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Price Transmission Dynamics in the Rice Market of Bangladesh

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Abstract

The principal objective of this paper is to investigate the price transmission mechanism of commodity 'rice' between Bangladesh and her major import destination country, India due to its importance in ensuring food security in Bangladesh. So, an in-depth study about the degree of market integration and price transmission mechanism in the domestic rice market is essential for the policy makers, rice producers and other rice value chain role players since it affects their decisions which in turn influence their profitability and determine the overall supply in the rice market of Bangladesh. To address the mentioned issue, this study engages both Johansen & Juselius (1990) cointegration technique and innovation accounting approach to critically examine the price transmission process of rice price from Indian market to Bangladeshi market covering the time period from July, 1998 to May, 2015. This paper finds that the price shock in Indian rice market induces price change in the Bangladeshi rice market both in short run and long run. The findings strongly suggest to consider the impact of external forces in stabilizing the domestic rice price of Bangladesh along with the role of existing internal factors.

Keywords: Rice market, price transmission, agriculture in international trade, economic integration, time-series models.

JEL classification: C32, F15, F42, O13, Q17

Introduction

Rice in Bangladesh represents important roles in domestic consumption, international demand, and GDP contribution from production. Rice prices in Bangladesh are not only determined by market system but also by government intervention through implementation

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of rice price policy. Generally, analysis of price transmission measures the effect of prices in one market on prices in another market. Price transmission from global to domestic market gives us an opportunity to comprehend the degree of the economic integration into the market process. This transmission is more observable in case of considering the diffusion of price in a developing country from the country it imports most.

A competitive pricing behavior concept delineates the idea of price transmission. The classical notion of the law of one price and various price determination models hypothesize that the price transmission is resulted in equilibrium price of a commodity sold on competitive foreign and domestic markets varying only by transportation cost, when converted to domestic currency. But the ideal state of one price notion described by the classical school of thought may deviate as we see in the reality due the distortion of commodity market through different intervening tools. The time necessary to transmit the price from exporting country to importing country differs depending on various factors between the two trading countries.

Price transmission mechanism is very important to achieve efficient outcome on which economic welfare depends. Various policies related trade and other issues, illegal trade, transaction cost arising from poor transportation facility e.t.c. can play role to reduce price information to economic agents and accrues inefficient outcome by product.

A very common argument among economists and policymakers is that market relaxation augments economic growth whereas intervention policies restrain it (Onafowara and Owoye, 1998). Agricultural trade needs to be integrated into the international market for ensuring realization of gains from liberalization by producers and consumers. Farmers cannot specialize according to the long-term competitive advantage unless they receive the correct price signals. Consequently, realization of potential gains from trade will be hampered (Ravallion, 1986). Many developing countries have taken various market oriented initiatives to make their agricultural sector liberalized in recent years so that their farmers can reap the maximum opportunity of market liberalization. Bangladesh is not different from those countries. Rice market of Bangladesh is very important for the inhabitants of the country. This market experienced mentionable liberalization during late 1980s and early 1990s.

Market liberalization cannot avoid the market integration in present period. So market integration can be considered as mandatory for bringing market liberalization in developing countries. “Without spatial integration of markets, price signals will not be transmitted from urban food deficit to rural food surplus areas, prices will be more volatile, agricultural producers will fail to specialize according to long term comparative advantage and gains from trade will not be realized” (Baulch, 1997).

The role of market liberalization in enhancing integration of spatial market is a fundamental idea preoccupying many researchers (Silumbu for Malawi, 1991; Goletti and Babu for Malawi, 1994; Barrett for developing countries, 1996, 2001; Hossain and Verbeke for Bangladesh, 2010; Dercon for Ethiopia, 1995). Spatial market integration is very influencing

on the smoothness of price transmission. Looking into the market integration can be a passive approach to examine the market efficiency (Hopcraft, 1987). The spatial and inter-temporal market integrations of maize market in Malawi was tested by Silumbu (1991) using monthly whole sale price where slight increment of urban market integration was found even under partial liberalization. Ghafoor and Aslam (2012) explored spatial market integration among major rice markets in Pakistan and price transmission from two international rice markets viz. USA and Thailand using Johansen's Co-integration approach and Error Correction Mechanism for the period January 2000 to December 2009. The analysis showed integration and price transmission in rice markets of Pakistan which implies that it is easier to disseminate policy impact through the rice marketing chain in Pakistan.

Huda (2014) analyzed the effect of global commodity market factors and domestic exchange rate development on domestic food price from Bangladesh perspective. Author used bi-variants co-integration approach for the analysis of shock transmission and eventually an error correction model was developed. The study found that only 46 per cent of the total world shock pass-through in domestic economy. Baltzer (2013) analyzed the evidence on price transmission from international maize, rice and wheat markets to domestic markets in fourteen developing countries for the global food crisis taken place in 2007-08. Author found great variation in the price transmission pattern: almost no price pass-through in China and India, close relationship between international and domestic prices in Brazil and South Africa, substantial domestic price overshooting in Ethiopia and Nigeria. The study concluded that price stabilization policies, public policy failure, incomplete market integration, and coinciding domestic shocks could explain much of this variation.

Hossain and Verbeke (2010) investigate the nature and extent of market integration from the divisional perspective using weekly market price data for the period 2004-2006. A co-integration analysis is carried out by Dorosh and Rashid (2012) between the monthly import parity prices of below-poverty-line rice and national average wholesale prices of coarse rice in Bangladesh covering the period July 1997 to March 2011. The analysis concludes with the long run relationship between the monthly import parity prices of below-poverty-line rice and national average wholesale prices of coarse rice in Bangladesh.

Akhter (2016) analyzed spatial market integration between an adjacent rice surplus market (India) and deficit markets (Bangladesh and Nepal) through Applying the maximum-likelihood method of co-integration over January 1999 to May 2013 sample period. The main focus is on the government policies of these three rice-producing countries which have been imposed to reduce domestic price volatilities in rice markets during the recent 'global food crisis' in 2007–2008. The co-integration tests found that domestic rice prices of India, Bangladesh and Nepal are integrated both in short-run and long-run periods despite the imposition of export restriction policies by India. The reason that prices are transmitted so effectively is most likely to be the widespread informal cross-border trade through the porous borders among India, Bangladesh and Nepal.

However, our study differs from Hossain and Verbeke (2010) and Akhter (2016) by

extending to cross border rice price transmission with wider sample period and from Dorosh and Rashid (2012) by extending the co-integration analysis between rice price of India and Bangladesh to the examination of long run relationship behavior in response to price shocks through impulse response. Thus, this paper concentrates on the techniques of time series analysis to investigate the price transmission of rice between Bangladesh and her major import destination, India.

The remaining of this paper is organized as follows. Section 2 describes recent development of rice trade in Bangladesh and India. Section 3 conducts the data and model specification. Section 4 provides estimation of price transmission dynamics in rice market of Bangladesh. The last section, Section 5, provides the conclusion along with policy prescription.

Brief overview of the rice markets in Bangladesh and India

Rice is the staple food of about 155.8 million people of Bangladesh. It provides nearly 48% of rural employment, about two-third of total calorie supply and about one-half of the total protein intake of an average person in the country. Rice sector contributes one-half of the agricultural GDP and one-sixth of the national income in Bangladesh. Almost all of the 13 million farm families of the country grow rice. Rice is grown on about 10.5 million hectares which has remained almost stable over the past three decades. About 75% of the total cropped area and over 80% of the total irrigated area is planted to rice. Thus, rice plays a vital role in the livelihood of the people of Bangladesh.

Total rice production in Bangladesh was about 9.61 million metric tons in the year 1971 when the country's population was only about 70.88 millions. However, the country has produced about 34.71 million metric tons to feed her 155.8 million people in FY15. This indicates that the growth of rice production was much faster than the growth of population. This increased rice production has been possible largely due to the adoption of modern rice varieties on around 66% of the rice land which contributes to about 73% of the country's total rice production.

Rice is the most important cereal food crop of India, which occupies about 24 percent of gross cropped area of the country. It contributes 42 per cent of total food grain production and 45 per cent of total cereal production of the country. Rice production in India has increased during last 60 years by about 3.5 times from 22.71 million metric tons during the first 5-yr plan period to 77.77 million metric tons during the tenth plan period. The average productivity of rice in India, at present, is 2.2 tons/hector, which is far below the global average of 2.7 tons/hector.

India is the largest rice exporting country in the world. Being the neighboring country of Bangladesh, India is a suitable destination of rice import for Bangladesh. Variety of transportation facility and low transportation cost are the main factors playing important role behind high rice trade relationship between the countries. As a result, the lion's share of Bangladesh's rice import comes from India. The Figure 1 (annex) shows the share of India in the total rice import of Bangladesh from the period of 2001-2015. Calendar year is

considered for the period 2001-2011 when fiscal year is considered for the period of 2012-2015 due to the rigidity on data availability. In 2001, about 50 percent of imported rice of Bangladesh came from India. In the period of 2002 to 2008, on average, about 88 percent of rice import was done from India by Bangladesh. The rice import of Bangladesh from India dropped significantly in the period 2009 to 2011 due to the Indian restriction on rice export. Following 2011, India again became important destination of rice for Bangladesh. In the fiscal year 2015, about 99 percent of Bangladesh's imported rice came from India. So there is huge scope of Indian rice price transmission into Bangladeshi rice price. The Figure 2 (annex) portrays the dynamics of Indian rice price and Bangladeshi rice price for the period of 1998-2015 on monthly basis. The overall movement of two rice prices adumbrates a conspicuous co-movement of the prices. Though the prices were away from each other in few years of the stated period, the movement of each Bangladeshi rice price followed the trajectory of Indian rice price. In rest of the years, the rice price of Bangladesh not only followed the movement of the Indian rice price but also moved very closely. The plotted relationship between Indian rice price and Bangladeshi rice price indicates close relationship between the prices.

Moreover, the domestic demand for rice in Bangladesh consists of the domestic production and import only as Bangladesh export very little amount of rice sporadically. The data from Food Production Monitoring Unit shows that rice import of Bangladesh varied from about 0.03 million metric ton to 1.56 million metric ton during FY10 to FY15. So the physical amount of the imported rice looks large enough to have the ability to affect the rice price in Bangladesh. The lion's share of the imported rice in Bangladesh comes from India and consequently Indian rice price is likely to affect the rice price in Bangladesh. In addition, India is the leading rice exporting country of the world, so rice price in India affects the world rice price. As a result, price of imported rice by Bangladesh from the countries other India is also likely to be guided by the Indian rice price. Lastly, geographical position of Bangladesh compare to India makes the whole Bangladesh economy sensitive to Indian economy and rice market of Bangladesh is not free of that fact either. Especially informal trade in the border area facilitates to transmit the Indian product price into Bangladesh (Akhter, 2016). Under the stated circumstances, we can easily expect that Indian rice price can affect Bangladeshi rice price which we are testing empirically in our paper.

The data and model specification

The monthly average of wholesale price of Bangladeshi and Indian rice was collected from Food and Agricultural Organization (FAO). The data period covers July 1998 to May 2015 and the price series are measured in dollar/kg. To avoid the seasonality problem, price series have been seasonally adjusted.

Generally time series data are characterized with unit root processes. To get the order of integration of price series, the individual price series are tested whether they are integrated in level or difference forms. The Augmented Dickey-Fuller (ADF) test is frequently used in this regard (Dickey and Fuller, 1979, 1981). In 1988, Phillips and Perron (PP) proposed

a modification of the Dickey-Fuller (DF) test and have developed a comprehensive theory of unit roots. A t-statistic on the unit-root coefficient has been introduced by PP in a DF regression, adjusted for autocorrelation and heteroskedasticity. Monte Carlo simulation shows that the power of the various DF tests can be very low (Enders, 2010). Maddala and Kim (1998) comment that the DF test does not have serious size distortions, but it is less powerful than the PP test. According to Choi and Chung (1995) PP test appears to be more powerful than the ADF test in case of low frequency data. Therefore, we adopt the PP methodology to test unit roots in the price series. If the price series are found to be stationary at same order of integration subsequently testing them for cointegration will be followed as per the Johansen approach, due to Johansen (1988), and Johansen and Juselius (1990). If the series are really cointegrated, the number of the cointegrating relation must be less than two in case of two variables (price series). If both the trace and maximum eigenvalue tests recommend the presence of one cointegrating relationship, the long-term relationship exists between the price series. Then estimating them in a vector error correction model (VECM) will be required.

The model is:

$$X_t = \beta_o + \beta_1 X_{t-1} + \ldots\ldots + \beta_p X_{t-p} + \nu_t \qquad (1)$$

Where p = lag length; X_t = the (n×1) vector of endogenous variables; β's are matrices of unknown parameters; and ν_t is an independently and identically distributed n- dimensional vector with zero mean and variance matrix ∑t. The VAR model in equation (1) written in error correction form is;

$$\Delta Xt = \Upsilon_o + \sum_{p-1}^{j=1} \gamma_j \Delta X_{t-1} + \pi X_{t-p} + \nu_t \qquad (2)$$

Where $\Upsilon_o = \beta_o$;

$\Upsilon_j = -(I - \sum_{p-1}^{j=1} \beta_j)$; j=1,2.....,p-1

$\pi = -(I - \sum_{i=1}^{p} \beta_i)$

and ΔX_{t-j} is an (n×1) vector of X_{t-j} in first differences, and π as well as Υ_j (j = 1, 2,……, k) are n by n matrices of parameters and Vt is an n-vector of residuals which are assumed to be normally distributed with mean zero and have a contemporaneous covariance matrix ∑t. The long-run information in Xt is summarized by the long-run impact matrix Υ. π (Defined by r) is the rank of the matrix of the VECM that determines the number of independent co-integrating vectors. If the matrix π has a rank, r, greater than 0, then co-integration exists. If the rank of π is 0, then the variables have no long relationship and the model translates into a standard VAR model in differences.

Estimation

Table 1 (annex) represents the results of the Phillips-Perron (1988) unit root tests for Bangladeshi and Indian rice prices. Both the price series exhibit unit roots at their level form but they become stationary at their first difference. So the order of the integration is I (1) that results allow to proceed for cointegration tests for checking the long run equilibrium relationship.

The main task in this step is to determine the rank of π, for this reason cointegration is tested using Johansen›s maximum likelihood procedure using two test statistics, namely the trace test (λtrace) and maximum eigenvalue (λmax). Before going to perform the cointegration test, it is prerequisite to determine optimal lag length for the model. In practice, the SBC will select a more parsimonious model than will either the AIC or t-tests. However, researcher has to ensure that residual act as white noise processes (Enders, 2010). To ensure the robustness of model, we take optimal lag 12 by the iterative process. The trace test (λtrace) and maximum eigenvalue (λmax) results are represented in Table 2 (annex). The test results indicate that Bangladeshi and Indian rice prices were cointegrated with one cointegrating vector and this cointegrating rank gives the number of stationary linear combinations of the price series. This result is consistent with the identification of one linear combination of prices (as it is a bi-variate case) that delineates stability over the time periods. Thus the rice markets in Bangladesh and India during the sample periods are linked together and that therefore, the long run equilibrium exists.

It is not only sufficient to know that markets are integrated but also essential to know the extent to which markets are integrated. This obliges distinction between the short and long-run dynamics of price changes deriving from one market to another. For this reason, we estimate vector error correction model (VECM) to see the dynamic adjustments of price series between markets.

The normalized cointegrating coefficients can be used to see the long-run cointegration of price series. The Johansen (1988) cointegration test has been used to estimate the cointegrating coefficients. The result is as follows:

BDRP = 0.092 + 0.708 INDRP

Where, BDRP indicates Bangladesh rice wholesale price and INDRP is India rice wholesale price. The estimated coefficient shows that the Indian rice price has positive impact on the Bangladeshi rice price and the coefficient is statistically significant at the 1 percent level.

In the short-run dynamics, the error correction term (Table 3) on the regression with first difference Bangladesh rice price is significant at the 1 percent level, addressing the adjustment behaviour of Bangladesh rice price market if by any means the long-run equilibrium relationship is stunned. The estimated error correction term of BDRP is - 0.1235 which means that almost 8 months need to bring the system into the steady state once it is disturbed. However, the INDRP coefficient is positive but not statistically significant, suggesting that in short-run Indian rice price is weakly exogenous in the relationship of the

model. Hence, though there is a long-run relationship prevail between BDRP and INDRP, it is only BDRP adjusts to bring the disequilibrium into equilibrium once the system is shocked.

Based on the estimated result of VECM, We derived impulse response functions (IRFs). To derive the impulse response functions, we used generalized impulse response analysis as it does not require orthogonalization of shocks and is invariant to the ordering of variables in the VAR. Figure 3 (annex) shows the impulse response of Bangladesh rice price. The response of Bangladesh rice price due to one standard deviation innovation in Indian rice price appears to be positive and very strong.

Conclusion and Policy Prescription

This study engages both Johansen and Juselius (1990) cointegration technique and innovation accounting approach to critically examine the price transmission process of rice price from Indian market to Bangladeshi market covering the time period from July, 1998 to May, 2015. It finds a long-run and short-run relationship between the rice price of Bangladesh and India (the result is consistent with Akhter, 2016). With the advent of Globalization, commodity price of giant exporters is going to influence the importing country's price of same commodity. Hence, Bangladesh corrects the disequilibrium in price justifying the norm of Indian leadership in rice market. Here both countries' prices affect each other. Own price shock also affect themselves. But the rice price shock of India is more sustainable to both herself and Bangladesh comparing with the rice price shock in Bangladesh. So this outcome of the study ensures that shock originating from outside of Bangladesh can affect the rice price of Bangladesh besides the domestic factors like input price, fuel price, natural calamities etc. From this token, the upshot of the study suggests that global market conditions need to be continually monitored. In addition to this, our internal policy formulation needs to be in a way where the economic condition of the trading partners is considered. Devising such type of policy needs to be continued till the reduction of domestic price sensitivity of rice to the rice price of international trading partners.

Annex

Table1. Results of Unit Root Tests

Variables	In levels		In first difference		
	Model A	Model B	Model A	Model B	Order of Integration
Bangladesh Rice Price	-1.965 (0.30)	-2.813 (0.19)	-11.613 (0.00)	-11.591 (0.00)	I(1)
India Rice Price	-0.795 (0.82)	-1.805 (0.70)	-12.516 (0.00)	-12.486 (0.00)	I(1)

Note: Model A includes intercept, and Model B includes both intercept and trend. The null hypothesis states that the variable has a unit root. P-values are shown in the parentheses following each adjusted t-statistic.

Table 2. Johansen-Juselius cointegration Tests

λ_{trace} test				λ_{max} test			
Null	Alternative	λ_{trace}	Prob	Null	Alternative	λ_{max}	Prob
r=0*	r>0	16.54005	0.0347	r = 0*	r = 1	15.59399	0.0306
r ≤ 1	r > 1	0.946057	0.3307	r = 1	r = 2	0.946057	0.3306

Note: The λtrace and λmax are calculated as per Johansen (1988) and Johansen and Juselius (1990). P-values are calculated as per MacKinnon et al. (1999). r stands for the rank of the matrix, which denotes the number of the conintegrating equation between the variables. Trace and Max-eigenvalue tests indicate 1 cointegration equation at 0.05 level.* Denotes rejection of the hypothesis at the 0.05 level.

Table 3. Estimation result of VECM

Regressors	D(BDRP)	D(INDRP)
ecm (t-1)	-0.123523*** (0.03607)	0.029700 (0.03098)
D(BDRP(-1))	0.172972 (0.07307)	0.030972 (0.06277)
D(BDRP(-2))	-0.020886 (0.07345)	0.043805 (0.06309)
D(BDRP(-3))	0.248916 (0.07346)	-0.026576 (0.06310)
D(BDRP(-4))	0.057093 (0.07575)	0.058706 (0.06507)
D(BDRP(-5))	0.239188 (0.7517)	-0.026573 (0.06457)
D(BDRP(-6))	-0.047218 (0.07758)	-0.056305 (0.06664)
D(BDRP(-7))	0.138554 (0.07690)	-0.057320 (0.06606)
D(BDRP(-8))	-0.056235 (0.7743)	-0.051907 (0.06652)
D(BDRP(-9))	0.148326 (0.07734)	-0.118654 (0.06643)

D(BDRP(-10))	0.103718 (0.07786)	-0.015559 (0.06688)
D(BDRP(-11))	0.037501 (0.07791)	0.045315 (0.06692)
D(BDRP(-12))	-0.152415 (0.07631)	0.015781 (0.06655)
D(INDRP(-1))	0.224367 (0.09219)	0.098343 (0.07919)
D(INDRP(-2))	0.017349 (0.09253)	-0.174886 (0.07948)
D(INDRP(-3))	0.102711 (0.09404)	0.047504 (0.08078)
D(INDRP(-4))	-0.037759 (0.09401)	0.078921 (0.08076)
D(INDRP(-5))	-0.039688 (0.09471)	0.142014 (0.08135)
D(INDRP(-6))	0.039357 (0.09581)	0.107220 (0.08230)
D(INDRP(-7))	0.004499 (0.09572)	0.011220 (0.08222)
D(INDRP(-8))	0.024952 (0.09542)	0.013051 (0.08196)
D(INDRP(-9))	0.068542 (0.09546)	-0.056782 (0.08200)
D(INDRP(-10))	-0.012433 (0.09588)	0.029232 (0.08236)
D(INDRP(-11))	-0.035161 (0.09353)	-0.088078 (0.08035)
D(INDRP(-12))	-0.196712 (0.09411)	0.008475 (0.08084)
C	-0.000194 (0.00093)	0.00595 (0.00080)
R^2	0.34	0.13

Cointegrating equation: ect (t) = DBRP(-1) - 0.708*** INDRP(-1) - 0.092
(0.07702)

Note:*** refer that coefficients are significant at the 1 percent level.

Values in parentheses against each coefficient indicate standard errors.

“D” stands for first-order difference operator.

“ect” stands for error correction term and “ecm” is error correction model.

Figure 1: Share of India in the total rice import of Bangladesh (2001- 2011 and FY2012-FY2015)

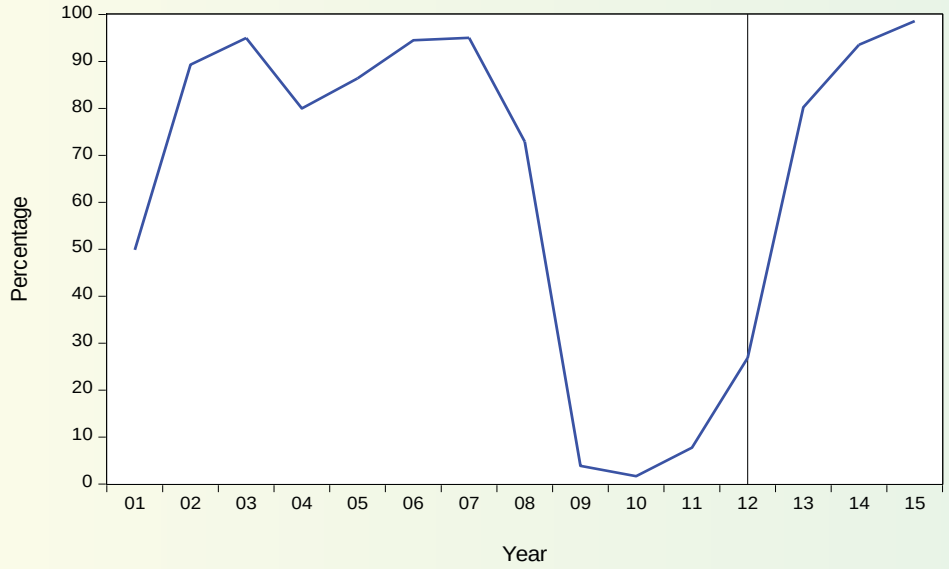


Figure 2: Bangladeshi rice price and Indian rice price: overtime movement

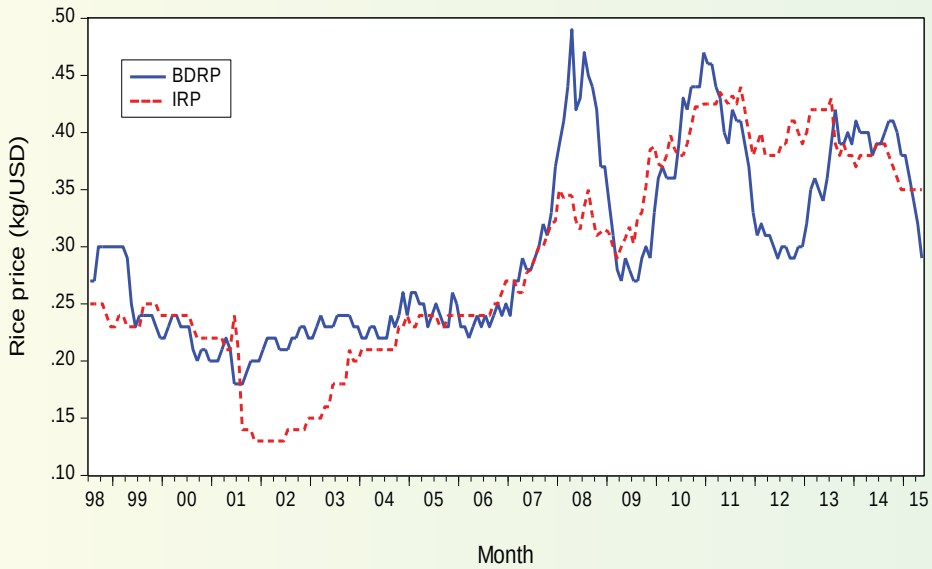
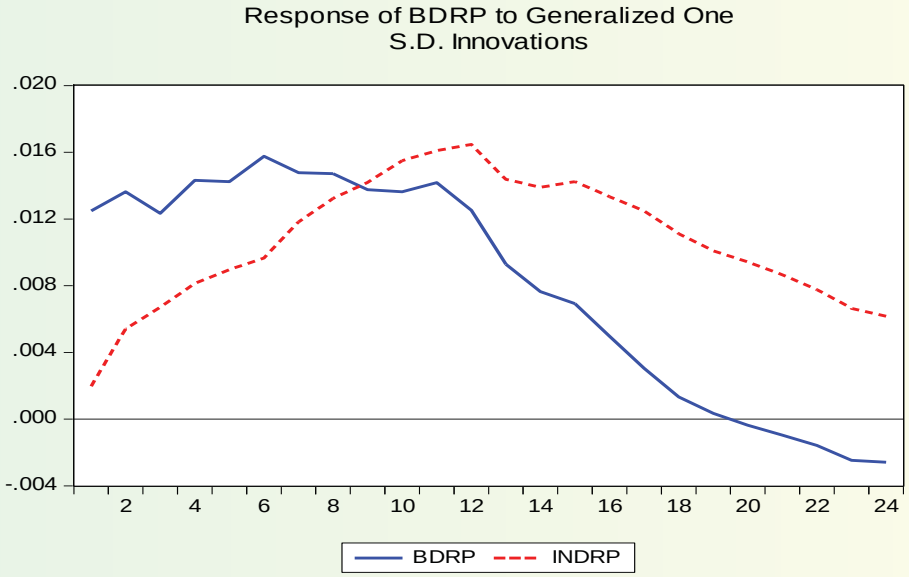


Figure. 3: Generalized Impulse response of Bangladesh rice wholesale price



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