The Journal of Agriculture and Natural Resources Sciences

Journal homepage: http://www.journals.wsrpublishing.com/index.php/tjanrs

ISSN:2383-238X

Original Article

Relationship between World and Domestic Prices of Raw Jute in Bangladesh: A Cointegration Approach

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ARTICLE INFO

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How to Cite this Article:
Molla, M.M.U., S.A. Sabur and M.J. Alam. 2015. Relationship between World and Domestic Prices of Raw Jute in Bangladesh: A Cointegration Approach. *The Journal of Agriculture and Natural Resources Sciences.* 2(1): 304-311.

Article History:
Received: 7 January 2015
Revised: 5 February 2015
Accepted: 7 January 2015

ABSTRACT

The study explores the dynamic relationship between world and domestic market prices of raw jute in Bangladesh. In the study, Johansen multivariate cointegration test was used, followed by error correction mechanism. Johansen cointegration model confirms that there is sufficient evidence to conclude that the Bangladeshi raw jute market is integrated with the world market in the long-run, while price signals are also being moderately transmitted in the short-run. In other words, there was a moderate level of market integration between world and Bangladeshi raw jute market following trade liberalization policies implemented by Bangladesh. Therefore, additional government policies are needed to further enhance market integration. Such policies should focus on the reduction of non-tariff barriers designed to avoid sudden restriction on raw jute export, improve infrastructure, marketing systems and market information.

Keywords: Cointegration, Error correction, Raw jute, Short and long run equilibrium, Transmission, World and domestic prices.

INTRODUCTION

Markets are considered to be integrated when price changes over a period of time are correlated. Price differences across primary markets can be attributed to transport cost and seasonal and product variation in prices can be due to storage and processing cost respectively. When price differences exceed the above normal cost, the market can be treated as inefficient. An inefficient market will hamper the pace of development in crop production by improper allocation of resources. The impact of market integration between domestic and world markets with respect to consumers and producers differs for net importing and exporting countries. For an exporting country, greater market integration and higher levels of price transmission increase producer welfare. For an importing country, greater market integration and higher levels of price transmission benefit domestic consumers through lower prices, which in turn help to reduce poverty (Alam *et al.*, 2012). In well integrated markets,

middlemen's share should be reasonable and consumers get produce at fair prices. So it is very important to understand whether commodity markets function efficiently. Markets function efficiently when these are integrated in price relationships. In integrated markets, there will be no scope for traders to make excessive profits by arbitrage. If there are imperfections in the form of either oligopoly power among the sellers or unequal information among sellers, then it is expected that they will be able to reap abnormal profits. Price varies only to the extent of transfer costs including costs of wastages in the transfer process.

Market integration provides the necessary mechanism by which lower or higher prices could be transmitted from the global to the domestic market, which would in turn result in consumer welfare gains and poverty reduction. Highly integrated markets allow for efficient transmission of price signals and information across markets or across the different stages of the supply chain. On the contrary, low levels of market integration indicates inefficiencies and misallocation of resources. In the case of Bangladesh, markets may not be well integrated because of government intervention policies, which distort market prices or because of high transaction cost due to poor transportation and communications infrastructure (Rapsomanikis *et al.*, 2004). Therefore, the long-run Bangladesh–world prices relationship, which measures the degree of market integration between Bangladesh and the rest of the world, is crucial to policymakers in formulating domestic policies and negotiating trade policies at the international level. Therefore, the main goal of this study was to determine if the raw jute market of Bangladesh is well integrated with the world raw jute market, and if so, to what extent.

Both in Bangladesh and abroad, numerous research studies were conducted on market integration issues of different crops. The researchers in Bangladesh gave more emphasis to test the degree of market integration for food crops like rice, wheat, potato, lentil, etc. using correlation matrix, Ravallion model (Ravallion, 1986), Engle-Granger (Engle and Granger, 1987) and Johansen multivariate cointegration approaches (Johansen, 1988). But, no investigation so far on the issues of raw jute market integration in Bangladesh was found by the researcher himself. This indicates that more investigation on this issue is essential for raw jute market in Bangladesh. Research work did in Bangladesh rarely use Johansen multivariate cointegration approach to test the degree of market integration. Recently, Hossain and Verbeke (2010) and Alam *et al.* (2012) both were applied this approach to test rice market integration. Following the footsteps of them, the present study aims to employ this approach to investigate the degree of integration between world and domestic raw jute market in Bangladesh. In 2011, Ssekuma recommended the use of Johansen's method because it is able to detect more than one cointegrating relationship, if present. The contribution of the present study to the literature is that it will represent the first empirical test of market integration between world and domestic raw jute in Bangladesh in a dynamic framework using a recent data set.

MATERIALS AND METHODS

Sources of Data

In analyzing spatial integration, only monthly average prices of raw jute are available in unpublished form, which were collected from the Department of Jute, Government of the People's Republic of Bangladesh. In the case of monthly export prices of raw jute, four major international markets namely, India, China, Pakistan and Vietnam were selected for measuring market integration. Because, they are the main importing countries of raw jute to the world market during the sample period. The period of world prices of raw jute (Taka/pucca bale) was considered from 2004-05 to 2010-11 on the basis of availability of data. Real prices were obtained by deflating the nominal prices with consumer price index (CPI). The prices are also transformed into logarithms in order to interpret the estimated parameters directly as elasticity's. E-views 7 programmes were used for data entry and data

analysis. The study did not use any series that had more than two missing values in a raw. Individual missing values were fitted in using linear interpolation.

Econometric Framework

Time series analyses usually advocate differencing and pre-whitening of non-stationary series to estimate multivariate time series models. Critics have pointed out that such differencing filters out long-run information in data and study only the relationship between the changes in the variables. Most economic theories are in favour of long-term relationships among variables in the level form but not in the difference form. Cointegration modeling enables to study the dynamics of long-run equilibrium relationship in the level form. Since differencing is not required to achieve stationary, this procedure does not involve any loss of long-run information contained in the data.

A cointegration analysis of time series leads to the construction of error correction models that enable separately the characterization of short-term relationship i.e. among stationeries time series and long-term relationship i. e. relationship between non-stationeries time series. In this study, standard time series techniques were used to estimate dynamic price relationships between world and domestic market of raw jute in Bangladesh. First, Augmented Dickey Fuller (ADF) test was used to determine if the price series contained a unit root. Optimal lag lengths were determined by the Akaike Information Criterion (AIC) and used the following specification:

$$\Delta LnP_{i,t} = c + \text{°}LnP_{i,t-1} + \sum_{j=1}^{k-1} \Gamma_i \Delta LnP_{i,t-j} + \quad T + \text{£}_{i,t}$$

Where, $LnP_{i.t}$ is the respective logged price series, Δ is a first-difference operator, T is the time trend and ε_t denotes white noise error term. The above equation tests the null of a unit root ($p = 0$) against a mean-stationary alternative ($p \neq 0$). The term $\Delta LnP_{i.t-j}$ is a lagged first-difference term to accommodate serial correlation in the error terms.

Johansen Cointegration Approach

The Johansen (1988) cointegration approach was used to estimate a stationary relationship between the markets. Formally, the following vector autoregressive (VAR) specification was estimated:

$$\Delta LnP_{i,t} = \prod LnP_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta LnP_{t-1} + \mu_t$$

Where, Ln $P_{i,t}$ is a column vector of logged prices, which are I(1), the $\prod$, Γ, and Φ, forming the parameter matrix, and ω_t is a vector of random error that follows a Gaussian white noise process. Specifically, we test the rank of matrix ($\prod$), which contains long-run information about the variables in level are stationary, meaning that no cointegration exists, and if rank $\prod = r = 0$, meaning that all the elements in the adjustment matrix have value zero, then none of linear combination is stationary. According to the Engle and Granger representation theorem (1987), when $0 <$ rank ($\prod = r$) $< k$, there are r cointegrating vectors. For example, if rank ($\prod = r$) = 1, there is a single cointegrating vector or one linear combination which is stationary such that the coefficient matrix $\prod$ can be decomposed into $\prod = \alpha\beta'$, where α is the adjustment vector and β is the cointegrating vector and $\beta' LnP_{t-1} \sim I(0)$. Johansen method is used to estimate the $\prod$ matrix from an unrestricted VAR and to test whether we can reject the restriction implied by the reduced rank of $\prod$. The trace test for testing reduced rank (r) from coefficient matrix ($\prod$) is as follows:

$$\text{a}_{trace} = -T \sum_{i=r+1}^{n} Ln(1 - \widehat{\text{a}}_i^2)$$

Where, λ_i is the estimated values of the ordered eigenvalues obtained from the estimated matrix and T is the number of usable observations. The trace statistic tests the null hypothesis

that the number of distinct cointegrating vectors (r) is less than or equal to r against a general alternative.

Vector Error Correction Model (VECM)

Now we estimate a VECM to capture the short-run dynamic relationships and the speed of the adjustment toward a long-run equilibrium in the following specifications:

$$\Delta LnP_t^r = \sim_1 (ECT_{t-1}) + \sum_{i=1}^{p-1} \Gamma_i \Delta LnP_t^r + \sum_{j=1}^{q-1} \Psi_j \Delta LnP_t^s + \mu_{1t}$$

$$\Delta LnP_t^s = \sim_2 (ECT_{t-1}) + \sum_{i=1}^{p-1} \Gamma_i \Delta LnP_t^s + \sum_{j=1}^{q-1} \Psi_j \Delta LnP_t^r + \mu_{2t}$$

Where, the one-period lagged error correction term (ETC_{t-1}) is the lag of estimated residuals from the cointegrating regression and estimated from the VAR specification. The relevant p and q are the number of lags, which are chosen through minimization of the AIC. The size and statistical significance of α_1 and α_2 parameters measure the speed of adjustment of world and domestic market to a perturbation from the long-run equilibrium price relationship.

Parameter Estimation

The cointegration vector (β) estimated from the Johansen model which is specified earlier measures the long-run elasticity of the Bangladeshi raw jute price with respect to world market price. The expected value of long-run elasticity is $0 < \beta \leq 1$. If $\beta = 1$, it implies that changes in world market price will be fully incorporated or transmitted to the Bangladeshi price in the long run. If $0 < \beta < 1$, then Bangladeshi market only partially adjusts to the world market price movements in the long-run. Conversely, if $\beta = 0$, it implies that there is no pass-through at all and the domestic market is an autarky. Short-run elasticity measuring changes in domestic market price with respect to the world market price changes is estimated by parameter vector (Ψ) in above equation. Specifically, it represents the percentage adjustment of Bangladeshi price following a j- period percentage change in the world market price. Similarly, the parameter vector (Γ) is an autoregressive term measuring the effect of each i-period change in the domestic market price on the change in current period domestic market price.

RESULTS

To test the stationary of the data, the ADF test for each price series of Bangladesh, India, Pakistan, China and Vietnam markets were performed and estimated tau (^{2}) statistics as well as *P* values in their level and first differences (with constant and trend) are presented in Appendix Table 1 and 2. The tau (^{2}) statistics compared with *P* values indicate that all the raw jute price series data were non-stationary in level on the basis of the critical values reported by MacKinnon (1996). In other words, the ADF tests fail to reject that the price series are non-stationary in levels. This set of regression was run once more after differencing all the terms. The tau (^{2}) statistics on the lagged first difference terms are significant at 1% level meaning that the series are stationary after first differencing (Appendix Table 2). However, the ADF rejects that the price series are non-stationary in first differences. In all cases of null hypothesis is rejected implying that the series do not require second differencing to achieve stationary. These findings lead to the conclusion that the world and domestic raw jute prices are stationary after first differencing once.

The estimated coefficient (β) of long-run relationship between Bangladesh and India is 0.622 which is significant at 1% level (Appendix Table 3). The estimated cointegrated equation is $LnP_t^B = 3.381 + 0.622 LnP_t^I$ (14.583). The figure in parenthesis indicates *t*- value. The result implies that a 10% change in price of raw jute in India induces a corresponding

6.22% long-run change in domestic prices of raw jute in Bangladesh. The sign and the significance level confirm integration of the markets but the magnitude is far from unity. It indicates that about 62% of Indian price of raw jute changes are incorporated by the Bangladeshi raw jute market, even in the long-run.

Table 1: Unit root test of raw jute prices during 2004-05 to 2010-11

Markets	P_{t-1}	^{2} values	P values	DW	R^2	Decision
Bangladesh	-0.143	-2.429	0.362	2.07	0.070	Non-stationary
India	-0.192	-1.849	0.671	1.96	0.316	Non-stationary
Pakistan	-0.123	-1.914	0.638	1.89	0.161	Non-stationary
China	-0.119	-2.098	0.538	1.94	0.119	Non-stationary
Vietnam	-0.227	-2.064	0.557	1.93	0.514	Non-stationary

Note: Augmented Dickey Fuller (ADF) critical values (with constant and trend) for 1% and 5% are -4.07 and -3.46 respectively. Lag length for ADF test is decided based on Akaike Information Criterion (AIC)

Table 2: Unit root test (first difference) of raw jute prices during 2004-05 to 2010-11.

Markets	ΔP_{t-1}	^{2} values	P values	DW	R^2	Decision
Bangladesh	-1.120	-10.030	0.000	1.96	0.560	Stationary
India	-1.513	-10.044	0.000	2.02	0.618	Stationary
Pakistan	-1.353	-12.684	0.000	1.91	0.671	Stationary
China	-1.237	-11.080	0.000	1.93	0.609	Stationary
Vietnam	-2.172	-11.015	0.000	1.95	0.845	Stationary

Note: Augmented Dickey Fuller (ADF) critical values (with constant and trend) for 1% and 5% are -4.07 and -3.466 respectively. Lag length for ADF test is decided based on Akaike Information Criterion (AIC)

The table shows that the estimated cointegration equation for Bangladesh and Pakistan is $LnP_t^B = 2.484 + 0.722LnP_t^P$ (16.608), estimated equation for Bangladesh and China is $LnP_t^B = 2.741 + 0.693LnP_t^C$ (21.130) and estimated equation for Bangladesh and Vietnam is $LnP_t^B = 2.168 + 0.757LnP_t^V$ (13.209). The figures in parentheses indicate *t*- values which meaning the estimated coefficients are significant at 1% level. The results show that a 10% change in price of raw jute in Pakistan, China and Vietnam induce a corresponding 7.22%, 6.93% and 7.57% long-run changes respectively in domestic prices of raw jute in Bangladesh. The sign and significance level confirm integration of the above mentioned markets but the extent is far from unity (Appendix Table 3).

Table 3: Long-run relationship between inflation adjusted of Bangladeshi and world raw jute prices during 2004-05 to 2010-11

Price relationship : Bangladesh	Regression Equation	*t* - values	*P* - values	R^2	DW
India	$P_B = 3.381 + 0.622P_I$	14.583	0.000	0.721	0.563
Pakistan	$P_B = 2.484 + 0.722P_P$	16.608	0.000	0.770	0.952
China	$P_B = 2.741 + 0.693P_C$	21.130	0.000	0.844	1.005
Vietnam	$P_B = 2.168 + 0.757P_V$	13.209	0.000	0.680	1.156

Next, the study estimates Johansen cointegration results which have been presented in Appendix Table 4. A vector autoregressive (VAR) specification of one lag was chosen for India and China, two lags for Pakistan and three lags for Vietnam using AIC. For the multivariate model, cointegration is tested using Johansen maximum likelihood procedure using one statistic namely the trace (λtrace). For the null hypothesis of r = 0, the calculated trace statistics was 21.147 for India, 32.603 for Pakistan, 30.366 for China and 26.063 for Vietnam which were larger than critical value (15.494) at 5% level of significance. The trace statistics for cointegration indicate that the null hypothesis of no integration is rejected at 5% significance level for model 3 (assume linear trend). It is evident from the results that the trace test indicates one cointegrating equation as the null hypothesis of r=0 is rejected. Thus, the Johansen cointegration model confirms that the world (India, Pakistan, China and

Vietnam) and domestic (Bangladesh) prices exhibit a long-run cointegrating relationship during the study period.

Table 4: Results of Johansen cointegration rank test

Price Relationship: Bangladesh	Test [H_0: rank ($\prod$) = r]	Model : 3 (assume linear trend)			
		Trace Statistics (λtrace)	*P* - values	Decision	
India	r = 0	21.147	0.0063	Rejected	Cointegrated
	r ≤ 1	3.401	0.0651	Not rejected	
Pakistan	r = 0	32.603	0.0001	Rejected	Cointegrated
	r ≤ 1	2.117	0.1456	Not rejected	
China	r = 0	30.366	0.0002	Rejected	Cointegrated
	r ≤ 1	2.119	0.1454	Not rejected	
Vietnam	r = 0	26.063	0.0009	Rejected	Cointegrated
	r ≤ 1	1.812	0.1782	Not rejected	
Critical Value (λ0.95)	r = 0	15.494	-	-	-
	r ≤ 1	3.841			

Although, the previously-mentioned test provides supporting evidence of the existence of long-run market integration between Bangladeshi and world raw jute markets, prices may depart from this long-run relationship in the short-run. Therefore, to capture the short-run price dynamics, the study estimated a vector error correction model (VECM) as described in materials and methods section. Empirical estimates of short-run price dynamics and error correction parameters are presented in Appendix Table 5.

Table 5: Results of Vector Error Correction Model (VECM)

Price Relationship: Bangladesh	Regressors	$\Delta \ln P_t^B$		$\Delta \ln P_t^i$ (i = 1,2,……,4)	
		Parameter estimates	*t*- value	Parameter estimates	*t*- value
India	ECM_{t-1}	-0.364(0.086)	-4.225	0.018(0.055)	0.326
	$\Delta \ln P^B_{t-1}$	0.129(0.109)	1.176	0.158(0.070)	2..252
	$\Delta \ln P^I_{t-1}$	-0.479(0.177)	-2.704	-0.141(0.113)	-1.238
	F - statistics	6.867		2.651	
Pakistan	ECM_{t-1}	-0.469(0.086)	-5.425	0.157(0.100)	1.559
	$\Delta \ln P^B_{t-1}$	-0.296(0.097)	-3.047	-0.015(0.113)	-0.139
	$\Delta \ln P^B_{t-2}$	-0.059(0.093)	-0.635	-0.098(0.108)	-0.906
	$\Delta \ln P^P_{t-1}$	-0.216(0.136	-1.587	0.089(0.158)	0.561
	$\Delta \ln P^P_{t-2}$	-0.068(0.122)	-0.557	0.252(0.142)	1.779
	F - statistics	13.033		1.361	
China	ECM_{t-1}	-0.315(0.071)	-4.410	0.173(0.092)	1.876
	$\Delta \ln P^B_{t-1}$	-0.256(0.097)	-2.624	0.115(0.126)	0.910
	$\Delta \ln P^C_{t-1}$	-0.046(0.106)	-0.438	0.023(0.138)	0.166
	F - statistics	11.066		1.890	
Vietnam	ECM_{t-1}	-0.653(0.138)	-4.713	0.105(0.096)	1.099
	$\Delta \ln P^B_{t-1}$	-0.410(0.128)	-3.203	-0.040(0.088)	-0.461
	$\Delta \ln P^B_{t-2}$	-0.150(0.118)	-1.274	-0.033(0.082)	-0.408
	$\Delta \ln P^B_{t-3}$	0.085(0.092)	0.928	-0.039(0.063)	-0.614
	$\Delta \ln P^V_{t-1}$	-0.970(0.207)	-4.685	0.012(0.143)	0.086
	$\Delta \ln P^V_{t-2}$	-0.036(0.227)	-0.162	0.244(0.157)	1.549
	$\Delta \ln P^V_{t-3}$	-0.304(0.217)	-1.397	-0.112(0.150)	-0.747
	F - statistics	23.262		0.988	

Note: Figures in the parentheses indicate Standard errors

It shows that the error correction parameter for India is negative (-0.364) and significant at 1% level. The negative sign of the error correction term is within the expectation. This estimate would suggest that 1% departure from the long-run price relationships would induce a 0.36% price response in the Bangladeshi price within one month to bring prices back in line and these price adjustments take approximately three months to fully realign Bangladesh and Indian prices to their long-run equilibrium level. This is consistent with the cointegrated

result that Indian and Bangladeshi prices are cointegrated and the Bangladeshi price adjusts to the long-run price changes in the Indian market. Validation of the VECM estimates is obtained by examining *F*- statistics results suggest that the model is well specified (Appendix Table 5).

The error correction coefficients for Pakistan, China and Vietnam are -0.469, -0.315 and -0.653 respectively which measures the speed of adjustment towards long-run equilibrium carries the expected negative sign and these are significant at 1% level (Appendix Table 5). The estimated VECM suggests that the adjustment prices are relatively fast with about 47%, 32% and 65% of divergence respectively from the long-run equilibrium being corrected each month. The short-run dynamics indicate that changes in the prices of raw jute in Pakistan, China and Vietnam are transmitted to the Bangladeshi price contemporaneously, although not fully. These indicate that the markets are not well integrated in the short-run, with changes in the world (Pakistan, China and Vietnam) prices being partly transmitted to the Bangladeshi market. However, lagged differenced terms are also estimated to be negative, reflecting somewhat complex short-run dynamics. Validation of the VECM estimates on the basis of *F*-statistics suggest that the model is well specified for all data sets of raw jute prices. Overall, there is sufficient evidence to conclude that the Bangladeshi raw jute market is integrated with the world (India, Pakistan, China and Vietnam) market in the long-run, while price signals are also being moderately transmitted in the short-run.

The large body of research on market integration and price transmission, both spatially and vertically, has applied different quantitative techniques and has highlighted several factors that impede the pass-through of price signals. Distortions introduced by governments in the form of policies either at the border or as price support mechanisms weaken the link between the international and domestic markets. Agricultural policy instruments such as import tariffs, tariff rate quotas and export subsidies or taxes, intervention mechanisms as well as exchange rate policies insulate the domestic markets and hinder the full transmission of international price signals by affecting the excess demand or supply schedules of domestic commodity markets (Mundlak and Larson, 1992; Quiroz and Soto, 1996; Baffes and Ajwad, 2001; Abdulai, 2000; Sharma, 2002).

DISCUSSION

The findings of the study confirmed that Bangladeshi and world raw jute markets were integrated. However, the degree of integration was not so high – ranged 62-76% (on an average 70%) of world price changes are incorporated into Bangladeshi market in the long-run. In other words, there was a moderate level of market integration between Bangladeshi and world raw jute markets following trade liberalization policies implemented by Bangladesh. Though, government of Bangladesh set its tariff and non-tariff barriers at a minimal level during the studied period. Prior government intervention that was banned on export of raw jute policy has already been revoked. Obviously, government policy on world jute trading was not sufficient to fully integrate the Bangladeshi raw jute market with the rest of the world. The main plausible reasons for incomplete transmission of world prices were transaction costs associated with poor transportation and communications infrastructure which still hinder raw jute exports from Bangladesh. It implies that additional government policies are needed to further enhance market integration.

Although, increased integration with the world market can improve the situation of producers of net exporting countries, but greater integration can also lead to increase price volatility. In this case, highly volatile prices in the world market will be transmitted to highly integrate domestic markets (Alam *et al.*, 2012). Therefore, it must be recognized that increased integration between Bangladeshi and world markets can also result in higher and more volatile prices in Bangladeshi raw jute markets, which would ultimately be transmitted to the country's jute manufacturing sector.

CONCLUSION

The sector would adversely be affected by the higher volatilities of the raw jute prices in Bangladesh. The study suggests that such policies should focus on the reduction of non-tariff barriers designed to avoid sudden restriction on raw jute export, improve infrastructure, marketing systems and market information.

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