangladesh is evolving from a conventional to a modern system. However, the rice sector has the most strategic significance in this transition phase, as it is the staple food for the entire population and the main source of livelihood for about 16 million farm households, thus it has become a gateway to Bangladesh's political economy [8].

The rice market's efficiency is critical for the welfare of both producers and customers. If, on the other hand, the rice market is suffering from problems, such as a shortage of credit to fund short-term stocks, incomplete information, insufficient transportation, a lack of quality management, and market power, the potential welfare gains of a well-functioning marketing scheme cannot be realized [8]. Under the Structural Adjustment Program initiated by the World Bank (WB) and International Monetary Fund (IMF), the government of Bangladesh has introduced major policy reorganizations over the last four decades to surge pricing capacity among its internal rice markets [9,10]. Bangladesh's internal rice markets were deregulated, and all sources of assistance were effectively eradicated as a result of that structural reforms. At the same time, transportation, infrastructure, highways, and communications, as well as mobile networks, have all been established. Better regional market integration was anticipated as a result of these transformations. Unintegrated markets can be the source of misleading price details, which may contribute to poor marketing decisions and resource mismanagement.

The integration of the Bangladesh rice markets has been the subject of numerous studies. The rice markets of Bangladesh are partly integrated, according to a classic analysis by Ravallion [11]. In contrast, Goletti et al. [12] said that Bangladesh's rice markets are moderately integrated. The pre-reform era's partial and modest integration of the rice markets reflected food grain movement restrictions, weak facilities, and insufficient connectivity. For example, before market restructuring, the Bangladesh government purchased rice from surplus regions to retain a buffer supply, and this strategy restricted private traders' incentives to transfer the rice from surplus to deficit areas. The regional market integration has come to a halt as a result of the reform. Dawson and Dey [13], on the other hand, showed that after the trade liberalization reforms, the Bangladesh rice markets have been completely integrated. They used a vector autoregressive error-correcting mechanism (VECM) to cross-check the Law of One Price on central to regional markets, following Ravallion [11]. Hossain and Verbeke [14] studied regional markets and discovered that rice markets in Bangladesh are weakly integrated but have become stable over time. Alam and Begum [15] and Murshid et al. [16] revealed well-integrated rice markets in Bangladesh. However, according to Mahmud and Wadood [17], rice markets in Bangladesh are highly integrated but the exception is farm-level. According to Chowdhury [18], Bangladesh's rice markets are generally integrated, but the linkage is not much sound. The rice markets in Bangladesh are well integrated, according to the findings of Rahman et al. [19] as well. Based on the available literature, some studies indicate moderately integrated rice markets in Bangladesh, although others contend with highly integrated rice markets. Alam et al. [20], for example, used an econometric method pioneered by Hansen and Seo [21] to investigate the convergence of Bangladesh's rice markets with the existence of a threshold effect. They also considered transaction costs while evaluating market integration, and the rice markets in Bangladesh have been reformulated as a result of the introduction of communication facilities. Furthermore, Rahman et al. [8] investigated how millers and traders in Bangladesh manipulate the rice market by wielding significant market power in the supply chain. So, many studies indicated highly integrated rice markets, few other contend the integration, but the context are based on the available data covering the time period more than a decade past. In the time being, Bangladesh rice sector has been modified in various aspects. Rice millers and traders are being organized and dominating to control the market [8]. Communication and infrastructural facilities have been improved. Government also became proactive to stabilize the rice market through maintaining buffer stock and controlling import and/or export decision. In these regards, this study therefore, aims to look for spatial market integration, long-run elasticity, and pace of adjustment in the rice sector of Bangladesh.

The analytical techniques of linear co-integration, as well as market-dominating causality test and econometrics review of the vector error correction model, are presented in the following portion of the article. Section 3 specifies the data details. The results are discussed in section 4 and 5, and the manuscript is concluded in the final section.

2. ECONOMETRICS METHODOLOGY

2.1 Price Instability Measure

In this analysis, the price instability is calculated using yearly time series wholesale price data. The data was divided into four sub-periods based on economic phenomena such as input subsidy, market liberalization, as well as the availability of rice wholesale price data (Period 1: 1986-1990, Period 2: 1991-2000, Period 3: 2001-2010, and Period 4: 2011-2017). The rice wholesale price volatility index was calculated using regression residuals obtained from the fitted exponential function, as defined by Parthasarathy [22] and Rahman et al. [19].

$$\text{Instability} = \frac{1}{\ln\bar{Y}}\sqrt{\left(\frac{\sum_{i=1}^{n}\left(Y_{it}-\hat{Y}_{it}\right)^2}{n-2}\right)\times 100} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where Y is the wholesale price of rice deflated by the respective wholesale price index.

2.2 Unit Root Test

A statistically sound long-run relationship between time series was established through co-integration analysis. This means, in the long term, two interrelated markets for the same product should not diverge significantly [23] Granger, 1986). The investigation of each time series stationarity properties was the starting point for this research. The price variable was tested using a regular augmented Dickey-Fuller (ADF) test of the following type in this analysis.

$$\Delta P_{it} = \beta_0 + \beta T + \rho P_{i,t-1} + \sum_{j=1}^{k}\alpha_j\,\Delta P_{i,t-j} + e_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where Δ = the difference operator. P_{it} = the price of the market i, at time t, and T is a time trend [24]. The trending term expresses the possibility of deterministic time series growth over time. The null hypothesis was that the sequence is nonstationary [I (1)], (the crucial inference in the Johansen method was that each time series is incorporated in order one; I (1) against the alternative hypothesis of stationarity [I (0)]. To eliminate any serial correlation in the residual (e_t) values, the number of lagged difference ($P_{i,t-j}$) terms is specified. The natural log of the prices is used in the calculations. The p-values are MacKinnon approximations published in MacKinnon [25], and the critical values were linearly interpolated from Fuller [26].

2.3 Johansen and Juselius Co-integration Model

If prices are non-stationary and in the same order of integration, the probability ratio test proposed by Johansen and Juselius [27] in the vector autoregressive (VAR) specification is:

$$\Delta P_t = \varphi D_t + \Pi P_{t-1} + \sum_{i=1}^{k-1}\Gamma_i \Delta P_{t-1} + \omega_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where, P_t includes all the price series of the model, which are I(1), the Π, Γ_i, and φ are parameter to be estimated, D_t is a vector with deterministic elements (constant, trend) and ω_t is a vector of random error follow the Gaussian process.

Except where a linear combination of the variables in P_t is stationary, if P_t is I (0), Π would be a zero matrix. If rank Π = r = K, the variables in levels are stationary, implying that no integration exists; if rank Π = r = 0, all elements in the adjustment matrix have zero values, implying that none of the linear combinations are stationary. When 0 <rank (Π =r) < K, there are r co-integrating vectors, according to the Engle and Granger [28] representation theorem. If rank (Π = r) = 1, for example, there is a single stationary co-integrating vector or a linear combination such that the coefficient matrix Π can be decomposed into $\Pi=\alpha\beta'$ where α is the loading factor vector and β is the co-integrating vector in where $\beta' P_{t-1}$ is I (0). The procedure used by Johansen is to approximate the Π matrix from an unregulated VAR and then evaluate if the constraints inferred by the reduced rank of Π can be rejected. The trace test and maximal eigenvalue checks are two ways of checking for reduced rank (Π). The null hypothesis that the number of distinct co-integrating vectors (r) is less than or equal to r is tested against a general alternative using trace statistics. The maximum eigenvalue statistic compares the null hypothesis that the amount of the co-integrating vector is r to the alternative of r +1.

2.4 Causality Tests from Johansen VECM

The presence of cointegration in a bivariate relationship implies Granger causality, which can be tested using the standard Wald test within the framework of Johansen VECM [20,9]. Jayanta et al. [29] investigated the interaction and causality between coarse rice wholesale and retail prices in two major Bangladesh cities (Dhaka and Chattagram). In a basic regression method, Jayanta et al. [29] used traditional Granger causality F-tests. The vector autoregressive error correction model was defined as follows to define the causal relationship:

$$\Delta R_t = \mu_1 + \sum_{i=1}^{K} \beta_i \Delta W_{t-i} + \sum_{j=1}^{L} \beta_j \Delta R_{t-j} + \alpha_1 Z_{t-1} + \varepsilon_{t,1} \ldots\ldots\ldots\ldots\ldots \quad (4)$$

$$\Delta W_t = \mu_1 + \sum_{i=1}^{K} \beta_i \Delta W_{t-i} + \sum_{j=1}^{L} \beta_j \Delta R_{t-j} + \alpha_2 Z_{t-1} + \varepsilon_{t,2} \ldots\ldots\ldots\ldots\ldots \quad (5)$$

Where Z_{t-1} is the lag of error correction term (ECT), R_t and W_t are the retail and wholesale price series, respectively. In Equations (4) and (5), the Granger causality decision is given as:

a) '$\alpha_1 \neq 0, \alpha_2 \neq 0$' Which implies bidirectional causality, it means that there exists a feedback long-run relationship between the variables and no individual price plays a leadership role.
b) '$\alpha_1 = 0 \text{ but } \alpha_2 \neq 0$' Implies a unidirectional causality and the retail price causes the wholesale price; the retail price is weakly exogenous.
c) '$\alpha_1 \neq 0 \text{ but } \alpha_2 = 0$' Implies unidirectional causality and the wholesale price causes the retail price; the wholesale price is weakly exogenous.

3. THE DATA DESCRIPTION

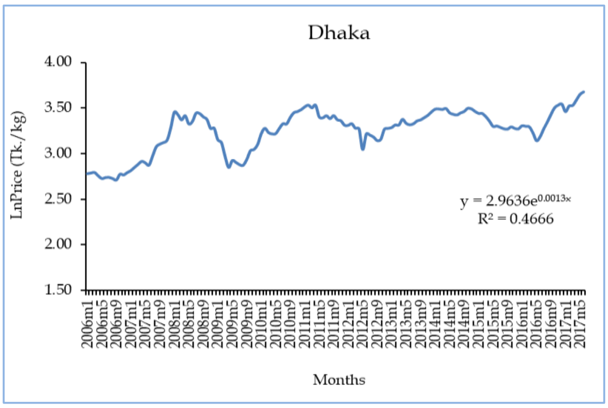
3.1 The Data

The data for this study is obtained from the Department of Agricultural Marketing (DAM), the people's republic of Bangladesh, and it covers the time from January 2006 to June 2017. It includes five major wholesale markets for rice in Bangladesh (Dhaka, Chattagram, Rajshahi, Khulna, and Barishal). In econometrics, time-series price transfer research requires an agreement that, for the time being, the internal price of a commodity at various regional level markets is trending collectively in nominal terms [13], that is why the data series calculated for the analysis are in nominal types. The data period was chosen based on availability.

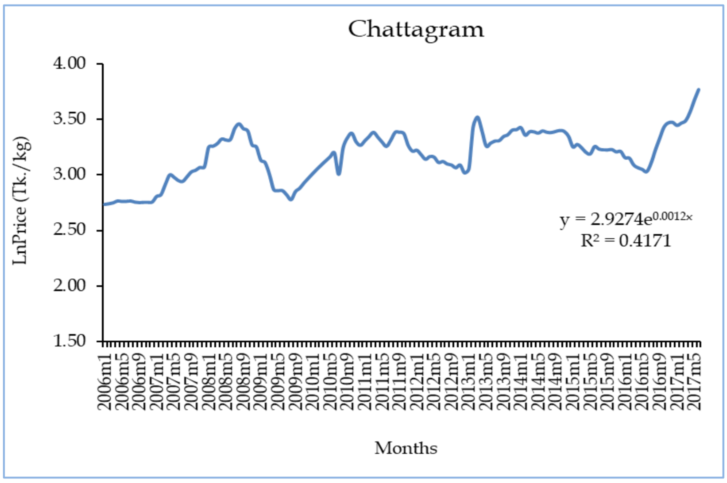
The agricultural product prices are collected by the DAM's district-level offices. The gathered prices are expected to be representative of prices in all local markets, and their average is the monthly wholesale price for each district's various locations. All price information, however, is translated to logarithmic types. A plot of wholesale prices for the selected rice markets is shown in Fig. 1(A to E). The pricing trend reveals a similar association or co-movement of all chosen markets' prices. The markets we chose for our study were chosen based on the availability of data that covered the whole geographical area as well as separate administrative divisions of Bangladesh.

3.2 Time Series Possessions

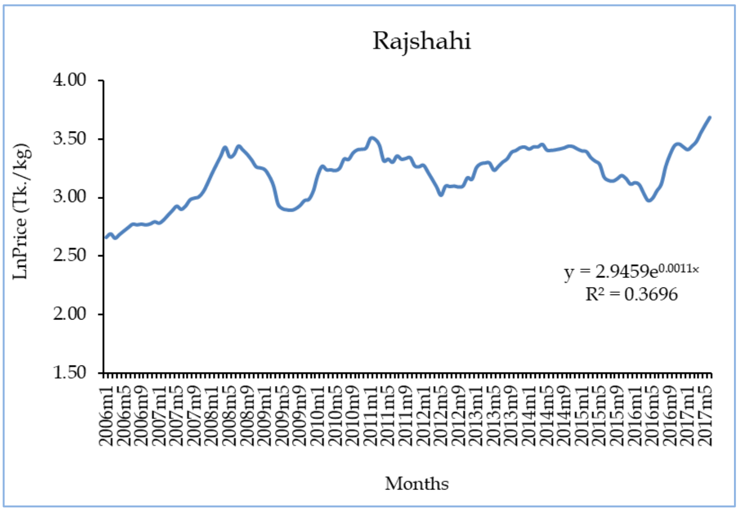
According to the equipped plots of the data series, none of the considered series are stationary in level. As a result, we evaluate the properties of time series data to determine the order of integration. The findings are presented in Table 1 using the Augmented Dickey-Fuller (ADF) and Phillips–Perron (PP) tests. All of the price series we tested were non-stationary at first, then were stationary after the first difference. For the ADF test, the optimal lag duration was determined using the Schwarz Information Criterion (SIC), whereas, for the PP test, it was determined using the Newey-West method [30]. The I (1) represent the incorporation of order 1 of the price series.



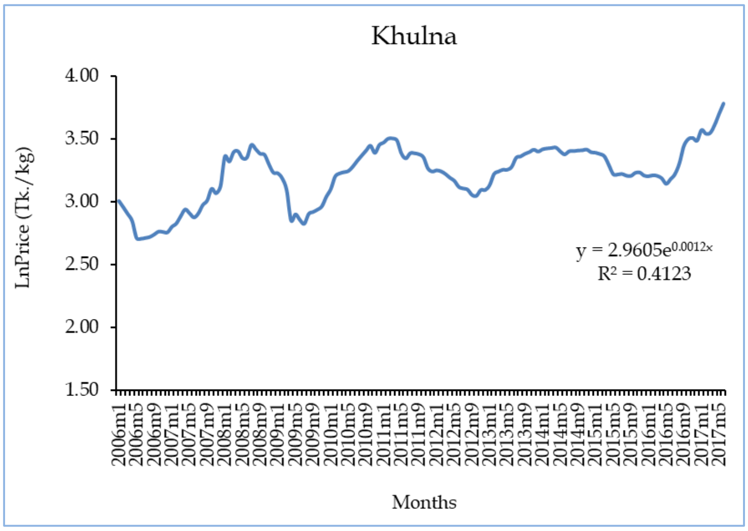
A. Dhaka



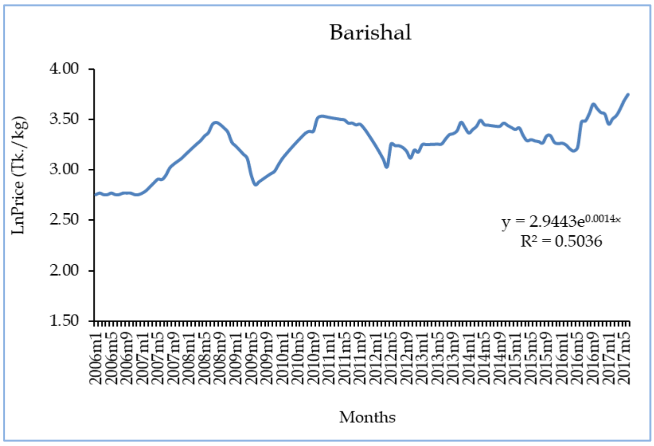
B. Chattagram



C. Rajshahi



D. Khulna



E. Barishal

Fig. 1. The plots of five markets (A to E) price series in logarithmic form

Table 1. Unit root test

Price Series		The deterministic term in test statistics				Order of integration, I(d)
		Level	P-value	1st difference	P-value	
Dhaka	ADF	-1.258	0.648	-10.718***	0.000	I(1)
	PP	-1.641	0.459	-10.822***	0.000	I(1)
Rajshahi	ADF	-1.322	0.618	-10.473***	0.000	I(1)
	PP	-1.770	0.394	-10.608***	0.000	I(1)
Khulna	ADF	-1.628	0.465	-3.685***	0.005	I(1)
	PP	-0.990	0.756	-9.108***	0.000	I(1)
Chattagram	ADF	-1.269	0.643	-10.426***	0.000	I(1)
	PP	-1.412	0.575	-10.353***	0.000	I(1)
Barisal	ADF	-1.308	0.625	-8.521***	0.000	I(1)
	PP	-1.377	0.592	-8.656***	0.000	I(1)

*Note: Analyzed and prepared by the authors. '***' indicates that the unit root in the first differences is rejected at 1% significant level*

4. EMPIRICAL FINDINGS AND INTERPRETATIONS

4.1 Price Instability Measure

The price instability index was calculated using regression residuals from the fitted exponential function. Fig. 2 shows the effects of predicted market volatility interventions for rice in Bangladesh across the four cycles considered. The findings showed that rice wholesale price volatility in Bangladesh is increasing over time. The estimated price instability in period 1 was 1.42 percent, while it increased to 1.59 percent in period 4. Price variability is increasing, indicating the need for price stabilization in Bangladesh's rice markets.

4.2 Co-integration Test Results

The trace test (trace) as well as the maximum eigenvalue (max) tests were used to find cointegrating relationships between market pairs. According to the test results, all market pairs have at least one cointegrating rank (r), which means that there are many stationary linear combinations of price pairs. For example, the price of Rajshahi and Dhaka has a single cointegrating rank, indicating that there is one common cause for which both markets' prices have a long-run equilibrium relationship. The cointegration relationship occurs in all market pairs, which is consistent with the findings of Dawson and Dey [13] and Alam et al. [20]. We checked the models with and without linear trends and came to the same result in both cases. As we do cointegration in the context of a vector error correction process, we also perform residual analysis (normality test, Ljung Box/Portmanteau test, white heteroscedasticity test) and find that there is no issue with approximate model misspecification in all situations.

The long-run coefficients are the approximate long-run elasticities (Table 3). Since the ratios are identical to one, the markets are almost completely cointegrated. Larger the absolute values of long-run elasticity, more reactive the market price is in long run. The absolute values of the speed of adjustment coefficient ranging from 0.40 to 0.98. It indicates that long-run perturbation anomalies are corrected in one to two months. A faster rate of adjustment reduces the risk of a rice shortage in the future. Our observations are consistent with those of Dawson and Dey [13] and Alam et al. [20], who found evidence of long-run cointegration after liberalization.

4.3 Causality Test Results

The poor exogeneity Wald test was used to assess the direction of rice price causality among the market pairs, and the findings are presented in Table 4. The findings show that none of the market pairs have a bi-directional price relationship among the ten cointegrated bivariate models. There is only one market pair that has no price linkage (Chattagram-Khulna). All other market pairs have one-way price connectivity, meaning one market precedes the other in the price formation phase. For example, in the Rajshahi-Dhaka pair, the price of Dhaka is determined by the price of the Rajshahi market, so any interference in the Rajshahi market would affect the Dhaka market. While both bivariate models indicate that markets are cointegrated, the overall findings of the causality tests indicate that there are still some bottlenecks in the interrelationship between the markets. In any case, interference in one market would not always spread to all others immediately.

Table 2. Johansen co-integration test results

Market pairs	Trace statistics (λ_trace)			Maximum eigenvalue statistics(λ_max)		
	Test statistics	Critical values	P-values	Test statistics	Critical values	P-values
Rajshahi-Dhaka						
$H_0: r = 0\ vs\ H_1: r \geq 1$	22.512***	15.495	0.003	19.652***	14.265	0.006
$H_0: r \leq 1\ vs\ H_1: r \geq 2$	2.861	3.841	0.090	2.860	3.841	0.091
Khulna-Dhaka						
$H_0: r = 0\ vs\ H_1: r \geq 1$	17.123**	15.495	0.028	16.208**	14.265	0.024
$H_0: r \leq 1\ vs\ H_1: r \geq 2$	0.916	3.841	0.339	0.916	3.841	0.339
Chhattagram-Dhaka						
$H_0: r = 0\ vs\ H_1: r \geq 1$	28.225***	15.495	0.000	25.313***	14.265	0.000
$H_0: r \leq 1\ vs\ H_1: r \geq 2$	2.913	3.842	0.088	2.913	3.842	0.088
Barishal-Dhaka						
$H_0: r = 0\ vs\ H_1: r \geq 1$	22.517***	15.495	0.004	20.092***	14.265	0.005
$H_0: r \leq 1\ vs\ H_1: r \geq 2$	2.426	3.841	0.119	2.426	3.841	0.119
Barishal-Chhattagram						
$H_0: r = 0\ vs\ H_1: r \geq 1$	18.599**	15.495	0.017	16.426**	14.265	0.022
$H_0: r \leq 1\ vs\ H_1: r \geq 2$	2.174	3.841	0.140	2.174	3.841	0.140
Barishal-Khulna						
$H_0: r = 0\ vs\ H_1: r \geq 1$	23.573***	15.495	0.003	22.876***	14.265	0.002
$H_0: r \leq 1\ vs\ H_1: r \geq 2$	0.697	3.841	0.404	0.697	3.841	0.404
Barishal-Rajshahi						
$H_0: r = 0\ vs\ H_1: r \geq 1$	16.385**	15.495	0.037	13.924	14.265	0.057
$H_0: r \leq 1\ vs\ H_1: r \geq 2$	2.461	3.841	0.117	2.461	3.841	0.117
Chhattagram-Khulna						
$H_0: r = 0\ vs\ H_1: r \geq 1$	25.230***	15.495	0.001	24.665***	14.265	0.000
$H_0: r \leq 1\ vs\ H_1: r \geq 2$	0.565	3.842	0.452	0.565	3.842	0.452
Chhattagram-Rajshahi						
$H_0: r = 0\ vs\ H_1: r \geq 1$	24.857***	15.495	0.002	22.519***	14.265	0.002
$H_0: r \leq 1\ vs\ H_1: r \geq 2$	2.338	3.842	0.126	2.338	3.841	0.126
Khulna-Rajshahi						
$H_0: r = 0\ vs\ H_1: r \geq 1$	24.558***	15.495	0.002	24.199***	14.264	0.001
$H_0: r \leq 1\ vs\ H_1: r \geq 2$	0.359	3.842	0.549	0.359	3.842	0.549

*Note: Analyzed and prepared by the authors. '**' and '***' indicate that the null hypotheses are rejected at a 5% and 1% level of significance, respectively*

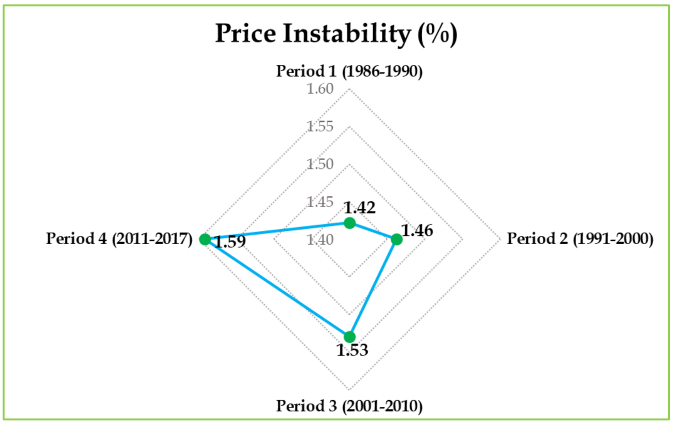


Fig. 2. Instability of deflated wholesale price of rice during different periods in Bangladesh

Table 3. Coefficients of the long-run elasticity and the speed of adjustment

Market pairs†	Speed of the adjustments		Long-run elasticity (β)
	Market 1 (α_1)	Market 2 (α_1)	
Rajshahi - Dhaka	-0.434***	0.879***	0.929***
Khulna - Dhaka	-0.897***	0.109	1.109***
Chattagram - Dhaka	-0.061	0.701***	0.901***
Barishal - Dhaka	-0.396***	0.959***	1.059***
Barishal - Chattagram	-0.459***	0.151	1.121***
Barishal - Khulna	-0.436***	0.915***	1.005***
Barishal - Rajshahi	-0.346	0.946***	1.106***
Chattagram - Khulna	-0.427	0.871**	0.876***
Chattagram - Rajshahi	-0.523*	0.975*	0.975***
Khulna - Rajshahi	-0.525***	0.073	1.113***

Note: †Right hand is standardized as an explanatory market. Analyzed and prepared by the authors. '', '**', and '***' indicate that the null hypotheses are rejected at 10%, 5%, and 1% level of significance, respectively. Market 1 and Market 2 indicates the first and second market in each market pairs, for example in A-B market pair, A is Market 1 and B is Market 2*

Table 4. Wald test under the VECM for market dominancy

Market pairs	Causality test		Results
	$H_0: \alpha_1 = 0$ vs $H_1: \alpha_1 \neq 0$	$H_0: \alpha_2 = 0$ vs $H_1: \alpha_2 \neq 0$	
Rajshahi-Dhaka	0.179	10.130***	Uni-directional
Khulna-Dhaka	4.909*	0.587	Uni-directional
Chattagram-Dhaka	0.205	2.412*	Uni-directional
Barishal-Dhaka	0.321	11.266***	Uni-directional
Barishal- Chattagram	0.662*	5.118	Uni-directional
Barishal-Khulna	1.112	7.604**	Uni-directional
Barishal-Rajshahi	4.706*	1.799	Uni-directional
Chattagram -Khulna	1.247	3.013*	Uni-directional
Chattagram -Rajshahi	7.635	0.143	-
Khulna-Rajshahi	14.616***	1.048	Uni-directional

Note: Analyzed and prepared by the authors. '', '**', and '***' indicate the null hypotheses are rejected at 10%, 5%, and 1% level of significance, respectively*

Two key findings emerge in terms of market interrelationship. One is that Chattagram and Rajshahi markets are business leaders (Fig. 3). Second, the Khulna market is the only one that adjusts prices in response to price shock in other regions. The three markets' geographical positions (Chattagram, Rajshahi, and Khulna) may be the key cause. Bangladesh imports about 5 to 10% of its annual rice requirements. Chattagram is Bangladesh's main and largest seaport, from where the majority of the country's imports originate. The likelihood of legal or illegal paddy/milled rice import from Myanmar, a neighboring nation, could explain the significance of the Chattagram markets in terms of price leadership. Rajshahi, on the other hand, is the country's main rice-growing and processing area. The area is the center of the majority of big auto rice mills, and it is the northwestern part of the country that shares a border with India. Bangladesh imports rice from India through the country's northern border. Furthermore, big millers use their market power to control the price of rice on the market [8]. Any interference in the Chattagram and Rajshahi markets will then be passed on to all other markets. This finding is interesting in terms of more research into the cointegration relationship between the Chattagram and Rajshahi market prices with the price of rice exported to Bangladesh by India and Myanmar. Furthermore, looking into the possibilities of illicit rice importation from India and Myanmar will shed light on the situation. However, all markets (Dhaka, Chattagram, Rajshahi, and Barishal) Granger cause to the price of Khulna. Khulna is the country's rice deficit area in terms of overall supply and demand. It might be a cause to blame for Khulna's propensity to follow other markets.

5. DISCUSSION

The study found that the wholesale price volatility of rice in Bangladesh is increasing. The major rice markets are strongly cointegrated. The import entry points markets (Chattagram and Rajshahi) are dominating over the others. Any price shock in these dominating markets takes two months to be adjusted to other markets. Findings of this study are very much consistence with Rahman et al. [19], Dawson and Dey [13], and Alam et al. [20] who presented linear cointegration results. This study creates a demand to investigate the price transmission scenario of the import entry markets of Bangladesh with the rice exporting countries, especially with markets from which Bangladesh imports rice. Besides, it is also important to figure out the reasons behind achieving comparative advantage of the exporting countries in rice production and export. The findings of the proposed studies will help to formulate policy to restructure the Bangladesh rice sector to achieve sustainability.

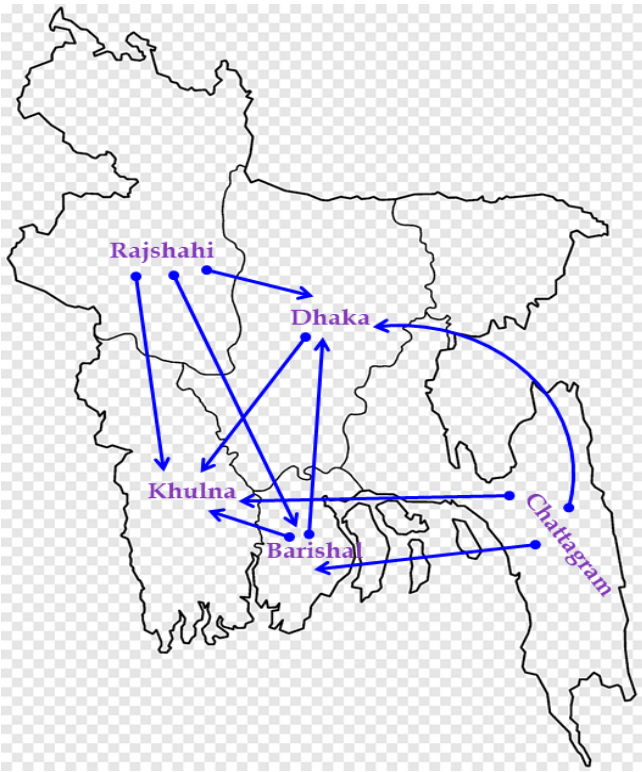


Fig. 3. Major rice markets in Bangladesh. Note: '$A \rightarrow B$' represents the direction of causality.
For example, '$Chattagram \rightarrow Dhaka$' represents Chattagram market is causing Dhaka market. Chattagram and Rajshahi markets are dominating over other markets. Prepared by the authors based on the information from Table 4

6. CONCLUSION

Using monthly time series data from 2006 to 2017, this research examined the spatial cointegration and speed of adjustment of Bangladesh's main rice markets. Wide market deviations from long-run equilibrium are adjusted within one to two months, according to the findings. The findings also have revealed that wholesale rice price volatility is increasing over time. Although communication and infrastructure facilities have improved, still the mechanism of price change is slower than in developed markets. The findings also indicate that private sector trading will reliably pass price signals across markets. The development of roads and communications, as well as the establishment of information dissemination centers, should be encouraged to boost business productivity and speed up the adjustment phase by lowering the cost and time of information and product transmission.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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