Linkage between World and Domestic Prices of Rice under the regime of Agricultural Trade Liberalization in Bangladesh

Mohammad J. Alam[1], [a &b], J. Buysse [a], Andrew M. McKenzie [c], Eric J. Wailes [c] and Guido Van Huylenbroeck[a]

[a & b] Department of Agricultural Economics, Ghent University, 653 Coupure Links, 9000 Ghent, Belgium

[b] Department of Agribusiness and Marketing, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

[c] Department of Agricultural Economics and Agribusiness, the University of Arkansas, Fayetteville, AR 72701, USA

Contributed Paper prepared for presentation at the Australian Agricultural and Resource Economics Society Conference, Adelaide, South Australia, February 10-12, 2010

[1] Corresponding author; E-mail: Jahangir.Mohammad@Ugent.be; alambau2003@yahoo.com

Linkage between World and Domestic Prices of Rice under the regime of Agricultural Trade Liberalization in Bangladesh

Abstract: The paper examines the relationship between the world market and domestic market prices of rice for Bangladesh in the regime of agricultural trade liberalization. The long run price relationship information is an important piece of information for the policy makers in formulating domestic polices and negotiating trade policies at the international level. The monthly data used for this study are taken from different sources, the Food outlook, FAO and Global Information and Early Warning System, FAO and the Bangladesh Bank for the period June 1998 to July 2007. Both Engle-Granger bi-variate and Johansen multivariate cointegration tests were used for the results sensitivity. We sequentially proceed to estimate the standard error correction model. The results showed that there is a long run equilibrium relationship between the world and the domestic prices and the relationship is uni-directional, meaning that, the domestic prices adjust to the world prices but not vice-versa. So the policy to ensure food security (via food price stability and price risk management) should be carefully designed as the movement of the world market price is higher and distorted and many consumers depend on the markets for their food, especially in the case of Bangladesh.

Key Words: market integration, domestic price, world price, error correction model

I. Introduction

Over the past two decades, many developing countries including Bangladesh embarked on structural adjustment programs with the objective of promoting market based development. The Bangladesh government has taken a substantial policy reform in the domestic markets including agricultural trade liberalization by tariff restructuring at the boarder level. Hence, greater integration between the domestic market and the world agricultural market was expected.

Following the structural adjustment reforms and the agricultural trade liberalization in the early 1990s, Bangladesh government substantially liberalized import and exports, almost abolished all the support programs for domestic producers and consumers for rice and allowed private traders to operate as importers and exporters in the markets. The key objectives of those reforms were the introduction of more efficient markets, better allocation of resources, lowering marketing margins, lower consumer prices and higher producer prices through global market integration. Therefore, a fundamental issue, when analyzing the domestic market integration with the global market is the extent to which the prices of domestic agricultural commodity in Bangladesh are linked with the prices at the world market for the short run and for the long run which can be defined as spatial integration between the domestic and the world market. Under certain conditions, the strong price integration may be viewed as a necessary condition for efficient resource allocation and hence maximum welfare (Samuelson, 1952; Takamaya and Judge, 1964). The process of price transmission accruing in the upstream stages through to final consumer prices in the food sector has long been studied for policy purposes (Palaska, 1995). The price linkage of commodity market at the domestic and at the global to domestic level has been documented rather extensively in the literatures either under the domain of law of one price (Ardeni, 1989, Baffes, 1991) or under the domain of market integration (Gardner and Brooks, 1994; Baulch, 1997; Navin, 2006). Another related domain of research is vertical price integration along the different stages of supply chain (Goodwin and Harper, 2000; Prakash, 1998; vonCramon-Taubadel, 1999). The success of market liberalization, and structural adjustment efforts undertaken by the countries therefore, is assessed quite very often by the degree to which markets are integrated (e.g. Goletti and

Babu, 1994; Alexander and Wyeth, 1994; Dercon, 1995; Goodwin, 2000) or segmented. Therefore, if the two level prices are integrated to each other and are involved each other with trading, the importing country can be benefited from lower world market prices (import parity prices) for the domestic consumers and the exporting country can benefit from the higher world markets prices (export parity prices) for the domestic producers given that there are no price distorting policies at the domestic level, at the boarder level and at the international level.

The price transmission studies are testing if price changes are transmitted from one market to another and provide important information about how these changes are transmitted, thus reflecting the magnitude of the market integration. Due to increasing global food prices in recent years 2007 and 2008, like many of the food importing countries, Bangladesh has experienced a sharp price increase for food items in the domestic market. This concerns the motivation of testing the existence of the relationship between international and the domestic market prices both for the short run and for the long run. On the basis of the findings, the country could introduce a policy to ensure the food security which is plausibly under threat from international price volatility. The relationship can be tested empirically for a net food importing country like Bangladesh using the domestic consumers' prices and the world prices (FOB Bangkok price) assuming that there is no quality differences of rice, thus, the domestically produced rice and imported rice are perfectly substitute. Therefore, the present paper examines whether the price changes in the international markets co-move to the changes of domestic prices in Bangladesh or vice-versa, for the main imported food commodity rice. Rice accounts for a larger share of the expenditure of the poor and the country is one of the largest rice importing countries for food grain (especially for rice) in the world market. The policy with respect to rice imports and its price stability at domestic level is politically very sensitive as well. There are some debates at the policy level whether the country can rely on the world market for the supply, thus, exhausting costly foreign currency or should focus to the policy of self sufficiency by domestic production or the mix of the policies, balancing two. The recent price surges mount the debate. In Bangladesh, an average of 10-15 per cent of the total requirements is imported annually (Dorosh, 2001). Dorosh (2001) showed that the agricultural

trade liberalization in Bangladesh contributed positively to the country's overall food security, especially during the period of domestic supply shocks in 1997 and in 1998. David (2008) analyzed whether the domestic markets for food importing country like Indonesia can rely upon on the world markets and found that the price at the world market are still relatively more stable than the period of food crisis in 1970s and in the decade of 1980s. Therefore, the conclusion of the study was 'yes'. In the line of David (2008), others studies (Dorosh, 2009; McCulloch, 2008) also showed that the world market price was more stable during the last decades and the real world price in dollar terms has declined. Therefore, the net importing countries have benefited from the declined real world prices, especially the net consumer households. But some crucial factors such as transportation cost, domestic policy, roads and infrastructure condition might jeopardize the expected benefit from declined real world prices. The opportunities of declined real international prices or the threats of temporary price surges depend on the price transmission from the international market to the domestic market. Therefore, our focus is to estimate whether the domestic market and the international market prices of rice are linked to each other. Insight in this price link can give an indication whether domestic market prices are solely determined by the interaction of domestic demand and supply or international market prices also play a role in the equilibrium price formation of rice. This kind of information is crucial for policy makers in formulating optimal policies at the domestic at the domestic level and at the boarder level.

The paper is the first to make an econometric analysis of the relationship of the price integration with the international market in Bangladesh. Some studies were previously done on the spatial integration of rice markets in Bangladesh during the period of past decades. Ravallian (1986) showed that there was limited market integration in the Bangladesh rice markets in the period of pre-liberalization; Goletti *et al.,* (1995) concluded that the market integration was moderate during the period of transition time, just after the trade liberalization taken place in 1993. Plausibly, the limited and the moderate market integration were arisen from the restricted food grain movement by the government (protectionism policy) and from the public intervention (producer and consumer support policies) at the domestic food grain markets. A relatively recent study, Dawson (2002) analyzed the spatial

monthly price data for the period from 1992 to 1997 and found that the rice markets are perfectly integrated in the regime of agricultural trade liberalization. All of the studies were conducted to test the spatial integration of rice markets at the domestic level. None of these studies conducted the price relationship between the world and the domestic market in the regime of agricultural trade liberalization in Bangladesh. The present analysis fills-in this gap and uses monthly data from June 1998 to June 2007 to understand both the short run dynamic and the long run relationships between international and domestic prices of rice.

An error correction model was specified to account for the dynamic nature of the price relationship. Short run price relation, the speed of the adjustment and the long run equilibrium relationship was estimated after the reforms of agricultural trade liberalization.

The organization of the paper is as follows. Following the introduction in the first section, section 2 provides the modeling framework and estimation procedures. The data used for this analysis and the results are presented in section 3 and 4. Section 5 presents the conclusion.

II. Econometric Framework and Empirical Specifications for Analyzing Price Relationship

The estimation of the price relationship between the world and the domestic market can be done by analyzing the transaction costs such as freight costs, import tariffs, para-tariffs (hence the import parity price) and trade margins. However, data on trade margins are very difficult to obtain and probably not reliable. That is why it is logical to model the price linkage using `price only` models as also has been done in Baffes and Gardner, 2003; Asche *et al*., 2007; Peter, 2005; Baffes and Ajwad, 2001; Navin *et al.*, 2006; Mohanty *et al.*, 1996; Miljkovic, 2009.

To test the price relationship between the world and the domestic market for rice in Bangladesh involves several methodological steps, which are presented sequentially as follows.

At the first step, since the data are monthly basis, it may exhibit seasonality. Therefore we tested the seasonality with the transformed (logarithm) price series to remove any deterministic seasonality (Johnston and DiNardo, 1997) from the data series and are used the following regression in equation (1)

$$P_{i,t} = \alpha_{i,0} + \sum_{j=2}^{12} \delta_{i,j} M_j + u_i \qquad (1)$$

Where $P_{i,t}$ is the price series, i=1, 2….n, M_j are orthogonalised centered monthly dummies (February to December) and u_i is Gaussian identical individually distributed (i.i.d) with zero mean and constant variance. January is the base month making α is an intercept for January. If there is no seasonality in $P_{i,t}$ once the M_j have been controlled for then δ_2 through δ_{12} are all zero ($\delta_2 = \delta_2 =$-----$= \delta_2 = 0$). This can easily be tested against ($\delta_2 \neq \delta_2 \neq$----$= \delta_2 \neq 0$) via F test (Jeffrey M. Wooldridge, 2000). Thus, the regressions in equation (1) are expected to show the seasonality effects in the data series. If the null hypotheses is rejected, the price series must be deseasonalised (no seasonality) before proceeding.

Unit Root Test of the Price Series

Next, all the price series are tested for their non-stationary. Therefore, we conducted unit root test by the standard augmented Dickey-Fuller (ADF) (1979) and the Philips Perron (PP) (1989) test on each of the price series. The ADF unit root test with an optimal lag length determined by the Akaike information criterion (AIC), Schwarz Bayesian information criterion (SBC) and Lagrangian multiplier (LM) criteria and is used in the following form:

$$\Delta P_{i,t} = c + \rho P_{i,t-1} + \sum_{j=1}^{k-1} \mathrm{d_j}\, \Delta P_{i,t-j} + \beta T + \varepsilon_{i,t} \qquad (2)$$

Where $P_{i,t}$ is the respective price series, Δ is first difference operator, T is the time trend and ε_t denotes white noise error term. Equation (2) tests the null of a unit root (ρ=0) against a mean-stationary alternative (ρ≠0). The term $\Delta P_{i,t-j}$ is a lagged first difference to accommodate serial correlation in the errors.

When the time series data are subject to both a deterministic trend (T) and an exogenous shock that causes a structural break, the ADF test tends to under-reject (Perron, 1989). Therefore, we also test the presence of a unit root using Philips Perron (1989) in the following specification.

$$P_{i,t} = c + \beta\left\{t - \frac{T}{2}\right\} + \rho P_{i,t-1} + v_{i,t} \qquad (3)$$

Where $P_{i,t}$ is respective time series, $\left\{t - \frac{T}{2}\right\}$ is the time trend and where T is the sample size, $v_{i,t}$ is the error term. This procedure, in fact, uses a non-parametric adjustment to the Dickey–Fuller test statistics and allows for dependence and heterogeneity in the error term.

Unit Root Test of the Estimated Residuals from the Bi-Variate Regression

The unit root test was applied also to the residuals estimated from the static regression $(lnpd_t = \beta_1 lnpw_t + \tau T + \varepsilon_t)$ between the price series, in order to test for cointegration following Engle and Granger (1987). If the residual is stationary at their level, which is an I (0), meaning that there is one cointegrating equation in the model which allows to proceed for estimating error correction model for testing the short run dynamic, long run relationship and the speed of the adjustment or the disequilibrium error. The equation (4) is for the test of estimated residuals for the unit root and is as follows:

$$\Delta\hat{\varepsilon}_t = a + \rho\hat{\varepsilon}_{t-1} + \sum_{j=1}^{k-1} \gamma_j \Delta\hat{\varepsilon}_{t-j} + u_t \qquad (4)$$

Johanson Multivariate Co-Integration Test

Once the price series are considered to be non-stationary, in addition to Engle-Granger residual based bi-variate test we also examined the price linkage between international to domestic market in the multivariate cointegration framework of Johansen and Juselius (1990) for testing the sensitiveness. We applied the Johansen likelihood ratio tests in the specification of equation 5.

$$\Delta P_t = \mu + \Pi P_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta P_{t-i} + \tau T + \omega_t \quad (5)$$

Where P_t includes all n variables in the model, T is the time trend and ε_t is random error with zero mean and constant variance. The rank ((Π) of matrix contains long run information about the variables and is a product of α (speed of the adjustment or the disequilibrium error) and β (long run con-integration relation) that is the rank matrix is . If Π =0, all elements in P_t are non-stationary and there are no cointegrating relations among the variables. If Π =1, there is single cointegrating vector and for 1< Π <n, there are multiple cointegrating relations. Our model comprises two price series and there must be one co-integrating vector, if the data series are co-integrated in the long run. The cointegrating vector is found using the following two test statistics: the trace test and the maximum eigen value test which are as follows:

Where, λ_i is the estimated value of the characteristic roots (eigen values) 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 is less than or equal to *r* against a general alternative. Another statistic called maximal Eigen value tests the null hypothesis that the number of cointegrating vectors is r against the alternative of r +1 cointegrating vectors. In the equation (5), α, β, τ, and μ are the parameters to be estimated. The relevant k is the number of lags which are chosen through the minimization of the AIC, supplemented by SBC and LM test results mainly to check the consistency of selected lag. The size and statistical significance of the dis-equilibrium error (α), measures the tendencies to return to equilibrium (Baghestani and McNown, 1992). The hypotheses that are tested from the equation (5) are the short run integration, the long run integration and the dis-equilibrium error or the speed of the adjustment. The short run integration is tested on the basis of the hypotheses that are (against an alternative of (. The estimated speed of the adjustment to the long run equilibrium will be tested on the null of (against the alternative of (.

III. Data

The data used for this study are taken from three different sources: the Food outlook of FAO, the Global Information and Early warning System (GIEWS), FAO and the Bangladesh Bank. The monthly world prices of rice (FOB Thailand 100% B) are taken from food outlook for the period from June 1998 to June 2007 and then it is adjusted to the local currency Bangladesh Taka. There are 3 different types of rice prices available for the world market. The reason of selecting Thai FOB 100% B is that this is the main imported type of rice in Bangladesh. The domestic wholesale consumer prices are taken from GIEWS for the same period. The monthly exchange rate data (USD to Bangladesh Taka) are collected from series of official publications 'Economic Trend' of Bangladesh Bank. The sample period was selected on the basis of availability of a continuous time series dataset for the entire set of the variables considered and because the period covers the liberalized phase.

During the considered period Thailand and India are the main rice exporting countries to Bangladesh. We used Thai price as a world price as Thailand is the top exporting country during last couple of decades and play a price leadership role in the world market. Navin Yavapolkul *et al.,* (2006) confirm our choice by showing that the prices of major rice exporting countries like Thailand and India among others are integrated. Summary statistics of the price series are presented in Table 1.

IV. Empirical Application and Results

Table 1: Descriptive statistics for the variables used in the models

Variables	Mean	Standard Deviation	Minimum	Maximum
pw (Taka/Ton)	10842	3138	6602	18148
pd (Taka/Ton)	13753	1922	10510	18860

The seasonality test rejects the presence of seasonality in all respective price series. Therefore, we decided to proceed with the level data. Initial testing for non-stationarity was performed on both levels and first differences. Table 2 presents the results of the augmented Dickey-Fuller (ADF) and Philips Perron (PP) unit root test for each prices series. Because the decision on whether to use equation 2 dependent upon the stationary properties of the price series, we supplemented the unit root rest with a PP test. The null hypothesis of non-stationary was

tested using a t-test. A negative and significantly different from zero values of ρ indicates that P_i is I (0). The PP test is similar to the ADF test but their difference lies on the treatment of any nuisance serial correlation aside that generated by the hypothesized unit root (Philips and Perron, 1989). Trend stationary can also be tested by adding a time trend in the relevant regression in equation 2. Based on the critical values reported by MacKinnon (1996), the tests indicate that the stationarity in levels is rejected irrespective of including trend in the regression. As the price series were all non-stationary in the levels, the first differences were then tested. The ADF and PP tests indicate that the first differences of the respective price series are stationary. Therefore, we concluded that every price series in our sample period is I (1) at their level and I (0) at their first differences which is a pre-requisite for the co-integration analysis.

Table 2: Non-stationary test results using the augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests

Results of variables	At level without trend		At level with trend		Decision
	ADF	PP	ADF	PP	
World price (lnpw)	-0.412	-0.036	-2.302	-1.492	Non-stationary
Domestic wholesale price (lnpd)	-0.641	-0.258	-2.02	-1.622	Non-stationary
	At first-differences without trend		At first differences with trend		
	ADF	PP	ADF	PP	
World price (lnpw)	-7.0687	-6.803	-7.248 (0)	-6.906	Stationary
Domestic wholesale price (lnpd)	-10.559	-10.946	-10.653 (0)	-14.949	Stationary

Notes: 1. Lag length for ADF tests are decided based on Schwarz information criterion (SBC). **2.** Maximum Bandwidth for PP test is decided based on Newey-West (1994) **3.** Critical values are -2.89 (5%), and -3.49(1%) without trend and -3.45 (5%), and -4.05 (1%) with trend (MacKinnon, 1996)

Then, we consider a linear long run-relationship expressed as $lnpd_t = \beta_0 + \beta_1 lnpw_t + \tau T + \varepsilon_t)$ in where ε_t is a residual. Simple ordinarily least square (OLS) regression was estimated on the basis of the equation. Using the Engel-granger (1987) two step estimation approach, we

estimated first the static long run equilibrium relationship and in the second step, the residuals from estimated equation are used to obtain the estimate of ρ from equation 4.

We also tested the granger causality to see the direction of the price relationship. We found that (Table 3) lnpw does ganger causes the lnpd but not the vice versa. This indicates that Bangladesh is a small player in the world rice market. The estimated (the estimated equation was $lnpd_t = 5.765 + 0.403lnpw_t + 0.005T + \varepsilon_t$) residuals are then tested for their stationarity and found to be stationary (Table 4) (the null hypothesis of a unit root was strongly rejected). So, the stationary of the residuals at their level suggesting that spurious regression is not an issue. However, the residual based Engel-granger integration test is not conclusive. Therefore, it is imperative to use an error correction model. This is possible because the Granger representation theorem states that an error correction representation exists for any co-integrated series (Engle and granger, 1987). Thus, an error correction model (ECM) could be estimated where all the variables are specified in the first differences, except the error correction term (the lagged residual) which is in levels. We also performed the Johansen (1990) multivariate test to check for the robustness of the results.

Table 3: Granger causality test

Hypotheses		F-Statistic	Decision
H_0:	lnpw does not Granger cause lnpd	9.971 (0.0001)	Rejected
H_0:	lnpd does not Granger cause lnpw	0.875 (0.419)	Accepted

The significant levels are in the parentheses

Table 4: Unit root test of the estimated residuals from the static regression

Results	At level: without trend		At level: with trend		Decision
	ADF	PP	ADF	PP	
Residual	-3.999	-4.087	-3.976	-4.061	Stationary

Notes: **1.** Lag length for ADF tests are decided based on Schwarz information criterion (SBC). **2.** Maximum Bandwidth for PP test are decided based on Newey-West (1994) **3.** Critical values are -2.89 (5%), and -3.49(1%) without trend and -3.45 (5%), and -4.05 (1%) with trend (MacKinnon, 1996)

Once the series are found to be integrated in the long run, next, we proceed for estimating the short run dynamics and speed of the adjustment in the error correction model in equation 5.

To capture the short run dynamics we need to use the appropriate number of lags in the model so that the model is correctly specified. For choosing the appropriate number of lags in the model we use the Akaike information criteria (AIC) supplemented by SBC, likelihood ration (LR) and final prediction error (FPE). In all the cases the selected number of lags was 2, except in the case of SBC. Nevertheless, we decided to use two lags in our model to capture the short run dynamics. The results of different information criteria are given in the Table 5.

Table 5: Lag order selection using different information criteria

Lag order	AIC	SBC	LR	FPE
0	-2.558075	-2.506915	-	0.000266
1	-7.226236	**-7.072757***	474.5831	2.49e-06
2	**-7.310318***	-7.054519	**15.85170***	**2.29e-06***
3	-7.265572	-6.907453	3.160656	2.40e-06
4	-7.273356	-6.812918	8.032636	2.38e-06
5	-7.204527	-6.641769	0.813373	2.55e-06
6	-7.186828	-6.521750	5.397376	2.60e-06

* indicates lag order selected by the criterion; LR: sequential modified likelihood ratio test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion and SC: Schwarz information criterion

Since our motivation is to estimate the price relationship between two price series, we have also applied multivariate co-integration test to the test the robustness of the results in addition to the bi-variate Engle-granger test. The trace test statistics (λ_{trace}) and maximum eigenvalue statistics (λ_{max}) results from equation (6) and (7) are presented in Table 6. Many studies (Dawson, 2002; Mohanty *et al.*, 1996; Taylor *et al.*, 1996) showed that the rejection of the null hypothesis of no integration by trace test is sufficient to identify the cointegration rank. The null hypothesis of the absence of a cointegration relation between the variables is rejected at the 0.05 per cent significant level at both the cases (case I) for both trace test and maximum eigen value test statistics but at the 0.06 percent level by maximum eigen value statistics in the case of II. From the tests result, it is concluded that rice market contains one cointegrating relation. That means, this cointegrating relation gives the number of stationary linear combinations of the price series. So it is also consistent with the identification of one linear combination of prices that exhibits stability over the time from the bi-variate Engle Granger test. Therefore, it is concluded that the world price and Bangladesh domestic wholesale

consumer prices are co-integrated, meaning that two prices move together. Our result confirms that the liberalization policy at the boarder level and policy reform at the domestic level leads to the domestic prices and world prices moving together.

Table 6: Multivariate co-integration rank test

Test (H_0: rank (Π) =r)	Case I (no linear trend in level)			Case II (linear trend in level)		
	Test statistics (λ_{trace}), (λ_{max})	Critical values ($\lambda_{0.95}$)	Decision	Test statistics (λ_{trace}), (λ_{max})	Critical values ($\lambda_{0.95}$)	Decision
Trace test statistic (λ_{trace})						
r=0	17.212	15.494	Rejected	27.901	25.872	Rejected
r ≤1	0.001	3.841	Not rejected	9.159	12.517	Not rejected
Maximum eigen value test statistic (λ_{max})						
r=0	17.211	14.264	Rejected	18.741	19.387	Rejected at 6% level
r ≤1	0.001	3.841	Not rejected	9.159	12.518	Not rejected

The estimate of the long run co-integration relationship is given to the Table 7. The result suggests that the co-efficient of the long run-relationship is found to be 0.392 and is significant at the 0.01 percent significance level. Meaning that if there is a 1 unit price change at the world market, there was a 0.39 unit prices change at the domestic market. The co-efficient of the trend variable in the co-integration estimate is very small and found to be insignificant.

Table 7: Co-integration estimates from maximum likelihood (ML) method

Explanatory Variables	ML estimates
Thai price (β)	0.392* (-6.518)
Constant	5.840
Trend	0.0009 (-1.752)

* indicates the level of significance and t-value is in the parenthesis

The error correction model was estimated in the equation 5 with two lags included in the model. The validation of the error correction model estimates were obtained by examining the Box-Pierce Portmanteau Q-statistics associated with the fitted residuals. The results are reported in Table 8. This suggests that the null hypothesis of no- autocorrelation or the white noise of residuals of the error correction model cannot be rejected. The most important finding in the model is statistical significance of the dis-equilibrium term. This suggests that the

Bangladesh rice price adjusts to correct the long run dis-equilibrium in the world market prices at the rate of 32 percent in every time period.

The result indicates that the Bangladesh rice price is not isolated from the world rice market but the reverse does not hold true. It was expected to integrate the domestic market to the world market after the structural adjustment and agricultural trade liberalization reform. It was concluded that from our discussion that domestic market were segmented from the world market prior the policy reforms. But the changes hold true that the domestic market and world market are integrated each other. Thus, if Bangladesh domestic market policies are design for altering rice prices at the domestic level without taking into account of the World market will not likely be effective.

Table 8: Results of the standard error correction model

independent variables and test statistics	$\Delta lnpd_t$
$\Delta lnpd_{t-1}$	0.0725 (0.746)
$\Delta lnpd_{t-2}$	0.147 (1.581)
$\Delta lnpw_{t-1}$	0.041 (0.466)
$\Delta lnpw_{t-2}$	-0.025 (-0.279)
c	0.002(0.510)
ECT_{t-1}	-0.320* (-4.393)
Q-statistics	
Q(3)	8.154
F-statistics	5.102

Notes: Numbers in parentheses are the t-values, * indicates the significance level, the Q-statistics denote Box-Pierce-Ljung Portmanteau test for autocorrelation; F-statistics measures the joint significance

The short run causality seems to be not significant between Bangladesh and Thai price meaning that there is no significant short run causation between the prices. The F-statistics shows the model overall fit and found to be significant.

V. Conclusion

The paper focuses on a time series estimation of the price relationship between the world and the domestic market for the main food import commodity rice. The objective of this paper was to estimate whether there is a price relationship between the domestic and international markets after the agricultural trade liberalization reform. Rice is a commodity that is subject to different levels of controversy in the policy level. Whether the country should focusing of self sufficiency or can continue on relying on the world market and this debate became more important especially after the world market price volatility at the end of 2007 and the beginning of 2008. The main result of this study is that there is a long run relationship between the prices and the relationship is unidirectional, meaning that world market price influences the prices at the domestic market but not vice-versa. The liberalization policy brought this relationship in effect. Global liberalization policy reduced the real world prices until 2006. This means that domestic consumers were benefitting if the domestic market was integrated with the world market but it was at the expense of domestic producers. Afterwards, there was a world price surge at the end of 2007 and the beginning of 2008. This obviously threatened the price stability thus, food security of the poor in a net importing country like Bangladesh. To some extent the price rise can be beneficial for the producers at the expense of the consumers, but benefit can be eroded as the country is a net importer and majority of the households (76.8 per cent) (Alberto *et al.,* 2008) are actually net consumers. Therefore, typically the concern arises whether a policy should be in place to protect the net consumers when their purchasing power is reduced. So, to maintain the food security (via price stability and food price risk management) of those who depend on the markets for their consumption should be carefully designed because the world market price is more volatile and influence domestic prices.

References

Alberto Zezza, Benjamin Davis, Carlo Azzarri, Katia Covarrubias, Luca Tasciotti and Gustavo Anriquez (2008). The Impact of Rising Food Prices on the Poor. ESA Working Paper No. 08-07, Agricultural Development Economics Division, FAO

Alexander, C. and J. Wyeth. (1994). Cointegration and Market Integration: An Application to the Indonesian Rice Market. *Journal of Development Studies*, 30: 303-328

Ardeni, P. G. (1989). Does the Law of One Price Really Hold for Commodity Prices? *American Journal of Agricultural Economics*, 71: 661-669

Asche, F., Shabbar Jaffry and Jessica H. (2007). Price Transmission and Market Integration: Vertical and Horizontal Price Linkages for Salmon. *Applied Economics*, 39: 2535-2545

Baffes, J. (1991). Some Further Evidence on the Law of One Price: The Law of One Price still holds. *American Journal of Agricultural Economics*, 73: 1264-1273

Baffes, J., and Bruce Gardner, (2003). The Transmission of World Commodity Prices to Domestic Markets under Policy Reforms in Developing Countries. *Policy Reform*, 6(3): 159-180

Baffes, J., and Mohammed Ihsan Ajwad (2001). Indentifying Price Linkages: A Review of the Literature and an Application to the World Market of Cotton. *Applied Economics,* 33: 1927-1941

Baghestani, H. and R. McNown (1992). Do Revenue and Expenditures Respond to Budgetary Disequilibria? *Southern Economic Journal*, 311-322

Baulch, B. (1997). Transfer Costs, Spatial Arbitrage, and testing for food market integration, *American Journal of Agricultural Economics,* 79: 512-34

David Dawe (2008). Can Indonesia Trust the World Rice Market? Bulletin of Indonesian Economic Studies, Vol. 44, No. 1 pp 115-132

Dawson P. J. and P. K. Dey (2002). Testing for the Law of One Price: Rice Market Integration in Bangladesh. *Journal of International Development 14:* 473–484

Dercon, S. (1995). On Market Integration and Liberalization: Method and Application to Ethiopia. *Journal of Development Studies*, 32: 112-143

Dickey, D., Fuller, W.A., (1979). Distribution of the Estimate for Autoregressive Time Series with a Unit Root. *Journal of American Statistical Association*, 74: 427–431

Dorosh, Paul A. (2009). Price Stabilization, International Trade and National Cereal Stocks: World Price Shocks and Policy Response in South Asia. *Food Security,* DOI 10.1007/s12571-009-0013-3

Dorosh, Paul, A. (2001). Trade Liberalization and national Food Security: Rice Trade Liberalization between Bangladesh and India. *World Development*, Vol. 29, No. 4 pp 673-689

Engle, R. F. and Granger, C. W. (1987). Cointegration and Error Correction: Representation, Estimation and Testing, *Econometrica,* 55, pp.251-276

Gardner, B. and Brooks, K. M., (1994). Food Prices and Market Integration in Russia: 1992-1993, *American Journal of Agricultural Economics,* 76: 641-46

Goletti F, Ahmed R, Farid N., (1995). Structural Determinants of Rice Market Integration: The Case of Rice Markets in Bangladesh. *The Developing Economies* 33: 185–202

Goletti, F. and S. Babu. (1994). Market Liberalization and Integration of Maize Markets in Malawi. *Journal of Agricultural Economics*, 11: 311-324

Goodwin Barry, K. and Daniel C. Harper (2000). Price Transmission, Threshold Behavior, and Asymmetric Adjustment in the U.S. Pork Sector. *Journal of Agricultural and Applied Economics,* 32 (3): 543-553

Jeffrey M. Wooldridge (2000). Introductory Econometrics-A Modern Approach. South-Western College Publishing, Michigan State University

Johansen, S., Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics,* 52: 160–210

Johnston J, NiDardo J. (1997). Econometric Methods. McGraw-Hill Companies Inc. New York

MacKinnon, James G. (1996). "Numerical Distribution Functions for Unit Root and Cointegration Tests," *Journal of Applied Econometrics*, 11, 601-618

McCulloch, Neil (2008). Rice Prices and Poverty in Indonesia. *Bulletin of Indonesian Economic Studies,* Vol. 44, No. 1 pp 45-63

Miljkovic Dragan, (2009). US and Canadian Livestock Prices: Market Integration and Trade Dependence. *Applied Economics,* 41: 183-193

Mohanty, S., E. Wesley F. Peterson and Darnell B. Smith (1996). Relationship Betwween U.S. and Canadian Wheat Prices: Co-integration and Error Correction Approach, *Canadian Journal of Agricultural Economics,* 44: 265-276

Navin, Y., Munisamy Gopinath and Ashok Gulatia (2006). Post-Uruguay Round Price Linkages between Developed and Developing Countries: the Case of Rice and Wheat Markets. *Agricultural Economics,* 34: 259-272

Newey, Whitney and Kenneth West (1994). "Automatic Lag Selection in Covariance Matrix Estimation," *Review of Economic Studies*, 61, 631-653

Palaska, T. B. (1995). Statistical Analysis of Price Transmission in the European Union. *Journal of Agricultural Economics,* 46: 60-69

Peter War (2008). The Transmission of Import Prices to Domestic Prices: An Application to Indonesia, Applied Economics Letter, 15(7):499

Philips, P.C.B., Perron, P. (1998). Testing for Unit Root in Time Series Regression. *Biometrika*, 65: 335–346

Prakash, A. (1998). The Transmission of Signals in a Decentralized Commodity Marketing System: The Case of the UK Pork Market. Unpublished PhD thesis, University of London

Ravallion, M. (1986). Testing Market Integration. *American Journal of Agricultural Economics*, 68: 102-109

Samualson, P. (1952) Spatial Price Equilibrium and Linear Programming, *American Economics Review,* 42:283-303

Takamaya, T. and Jugde, G. (1964). Spatial Equilibrium and Quadratic Programming, *Journal of Farm Economics,* 46: 67-93

Taylor, E. L., Bessler, D. A., Waller, M. L., Rister, M. E., (1996). Dynamic Relationships between US and Thai Rice Prices. *Agricultural Economics,* 14: 123–133

Von Cramon-Taubadel, S. (1999). Estimating Asymmetric Price Response with the Error Correction Representation: an Application to the German Pork Market. *European Review of Agricultural Economics,* 25:1-18