Nature of relations between various food prices:
Insights from secondary data

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1. Introduction

This note is an introductory chapter to a study on how people, living in the urban areas, are coping with the high prices of essential foods. As the recent price hike was the main reason for us to study this issue, our first job was to understand the price dynamics clearly. This particular brief is dedicated to this query.

Basic economics inform us of time and space contingent commodities. With that perspective, food prices are considered over time, and distinctions are made between wholesale and retail prices, as well as between international and domestic wholesale prices. These various prices/price movements can be interrelated in many ways. Graphical analysis was employed to get a general idea of their movements and to search for the interrelation among the commodities. In addition, econometric analysis using cointegration techniques often used to analyze spatial price integration, was done to understand the scenario more rigorously.

2. Methodology

2.1 Data source

There are weekly time series data on retail and wholesale prices of 84 food items for the period between January 2004 and January 2008. These were collected from the Department of Agricultural Marketing (DAM), GOB.

Monthly data were obtained on consumer price index (CPI) for general, food and nonfood categories, in terms of national, rural and urban for the period between January 2004 and December 2007. These data were collected from Bangladesh Bureau of Statistics (BBS), GOB.

In addition, monthly data on international rice prices were obtained from Osiriz/InfoArroz (collected from FAO) for the period between January 2004 and February 2008.

Data on monthly foreign exchange rates were collected from different issues of the Economic Trends published by Bangladesh Bank which were used to convert Dollar prices into local currency (Taka).

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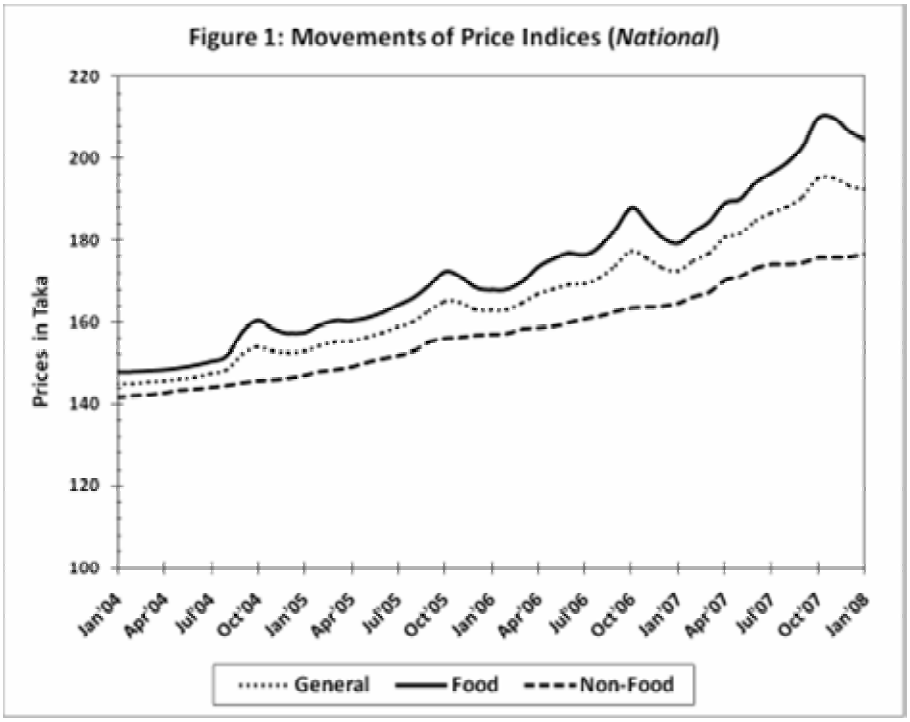
2.2 Data compilation

- The weekly price series data were converted to monthly by taking simple mean of average wholesale and retail prices. It was done for the convenience of comparing the food prices with the monthly CPI data.
- A bundle of essential food items were chosen for the work. Importance of individual food items included in this bundle was cross-checked with Household Income Expenditure Survey (HIES) data in terms of their relative importance in food expenditure. A simple average of the (nominal) prices of all the items was taken to construct a proxy price for essential foods.
- The data on international rice prices in US Dollar per ton were converted to prices in Taka per KG by simply multiplying the prices with foreign exchange rates for the corresponding months and dividing the latter by 1000.

3. Price movements of selected commodities – graphical analysis

It is very important to account for relative shares of food index and nonfood price index on general index. Among essential food items, there are commodities which move up and down rapidly and clearly show their greater weights in the food price index. So we did our graph analysis to have general idea on movements of different commodities and their interrelation.



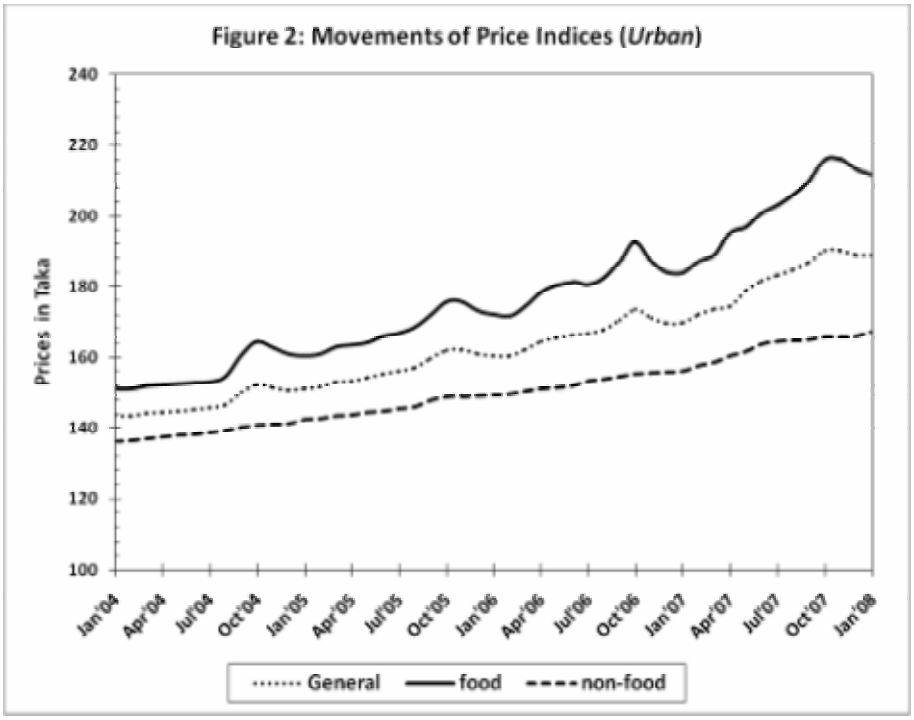


Figure 2: Movements of Price Indices (*Urban*)
Prices in Taka
240
220
200
180
160
140
120
100
Jan'04
Apr'04
Jul'04
Oct'04
Jan'05
Apr'05
Jul'05
Oct'05
Jan'06
Apr'06
Jul'06
Oct'06
Jan'07
Apr'07
Jul'07
Oct'07
Jan'08
General
food
non-food

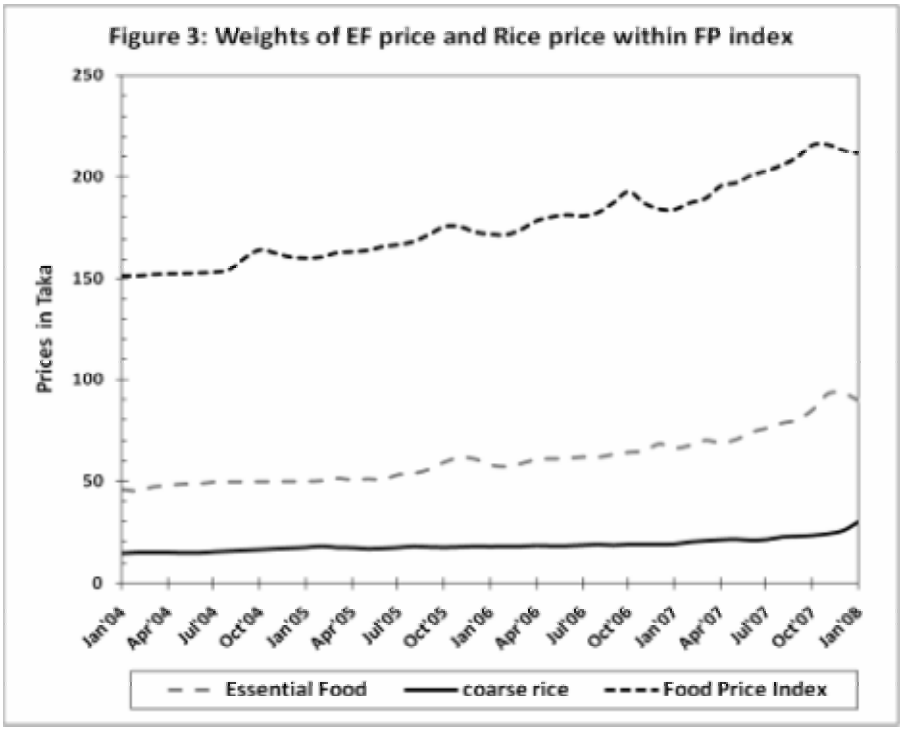
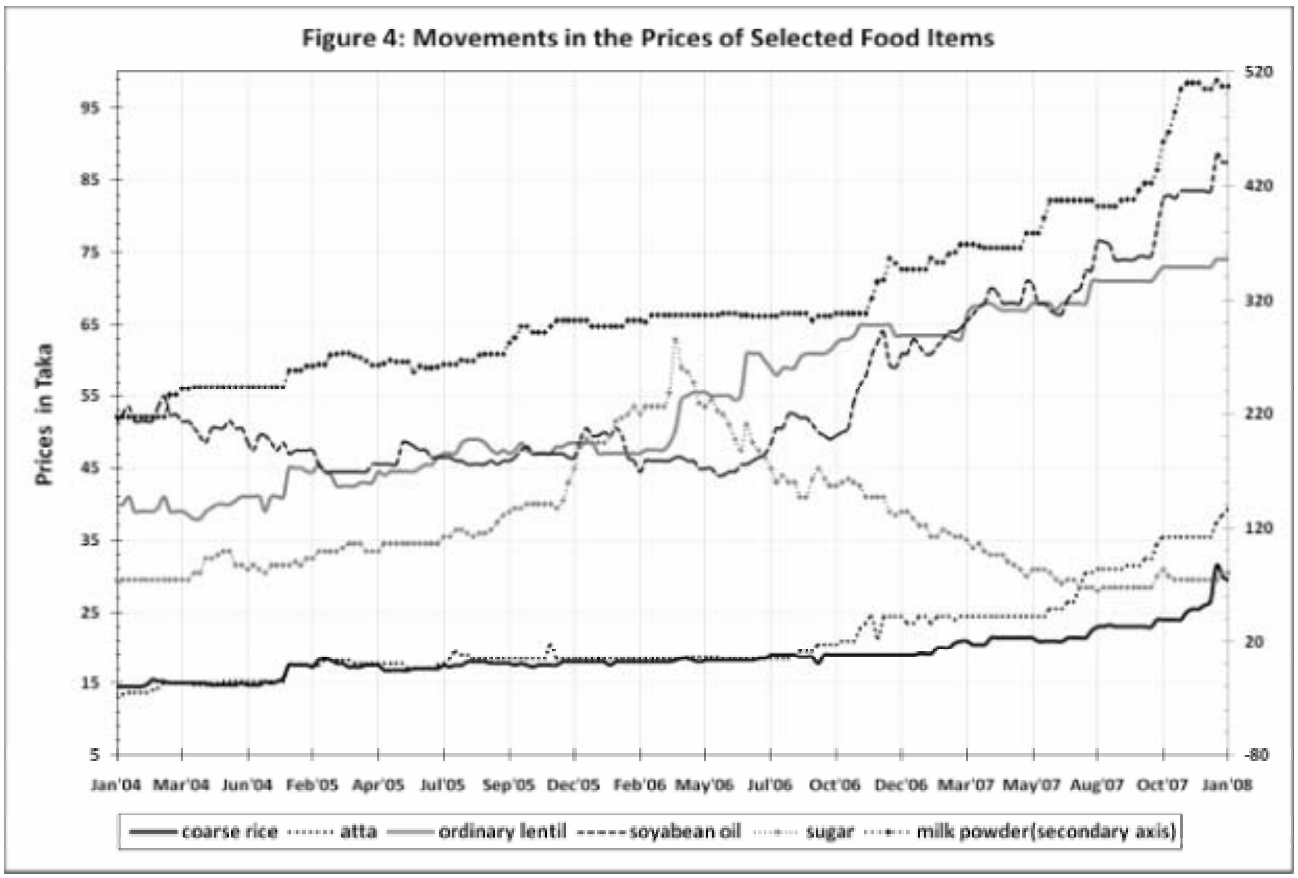


Figure 3: Weights of EF price and Rice price within FP index
Prices in Taka
250
200
150
100
50
0
Jan'04
Apr'04
Jul'04
Oct'04
Jan'05
Apr'05
Jul'05
Oct'05
Jan'06
Apr'06
Jul'06
Oct'06
Jan'07
Apr'07
Jul'07
Oct'07
Jan'08
Essential Food
coarse rice
Food Price Index



3.1 Summary observations on movements in domestic prices

The similar movement of general price index and food price index in national level and in urban areas indicates the higher weight of food in the construction of general price index compared to the nonfood price index (Figures 1 and 2). Especially in the urban area, Food price index and the constructed average price of essential foods are found to move together reflecting the high weight of essential food items in the food price index (Figure 3).

It is possible to get a clearer view after observing the individual movement of the commodities of essential food bundle. Firstly, the movement of the price of the coarse rice did not show any notable increasing trend till the beginning period of 2007. But from the starting of 2007, it started to move upward persistently. Even we have seen a jump of its price at the end of 2007 and in early 2008 (Figure 4). The level and direction of movements of the price of atta has been found almost same as in coarse rice but from July 2006, the price of *atta* started to surpass the price of coarse rice. From October 2006, it started to increase at a higher rate (Figure 4).

Among the essential food items, the retail average price of milk powder is showing very high rate of increase. From November 2006, it started to jump upward at a faster rate. On the other hand, the average price of soyabean oil was moving inconsistently up

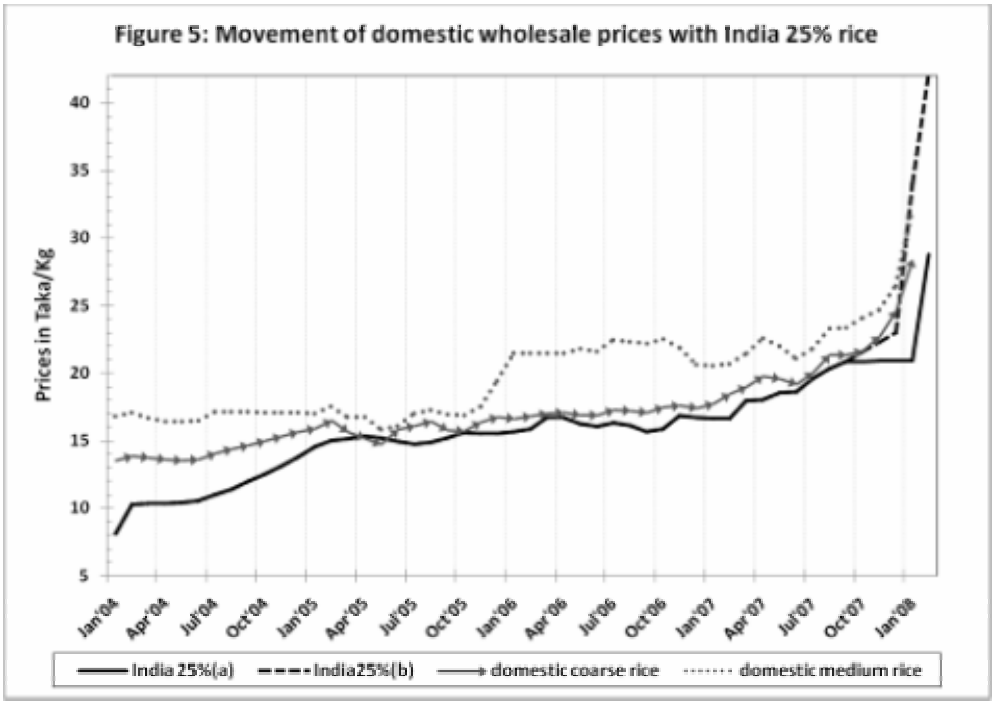
and down till the last half of 2006. Since then it started to increase persistently at a higher rate.

The average retail price of lentil (ordinary) was moving upward with reasonable fluctuation. On April 2006, the price of lentil registered a significant increase. With that jump it started to increase persistently at a faster rate. The price of sugar was at its peak on April 2006. Then it was consistently decreasing until August 2007. From October 2007, it was showing a slight rising movement.

3.2 Summary on movements in domestic and international rice prices

The main interest for this part of the analysis was to assess how the domestic wholesale prices of coarse and medium rice are related with the import prices (FOB) of rice. That is, whether there is any inconsistent movements or the domestic prices always follow the international prices. The focal part was to check the relationship with Indian export prices. So, our domestic rice prices were plotted against India 25 percent broken rice (Figure 5).

Interestingly, while conducting the assessment, another data on India 25 percent broken rice were available beside our FOB data set, which were showing different prices for the last few months (Sep'07 to Feb'08) of the series. These data were also claimed to be collected from FAO. The broken line in the plot (India25%-b, in Figure 5), represents that segment.



Before September'07, the prices of coarse rice and India25 percent broken rice were moving consistently upward moderately while maintaining a reasonable difference between them. From September'07, if we consider the line *India25% (a)*, prices of India 25 percent broken rice were stable till mid January'08 and then it showed a big jump

upward. But for the same period if we consider the line *India25% (b)*, completely a different relation can be seen. In this case the jump in the price started from September'07 and reached at a very high price (above Tk.40 per Kg) in February'08.The last case explains the jumps in the domestic rice prices in October'07 and at the end of December'07 more strongly.

3.3 Movements in wholesale and retail price difference for selected commodities

The price difference between the retail and wholesale price vary from month to month. To show this monthly variation and to compare the recent price regime with its preceding years, yearly average wholesale-retail margins were plotted. The average of absolute and relative price differentials for three years (from 2004 to 2006) and for one-year (from February 2007 to January 2008) were plotted separately for each selected commodity[1].

Generally, the relative margin (in % terms) declines when the price level of wholesale market increases. This general view can be applied to all the graphs. Another common feature of these graphs is that the relative margin has been lower for the period of Feb'07 to Jan'08, compared to the earlier period studied.

For example in the case of coarse rice (Figure A1 in the Annex), the average wholesale-retail margins for Jan'04 to Dec'06 shows that usually during the slack periods both absolute and relative margins remain higher. On the other hand during post-harvest periods they remain comparatively lower. But this relationship did not hold for the period Feb'07 to Jan'08, as both absolute and relative margins grew higher during the months of December and January. Late harvesting and crop loss due to natural disasters could possibly explain such deviations.

3.4 Movements of wholesale-retail margin with wholesale prices

Generally, during the slack seasons, the wholesale-retail margin (i.e., retail minus wholesale prices) becomes lower as the wholesale price stay higher in that period. But during harvest season, margin becomes higher as the wholesale prices stay lower.

In last four years, the wholesale-retail margin for coarse rice (figure 6) was at its highest position between the period of March'05 and May'05 which, in absolute term, amounted to more than Tk.2 per kg. But from July'06, both the amplitude (vertical distance between trough and peak) and the phase (horizontal distance between trough and peak) were decreasing. Though from Feb'07 the amplitude and the phase have been found to be increasing, it maintained an average margin of Tk.1.6 per Kg.

[1] The graphs of the wholesale-retail margin are available in the annex.(Figure A1 to Figure A6)

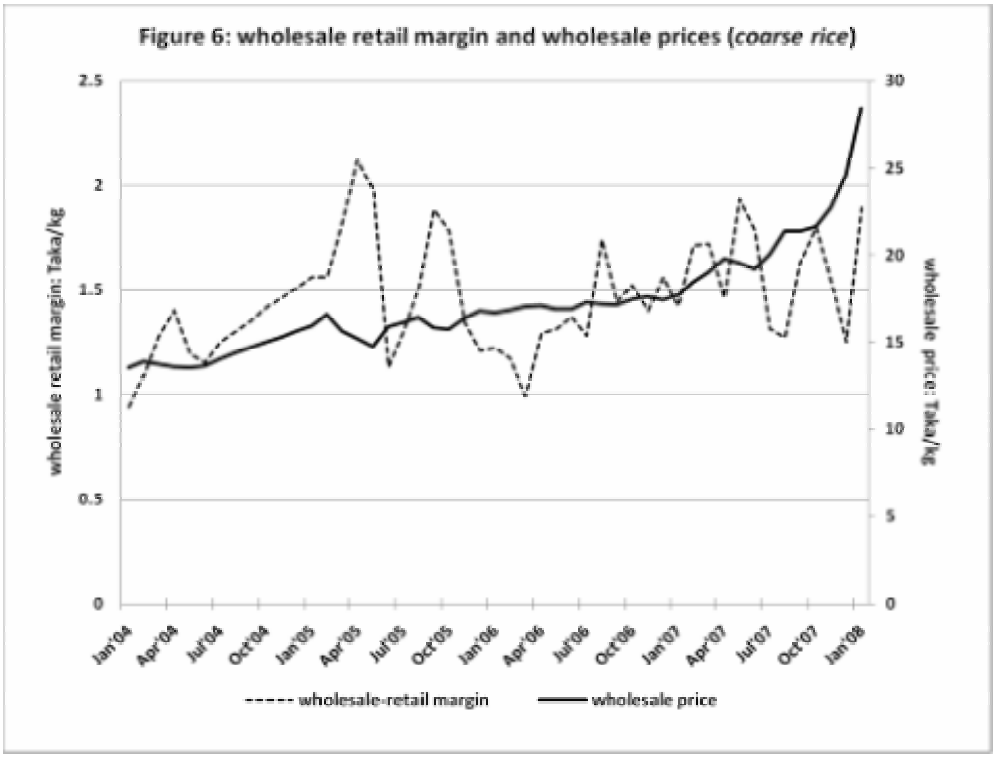


Figure 6: wholesale retail margin and wholesale prices (*coarse rice*)
wholesale retail margin: Taka/kg
wholesale price: Taka/kg
2.5
2
1.5
1
0.5
0
30
25
20
15
10
5
0
Jan'04
Apr'04
Jul'04
Oct'04
Jan'05
Apr'05
Jul'05
Oct'05
Jan'06
Apr'06
Jul'06
Oct'06
Jan'07
Apr'07
Jul'07
Oct'07
Jan'08
wholesale-retail margin
wholesale price

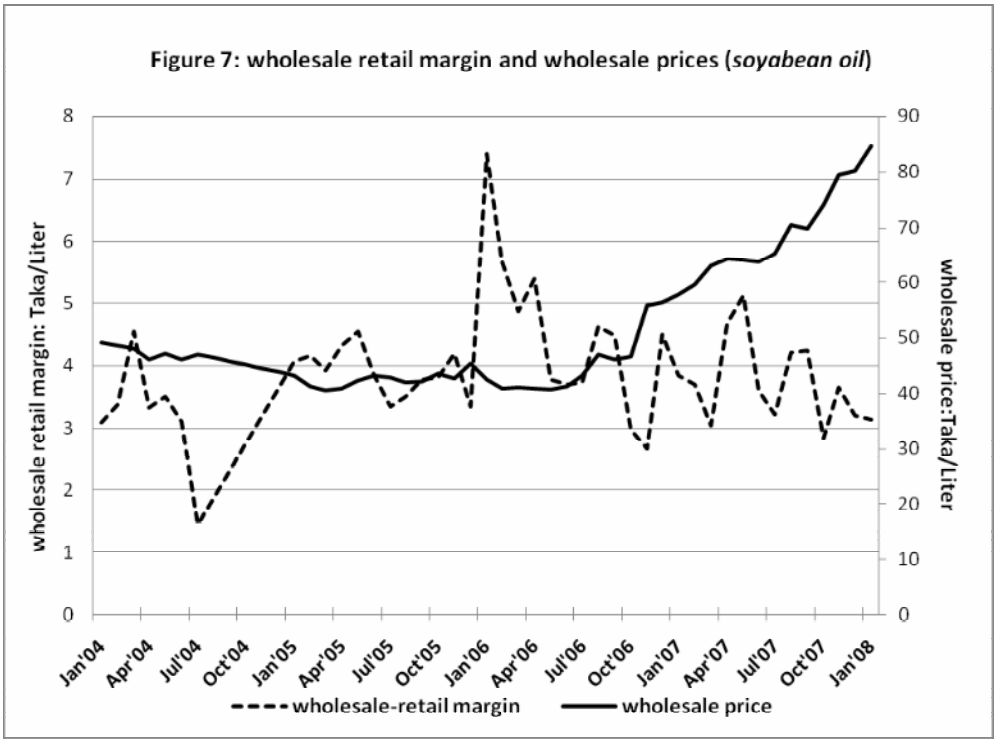


Figure 7: wholesale retail margin and wholesale prices (*soyabean oil*)
wholesale retail margin: Taka/Liter
wholesale price:Taka/Liter
8
7
6
5
4
3
2
1
0
90
80
70
60
50
40
30
20
10
0
Jan'04
Apr'04
Jul'04
Oct'04
Jan'05
Apr'05
Jul'05
Oct'05
Jan'06
Apr'06
Jul'06
Oct'06
Jan'07
Apr'07
Jul'07
Oct'07
Jan'08
wholesale-retail margin
wholesale price

The upward and downward movement of the wholesale retail margin of soyabean oil (Figure 7) did not show any consistent behavior. It was lowest at Tk.1.5 per liter in July 2004. In January 2006, it was highest at more than Tk.7 per liter. Then it was decreasing. Some consecutive jumps have been seen on November'06, April'07, July'07, and October'07. Similarly sharp falls have been seen December'06, March'07, and September'07.

The wholesale price of soyabean oil started to increase consistently from October'06 with a jump. This increasing movement of wholesale was reflected on the lower margin. From November'06 to January'08, the margin was moving between the amount of less than Tk.3 and Tk.5 per liter. Before that period, the lowest and highest margins were between Tk.1.5 and more than Tk.7 per liter respectively. This analysis simply implies that in the period of consistently increasing wholesale prices of soyabean oil, its wholesale-retail margins were moving within a smaller range.

4. Price integration across selected commodities: cointegration analyses

4.1 Retail-retail and wholesale-wholesale price levels

In the preceding section, it was seen that essential food prices bear the major portion of weight of food price index compared to coarse rice prices. This scenario produced the enthusiasm to investigate whether the prices of coarse rice caused the rise in prices of other essential food items or it happened in the opposite direction. To get the exact causation process, bilateral Granger Causality tests were used.[2]

Both wholesale and retail price series of coarse rice, medium rice, atta, soyabean oil and lentil were used for this analysis. Initially all the series were found non-stationary at levels applying ADF tests with a drift or constant term[3]. All these series were found stationary in their first differences[4]. To check cointegration between coarse rice and other individual essential food prices, Engel Granger tests were applied. Retail prices of coarse rice and *atta* were found cointegrated at 5% level of significance[5]. Wholesale prices of atta-coarse rice and soyabean oil-coarse rice were also found cointegrated at 5% level[6].

[2] It is acknowledged that the test can only reject or accept with some degree of confidence that there is no causality, but cannot establish a proposition that there is 'causality'.

[3] The τ-statistics for the value of coefficients for retail and wholesale prices of coarse rice respectively, 2.477 and 0.862, for soyabean oil 1.16 and 1.50, for lentil ordinary -0.15 and -0.26, for atta 3.155 and 2.858.

[4] The τ-statistics for the first difference coefficient for retail and wholesale prices for coarse rice were respectively, -9.610 and -10.263, for soyabean oil -7.870 and -7.807, for lentil ordinary -8.343 and -8.379, for atta -8.568 and -8.936.

[5] The τ -statistic for the coefficient in the specification with the error term for the retail price cointegration between coarse rice and soyabean oil, lentil , atta, rice medium were respectively -1.621, 0.435, -3.060 and -1.337.

[6] The τ -statistic for the coefficient in the specification with the error term for the wholesale price cointegration between coarse rice and soyabean oil, lentil , atta, rice medium were respectively -2.951, -1.716, -3.857 and -1.902.

The following sets of models were specified for Granger causality test using optimal number of lags[7].

$$\Delta Py_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i \, \Delta Py_{t-i} + \sum_{j=0}^{n} \beta_j \, \Delta Px_{t-j} + \epsilon_{1t}$$

$$\Delta Px_t = a_0 + \sum_{i=1}^{n} a_i \, \Delta Px_{t-i} + \sum_{j=0}^{n} b_j \, \Delta Py_{t-j} + \epsilon_{2t}$$

Here, *Px* denotes retail or wholesale price of coarse rice and *Py* denotes retail or wholesale price of other individual essential food items. The null hypothesis is that changes in retail prices of coarse rice do not cause changes in retail prices of the other essential food item and vice versa. That is, $\boldsymbol{H_0}: \sum \boldsymbol{\beta_j} = \mathbf{0}$ and $\boldsymbol{H_0}: \sum \boldsymbol{b_j} = \mathbf{0}$.

The same model can be used for testing causality between wholesale prices with the null hypothesis that changes in wholesale prices of coarse rice do not cause changes in wholesale prices of the other individual food item and vice versa. Another Hypothesis was that the ratio of the restricted and unrestricted residual sum of squares has an F-distribution.

For the whole sample period of Jan'05 to Jan'08, bilateral causality was found between retail coarse rice price and other individual retail prices of our concern except the retail price of ordinary lentil. The results show that the null hypothesis was easily rejected at 5% significance level for all the relations other than that of retail prices of coarse rice and ordinary lentil.

Surprisingly, for the first two years period of the sample (Jan'05 to Dec'06) none of the prices within the framework of the specified model was found to be granger caused by another even if we consider 10% level of significance. But for the period of Jan'07 to Jan'08, bilateral causality was found for the same relationships except coarse rice-lentil relationship which showed exactly the same result for the whole sample period.

This kind of result suggests that the price regime of 2007 and of early 2008 played a dominant role in the causation of retail price changes of rice and other essential food items like soyabean oil and atta.

[7] The optimal lags found from using Akaike Information Criterion for retail-retail regression between coarse rice and soyabean oil were 5(n=5). Retail-retail regressions between coarse rice and atta, lentil, rice medium were done with a single lag (n=1). The optimal lags in case of wholesale-wholesale regressions between coarse rice and atta and lentil were 4 (n=4), lags for regression between coarse rice and soyabean oil, rice medium were respectively 5 (n=5) and 2 (n=2).

Table 1: Results from Granger Causality tests on retail prices of coarse rice and other essential food items.

Period: week 1 of Jan'05 to week 3 of Jan'08				
Direction of causality	**Degree of freedom**	**F value**	**Critical F value (5% sig. level)**	**Decision on H_0**
coarse rice → Atta, retail price	2, 153	4.58	3.06	rejected
Atta →coarse rice, retail price	2, 153	3.26	3.06	rejected
coarse rice→ soyabean oil, retail price	6, 141	5.08	2.16	rejected
Soyabean oil →coarse rice, retail price	6, 141	3.73	2.16	rejected
coarse rice→ ordinary lentil, retail price	2, 153	1.68	3.06	Not rejected
ordinary lentil→ coarse rice, retail price	2, 153	1.61	3.06	Not rejected
coarse rice→ medium rice, retail price	2, 153	61.18	3.06	rejected
medium rice→ coarse rice, retail price	2, 153	60.50	3.06	rejected
Period: week 1 of Jan'05 to week 4 of Dec'06 [8]				
Direction of causality	**Degree of freedom**	**F value**	**Critical F value (5% sig. level)**	**Decision on H_0**
coarse rice → Atta, retail price	2, 98	0.21	3.05	Not rejected
Atta →coarse rice, retail price	2, 98	0.21	3.05	Not rejected
coarse rice→ soyabean oil, retail price	7, 83	0.75	2.13	Not rejected
Soyabean oil →coarse rice, retail price	7, 83	1.21	2.13	Not rejected
coarse rice→ ordinary lentil, retail price	7, 83	0.39	2.13	Not rejected
ordinary lentil→ coarse rice, retail price	7, 83	1.76	2.13	Not rejected
coarse rice→ medium rice, retail price	2, 98	1.29	3.05	Not rejected
medium rice→ coarse rice, retail price	2, 98	1.60	3.05	Not rejected
Period: week 1 of Jan'07 to week 3 of Jan'08 [9]				
Direction of causality	**Degree of freedom**	**F value**	**Critical F value (5% sig. level)**	**Decision on H_0**
coarse rice → Atta, retail price	2, 49	4.03	3.19	rejected
Atta →coarse rice, retail price	2, 49	4.66	3.19	rejected
coarse rice→ soyabean oil, retail price	2, 49	10.80	3.19	rejected
Soyabean oil →coarse rice, retail price	2, 49	10.79	3.19	rejected
coarse rice→ ordinary lentil, retail price	2, 49	1.16	3.19	Not rejected
ordinary lentil→ coarse rice, retail price	2, 49	1.33	3.19	Not rejected
coarse rice→ medium rice, retail price	2, 49	61.88	3.19	rejected
medium rice→ coarse rice, retail price	2, 49	60.39	3.19	rejected

[8] Different specifications were used for different sample periods using AIC. For Jan'05 to Dec'06 period, n =1 was optimal for coarse rice-atta and coarse rice-rice medium regressions (retail-retail). n = 6 were optimal for coarse rice-lentil and coarse rice soyabean oil regressions (retail-retail).

[9] For Jan'07 to Jan'08 period, n=1 was optimal for all the relations.

Table 2: Results from Granger Causality tests on wholesale prices of coarse rice and other essential food items.

Period: week 1 of Jan'05 to week 3 of Jan'08				
Direction of causality	**Degree of freedom**	**F value**	**Critical F value (5% sig. level)**	**Decision on H_0**
coarse rice → Atta, wholesale price	5, 143	3.82	2.28	rejected
Atta →coarse rice, wholesale price	5, 143	2.68	2.28	rejected
coarse rice→ soyabean oil, wholesale	6, 141	3.72	2.16	rejected
Soyabean oil →coarse rice, wholesale	6, 141	2.25	2.16	rejected
coarse rice→ ordinary lentil, wholesale	5, 144	1.13	2.28	Not rejected
ordinary lentil→ coarse rice, wholesale	5, 144	1.29	2.28	Not rejected
coarse rice→ medium rice, wholesale	3, 150	51.13	2.67	rejected
medium rice→ coarse rice, wholesale	3, 150	47.81	2.67	rejected
Period: week 1 of Jan'05 to week 4 of Dec'06 [10]				
Direction of causality	**Degree of freedom**	**F value**	**Critical F value (5% sig. level)**	**Decision on H_0**
coarse rice → Atta, wholesale price	8, 80	2.23	2.06	rejected
Atta →coarse rice, wholesale price	8, 80	2.07	2.06	rejected
coarse rice→ soyabean oil, wholesale	8, 80	0.70	2.06	Not rejected
Soyabean oil →coarse rice, wholesale	8, 80	1.02	2.06	Not rejected
coarse rice→ ordinary lentil, wholesale	8, 80	3.66	2.06	rejected
ordinary lentil→ coarse rice, wholesale	8, 80	1.01	2.06	Not rejected
coarse rice→ medium rice, wholesale	8, 80	2.16	2.06	rejected
medium rice→ coarse rice, wholesale	8, 80	2.55	2.06	rejected
Period: week 1 of Jan'07 to week 3 of Jan'08 [11]				
Direction of causality	**Degree of freedom**	**F value**	**Critical F value (5% sig. level)**	**Decision on H_0**
coarse rice → Atta, wholesale price	5, 49	1.64	2.41	Not rejected
Atta →coarse rice, wholesale price	5, 49	0.97	2.41	Not rejected
coarse rice→ soyabean oil, wholesale	6, 48	2.47	2.31	rejected
Soyabean oil →coarse rice, wholesale	6, 48	1.48	2.31	Not rejected
coarse rice→ ordinary lentil, wholesale	7, 34	0.56	2.30	Not rejected
ordinary lentil→ coarse rice, wholesale	7, 34	0.45	2.30	Not rejected
coarse rice→ medium rice, wholesale	3, 46	52.77	2.80	rejected
medium rice→ coarse rice, wholesale	3, 46	50.62	2.80	rejected

[10] For the period n = 7 were specified for all the wholesale-wholesale relations.

[11] For the regressions of coarse rice with atta, soyabean oil, lentil and medium rice optimal lags were respectively 4, 7, 6 and 2.

The result table for causality between wholesale prices shows similar result as in the table for retail-retail causality tests considering the whole sample period. That is, except for coarse rice-lentil relationship, wholesale prices of each food item of our concern and coarse rice price have bi-directional causality between them.

For the first two years of the sample period (Jan'05 to Dec'06), bilateral causality was found between wholesale prices of medium and coarse rice as well as between wholesale prices of atta and coarse rice. A unidirectional causality from lentil to coarse rice wholesale prices was also found. The null hypothesis could not be rejected at 5% level for relationships of wholesale prices of atta and soyabean oil with wholesale price of coarse rice.

For the final year of the sample period (Jan'07 to Jan'08), different results were found. The exceptions were a unidirectional causality from wholesale prices of coarse rice to soyabean oil and no causality between coarse rice and lentil prices as well as between coarse rice and atta prices.

These results suggest, unlike the case of retail prices the price regime of 2007-08 period did not play a dominant role in the causation of wholesale price changes of rice, atta and soyabean oil.

4.2 Cointegration between wholesale and retail prices

In the graphical analysis, movements of wholesale-retail margin were presented against the wholesale price levels. In this part of the paper relationships between wholesale and retail prices of some selected food items are looked into more rigorously.

Firstly, bilateral Granger Causality tests were used to understand the direction of relationship between wholesale and retail prices. The stationarity of individual price series and whether there is cointegration between pair wise combinations of them are needed for the appropriate specification of Granger causality. Stationarity of individual price series (wholesale and retail price series of coarse rice, soyabean oil, ordinary lentil and atta) were checked applying ADF tests with a drift. Initially all these series were found non-stationary in levels but their first differences were found to be stationary even in 1% level of significance[12]. For each commodity Engel Granger test was applied to check cointegration between its wholesale and retail prices. Results showed that they were cointegrated at 1% level[13].

[12] The τ-statistics for the value of coefficients for retail and wholesale prices of coarse rice respectively, 2.477 and 0.862, for soyabean oil 1.16 and 1.50, for lentil ordinary -0.15 and -0.26, for atta 3.155 and 2.858.The τ-statistics for the first difference coefficient for retail and wholesale prices for coarse rice respectively, -9.610 and -10.263, for soyabean oil -7.870 and -7.807, for lentil ordinary -8.343 and -8.379, for atta -8.568 and -8.936.

[13] The τ -statistic for the coefficient in the specification with the error term for the coarse rice, soyabean oil, lentil and atta were -5.610, -4.808, -5.555 and -4.582 which are greater than the critical value -3.491.

Then the following sets of models were specified with optimal number of lags[14].

$$\Delta Pr_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i \, \Delta Pr_{t-i} + \sum_{j=0}^{n} \beta_j \, \Delta Pw_{t-j} + \varepsilon_{1t}$$

$$\Delta Pw_t = a_0 + \sum_{i=1}^{n} a_i \, \Delta Pw_{t-i} + \sum_{j=0}^{n} b_j \, \Delta Pr_{t-j} + \varepsilon_{2t}$$

Here, *Pr* and *Pw* denote retail and wholesale prices. The null hypothesis for first Model is, $\boldsymbol{H_0}: \sum \boldsymbol{\beta_j} = \mathbf{0}$ and for second Model is, $\boldsymbol{H_0}: \sum \boldsymbol{b_j} = \mathbf{0}$. That is, the changes in wholesale prices do not cause the changes in retail prices and vice versa. The ratio of the restricted and unrestricted residual sum of squares has an F-distribution.

It is very clear from the results that wholesale and retail prices of all commodities caused each other. This bilateral causality holds for all three sample periods considered above as it shows that the null hypothesis can be rejected at 1% level of significance for all cases. The only exception is retail prices of coarse rice did not cause its wholesale price for the period Jan'2005 to Dec'2006 at even 10% level of significance. For that time period a unidirectional causality was there between wholesale and retail prices of coarse rice.

Secondly, an exercise was done to test for asymmetric price response. The main objective was to understand in what extent retail prices increase or decrease in response to an increase or decrease in wholesale prices and how rapidly it happens. This exercise was conducted only for coarse rice and soyabean oil prices. Retail and wholesale prices of both the commodities were found to be non-stationary and cointegrated significantly. The following model was employed to serve this purpose with optimal number of lags[15].

$$\Delta Pr_t = \alpha_0 + \alpha_1 \Delta Pw_t + \alpha_2 \Delta Pw_t * \mathrm{D}_t + \alpha_3 Pw_{t-1} + \alpha_4 Pr_{t-1} + e_t \quad [16]$$

Here, $D_t = 1$ if $\Delta Pw_t \geq 0$ and $D_t = 0$ if $\Delta Pw_t < 0$. Lagged price terms were added to this basic model allowing both pace and extent of price response. The null hypothesis is, the coefficient α_2 is not different from zero, that is, there is no asymmetric pricing.

[14] To have the optimal lags, Akaike information criterion (AIC) was taken. That information provides optimal lags for coarse rice are 5 (n=5), for soyabean oil and lentil ordinary are 7 (n=7) and for atta are 2 (n=2).
[15] The model was found to fit best using Akaike Information Criterion (AIC).
[16] The basic model was taken from the error correction framework by Reilly and Witt (1996).

Table 3: Results from Granger Causality tests on wholesale and retail prices

Period: week 1 of Jan'05 to week 3 of Jan'08				
Direction of causality	**Degree of freedom**	**F value**	**Critical F value (1% sig. level)**	**Decision**
Wholesale →retail, coarse rice	6, 141	66.19	2.94	rejected
Retail →wholesale, coarse rice	6, 141	58.83	2.94	rejected
Wholesale →retail, soyabean oil	8, 135	27.19	2.65	rejected
Retail →wholesale, soyabean oil	8, 135	21.19	2.65	rejected
Wholesale →retail, ordinary lentil	8, 135	8.93	2.65	rejected
Retail →wholesale, ordinary lentil	8, 135	6.58	2.65	rejected
Wholesale →retail, Atta	3, 150	54.22	3.93	rejected
Retail →wholesale, Atta	3, 150	37.32	3.93	rejected
Period: week 1 of Jan'05 to week 4 of Dec'06 [17]				
Direction of causality	**Degree of freedom**	**F value**	**Critical F value (1% sig. level)**	**Decision**
Wholesale →retail, coarse rice	8, 80	3.95	2.74	rejected
Retail →wholesale, coarse rice	8, 80	1.52	2.74	not rejected
Wholesale →retail, soyabean oil	8, 80	13.26	2.74	rejected
Retail →wholesale, soyabean oil	8, 80	8.27	2.74	rejected
Wholesale →retail, ordinary lentil	8, 80	5.21	2.74	rejected
Retail →wholesale, ordinary lentil	8, 80	3.47	2.74	rejected
Wholesale →retail, Atta	5, 89	15.01	3.25	rejected
Retail →wholesale, Atta	5, 89	12.11	3.25	rejected
Period: week 1 of Jan'07 to week 3 of Jan'08 [18]				
Direction of causality	**Degree of freedom**	**F value**	**Critical F value (1% sig. level)**	**Decision**
Wholesale →retail, coarse rice	6, 37	64.00	3.29	rejected
Retail →wholesale, coarse rice	6, 37	58.89	3.29	rejected
Wholesale →retail, soyabean oil	6, 37	28.96	3.29	rejected
Retail →wholesale, soyabean oil	6, 37	22.64	3.29	rejected
Wholesale →retail, ordinary lentil	8, 31	5.52	3.17	rejected
Retail →wholesale, ordinary lentil	8, 31	5.54	3.17	rejected
Wholesale →retail, Atta	8, 31	7.00	3.17	rejected
Retail →wholesale, Atta	8, 31	4.53	3.17	rejected

[17]For the period Jan'05 to Jan'06, optimal lags were 4 for specification between wholesale and retail prices of atta and optimal lags were 7 for three other specifications.

[18]For this period optimal lags were 5for coarse rice and soyabean oil prices and 7 for atta and lentil prices.

Table 4: Results from asymmetric price tests

Period: week 1 of Jan'05 to week 3 of Jan'08						
	Coarse rice			**Soyabean oil**		
variables	**coefficient**	**t-ratio**	**Sig. level**	**coefficient**	**t-ratio**	**Sig. level**
α_0	.480	2.757	.007	2.040	5.711	.000
ΔPw_t	.380	6.340	.000	.118	1.046	.297
$\Delta Pw_t * D_t$	.376	4.476	.000	.706	4.724	.000
Pr_{t-1}	-.375	-7.618	.000	-.456	-8.907	.000
Pw_{t-1}	.378	7.536	.000	.448	8.935	.000
Period: week 1 of Jan'05 to week 4 of Dec'06						
	Coarse rice			**Soyabean oil**		
variables	**coefficient**	**t-ratio**	**Sig. level**	**coefficient**	**t-ratio**	**Sig. level**
α_0	1.626	2.489	.015	1.907	1.844	.068
ΔPw_t	.206	1.790	.077	.179	1.112	.269
$\Delta Pw_t * D_t$	.125	.644	.521	.509	2.181	.032
Pr_{t-1}	-.412	-6.012	.000	-.409	-6.544	.000
Pw_{t-1}	.350	6.095	.000	.401	6.715	.000
Period: week 1 of Jan'07 to week 3 of Jan'08 [19]						
	Coarse rice			**Soyabean oil**		
variables	**coefficient**	**t-ratio**	**Sig. level**	**coefficient**	**t-ratio**	**Sig. level**
α_0	.767	1.966	.055	3.225	3.256	.002
ΔPw_t	.445	5.240	.000	-.007	-.041	.968
$\Delta Pw_t * D_t$	.332	2.830	.007	.950	4.273	.000
Pr_{t-1}	-.444	-4.979	.000	-.640	-6.624	.000
Pw_{t-1}	.440	4.803	.000	.624	6.644	.000

In case of coarse rice prices, the results suggest that for the whole sample period (week 1 of Jan'05 to week 3 of Jan'08) the value of the coefficient α_2 = 0.376 is statistically different from zero at 1% level of significance. It means there is evidence of asymmetric pricing information. So, the coefficients in Table 4 shows that over a week period a 10% fall in wholesale price of coarse rice would be expected to cause a 3.8% decline in retail price of coarse rice. On the other hand 10% rise in the wholesale price would be expected to cause a 7.5% (0.380+0.376) increase in retail prices.

Similarly, in case of soyabean oil prices, for the whole sample period the value of the coefficient α_2 = 0.706 is statistically different from zero at 1% level of significance. Over a week period a 10% fall in wholesale price would be expected to cause a 1.2% decline in retail price, while a 10% rise in the wholesale price would be expected to cause an 8.2% (0.118+0.706) increase in retail prices.

For the first two years of the sample, in case of coarse rice prices, α_2 was not found statistically different from zero. So no asymmetric pricing information was there. But

[19]Models for different time periods were specified with optimal lags using AIC.

for soyabean oil the null hypothesis was easily rejected. It implies, over a week 10% fall in wholesale prices of soyabean oil would be likely to cause 1.1% decline in its retail prices. Again, 10% rise in wholesale prices of soyabean oil would be likely to cause 3.3% increase in its retail prices.

The results are quite different for the final year of the sample. The α_2 coefficient for coarse rice prices are significantly different from zero which implies, over a week 10% fall in wholesale prices of coarse rice would be expected to cause 4.5% decline in its retail prices. Reversely, 10% rise in wholesale prices of coarse rice would be expected to cause a 7.8% increase in its retail prices. For the same period, soyabean oil prices showed evidence of price asymmetry but because of inconsistent coefficients no predictions can be drawn.

5. Summary and conclusions

To see the nature of relations between various food prices, at first graphical analyses were done to get a general idea about their relations. The essential food price was constructed upon accounting for the major items included in the food price index. The ending period of 2007 came out as a crucial period for most of the essential goods as their prices started to move sharply upward on that period. The international rice price (India25% broken) also showed a sudden rise during that period. Domestic wholesale prices of coarse and medium rice followed the rise in international price.

The absolute and relative margins of retail prices over wholesale prices were checked to understand the price hike more clearly. But no abnormal behavior of the margins was detected for the recent time. In case of coarse rice prices the absolute margins were fluctuating around 1.6 TK per Kg for the period Jan'07 to Jan'08. In case of soyabean oil it was around 3.7 TK per Liter. The relative margins for both commodities decreased during this period.

Then rigorous econometric analyses were employed to see the nature of interrelationship among food prices more accurately. To see the exact causation process between coarse rice price and other essential food prices, the granger causality tests were adopted. With our limited evidence, except ordinary lentil, bidirectional causality was found between retail prices of coarse rice and other selected food items for the period between Jan'05 and Jan'08. Surprisingly, none of the relationships held for the first two years of the sample period. Results suggest that the period between Jan'07 and Jan'08 played the dominating role on the causation process. The same conclusion was true for the causation between wholesale prices taking the whole sample period but no specific period was found to be dominating.

Bidirectional causality was found for both wholesale and retail prices for all selected commodities. Only exception was coarse rice prices as the evidence says before 2007 the retail price of coarse rice did not 'Granger cause' its wholesale price. The asymmetric price tests explained the wholesale-retail relations more evidently. It showed, during the period Jan'07 to Jan'08 retail prices of coarse rice and soyabean oil were more responsive to their wholesale prices both in terms of pace and extent.

This paper definitely has some limitations as so many things were experimented with a limited range of data. Hopefully, it will be able to answer some basic questions regarding price changes in recent years.