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Market Reforms, Spatial Price Spread and Market Connectedness: Evidence from Wheat Markets in Pakistan

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Abstract: This study, while using the data from 8 wheat markets of Pakistan, examines the extent of spatial price spread and market connectedness during reform and pre-reform periods. It is found that market reforms reduced the spatial price spread in 21 of 28 pairs of markets during reform period. The general view that more near the two markets are, stronger will be the co-movement of their prices, did not get support from empirical evidences. By encouraging the private sector and also limiting the extent of government intervention in the trading activity, correct price signals can be transmitted down to the marketing channel and can guide the farmers to specialize according to their comparative advantages.

Key words: Spatial price spread, market connectedness, market reforms

INTRODUCTION

Any definition of pricing or market efficiency, in some way or another, is based on the notion that market price fully reflects market information. Market Price is thought a primary mechanism by which different markets are linked and response to each other. The extent of their linkages is normally captured by the speed with which information are transmitted among different markets. The speed of transmission of these information shocks reflects the level of competition in the market.

Generally, in an efficient and competitive market with complete information, price changes at one market are usually assumed to be fully and instantly reflected in the prices of other markets of the system. So the price of a homogenous product at any two locations of such market is based on a profit relation;

$$\Pi^{ij} = P_i - P_j - C_r$$

Where C_r is transportation cost and 'i' and 'j' are spatially separated markets. In practice, there would be divergence from this relationship but the actions of arbitragers will, in a well-functioning market, tend to move price spread toward transaction costs by reducing profit. In the words of Marshall (1890) ... the more nearly perfect a market is, the stronger is the tendency for the same price to be paid for the same thing at same time in all parts of the market.

Because of the importance of agricultural commodity prices to economic growth and efficiency, Pakistan government like other national governments adopted liberalized commodity pricing policies during late 1980s. In order to maintain rational price support system, Agricultural Prices Commission (APCOM) was established in 1981. Its job is to advise government on the pricing matters while taking into account the factors like cost of production, international prices. The agricultural policies during late eighties focused on to make competition more dynamic and transparent in order to improve the efficiency of market by facilitating arbitrage (Khan, 1994).

Prices are thought an important determinant of the level of farm incomes, cost of food to consumers and the profit for marketing firms. So price level, its variability, its transmission across the marketing system and its spread are the issues that are very important to government. The price spread (margin) is an important aspect of price behavior that helps in the evaluation of market performance during different periods. In other words, the behavior of these spreads (margins) is thought an index of economic efficiency and market transparency. The extent or magnitude of these marketing spreads (margins) has been major concern to policy makers, especially if they are unjustifiably large over time/space in relation to storage/transaction costs. Against this background, this research investigates price spread and market connectedness in different markets of wheat in Pakistan.

MATERIALS AND METHODS

Data used in this study are monthly and obtained from the Department of Agricultural and livestock

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Products, Marketing and Grading, ALMA, Government of Pakistan. (Pakistan Various issues). After deflating nominal monthly wholesale prices by the Consumer Price Index (CPI), these prices are used for analysis. The data on CPI is obtained from the International Financial Statistics CD-Rom (IMF, 2002). The data covers the period 1981:01-2001:04. The choice of the period was made on the basis of availability of price data and the objective to cover both the pre-reform and post reform periods. The whole period was subdivided into two parts: (i) the pre-reform period, from January, 1981 to April, 1987 and (ii) the reform period, from May, 1987 to April, 2001.

This study focuses on eight wheat markets selected from 4 provinces of the country. From Punjab province, Lahore, Sargodha, Faisalabad, Multan and Rawalpindi markets are selected and from Sind province, Hyderabad and Karachi markets are taken. Only Peshawar market is selected from NWF province.

According to standard spatial price equilibrium analysis pioneered by Enke (1951) and Samuelson (1952), if the price difference between two trading markets is larger than transfer costs then the volume of trade between two markets is determined by the functions of local supply and demand. Accordingly the changes in commodity flow, which induces adjustments in prices in a market, will finally restore equilibrium. So the spatial arbitrage condition is an equilibrium concept rather than a yardstick of market efficiency and is, hence, thought a starting point for any model of spatial price behaviour.

The main point that emerges from the literature is that the common definitions of arbitrage, efficiency and integration that characterise the spatial market integration do not exist in literature (Fackler and Goodwin, 2001). So in what follows in this paper, the intention is, to use a variety of approaches to capture market efficiency and to look for convergence across these approaches.

RESULTS AND DISCUSSION

There is a generalization that liberalization process generates competition among traders that, in turn, lowers the marketing and profit margins. Market liberalization is expected to encourage spatial arbitrage i.e. the movement of products from a low price markets (rural markets) to a high price market (urban market)--Which, in turn, may reduce price gaps between some markets while raising them between others. Thus, market liberalization is thought to reduce inter-market price spread.

Table 1 shows the distance and real price spread for wheat among different pairs of markets. These results of price spreads among different pairs of markets in Pakistan during two periods, before and during reform period, revealed that, in 21 out of 28 pairs of markets, magnitude of spatial price spread decreased during reform period as compared to that of pre-reform period.

These results suggest that inter-market arbitrage is taking place at lower costs during reform period than in the pre-reform period. During reform period, as explained earlier, the markets are expected to be more connected and more responsive to each other and resultantly the product will move from surplus to deficit areas in response to higher prices. Accordingly the prices in surplus/deficit regions are expected to increase/decrease during reform period and hence, will reduce the spatial margin between two markets. The examination of Table 1 endorses this view.

Within the context of efficient market paradigm, prices in space, form and time should differ by no more than the costs of transfer, transformation and storage. Transfer cost, one of the categories affecting price differential between two markets, is the most used in explaining geographic price differentials. In competitive market, theoretically, spatial prices would be assumed to differ by no more than the cost of transportation between any two points (Bressler and King, 1970). This norm of efficient market sometimes does not hold when actual prices in different markets may diverge from spatial price differences, for example, due to delivery lags caused by poor transport and communication infrastructure. Prices are, therefore, assumed to vary within a band too narrow to provide profit opportunities from arbitrage over space, form and time.

Next, we computed the correlation coefficients for each pair of different localities. This is a simplest approach in the literature to analyze the degree of market connectedness and is based on simple intuition: the more connected markets are, the higher the co movement between their prices.

This method has been criticised by Harris (1979), Blyn (1973). This method, according to them, masks the influences of common components such as inflation, population growth, procurement policy, climatic patterns that affect all markets, regardless the extent to which the markets are linked through trade. In order to overcome these problems, correlation coefficient of first differenced price series is computed (Goelti *et al*., 1994). Since first differencing of prices eliminates the technical problems related to spurious correlation arising from the presence of common trends, the coefficients can then be the indicators of the extent to which prices move together in different markets.

Table 2 shows the correlation coefficients of the prices of different markets during pre-reform period. Higher the estimated coefficient, the stronger the

Table 1: Real wheat price spreads between different pairs of markets.1981-2001(In Rs.)

		Spatial Margin*		
Market Pairs	Distance between markets (KM)	Pre-reform period 1981:01 -1987:04	Reform period 1987:05- 2001:04	Change in spatial margin
Faisalabad-Hyderabad	1006	-7.8938	0.7743	Decreased
Faisalabad-Multan	237	10.9843	7.4661	Decreased
Faisalabad-Peshawar	519	9.6291	-7.4838	Decreased
Faisalabad-Sargodha	90	5.7734	3.4214	Decreased
Hyderabad-Multan	769	18.8781	6.6918	Decreased
Hyderabad-Sargodha	1051	13.6672	2.6471	Decreased
Karachi-Faisalabad	1181	21.6915	22.6290	Increased
Karachi-Hyderabad	175	13.7977	23.4033	Increased
Karachi-Lahore	1292	14.9881	16.8915	Increased
Karachi-Multan	945	32.6758	30.0951	Decreased
Karachi-Peshawar	1728	31.3206	15.1452	Decreased
Karachi-Rawalpindi	1567	4.6923	20.7141	Increased
Karachi-Sargodha	1226	27.4649	26.0504	Decreased
Lahore-Faisalabad	137	6.7034	5.7375	Decreased
Lahore-Hyderabad	1117	-1.1904	6.5118	Increased
Lahore-Multan	335	17.6877	13.2036	Decreased
Lahore-Sargodha	172	12.4768	9.1589	Decreased
Peshawar-Hyderabad	1552	-17.5229	8.2581	Decreased
Peshawar-Lahore	436	-16.3325	1.7463	Decreased
Peshawar-Multan	783	1.3552	14.9499	Increased
Peshawar-Rawalpindi	160	-26.6283	5.5689	Decreased
Peshawar-Sargodha	488	-3.8557	10.9052	Increased
Rawalpindi-Faisalabad	357	16.9992	1.9149	Decreased
Rawalpindi-Hyderabad	1392	9.1054	2.6892	Decreased
Rawalpindi-Lahore	275	10.2958	-3.8226	Decreased
Rawalpindi-Multan	623	27.9835	9.3810	Decreased
Rawalpindi-Sargodha	248	22.7726	5.3363	Decreased
Sargodha-Multan	282	5.2109	4.0447	Decreased

Source: ALMA (various issues), Note: Prices are deflated using the monthly CPI for Pakistan (1995=100) obtained from the International Financial Statistics CD-ROM (IMF [2002], * Shows absolute value (in Rs.) of spatial margin in the cells

Table 2: Correlation coefficients of price first differences (1981:01-1987:04)

	Faisalabad	Hyderabad	Karachi	Lahore	Multan	Peshawar	Rawalpindi
Hyderabad	0.328(1006)						
Karachi	0.377(1181)	0.473(175)					
Lahore	0.367(137)	0.234(1117)	0.127(1292)				
Multan	0.264(237)	0.190(769)	0.076(945)	0.385(335)			
Peshawar	0.040(519)	0.146(1552)	0.071(1728)	0.13(436)	0.238(783)		
Rawalpindi	0.256(357)	0.425(1392)	0.08(1567)	0.396(275)	0.291(623)	0.242(160)	
Sargodha	0.752(90)	0.449(1051)	0.383(1226)	0.402(172)	0.397(282)	0.124(488)	0.482(248)

Source: Data from ALMA, Figure in parentheses is distance (in KM) between two markets

relationship between the prices of two markets. During pre-reform period, out of the all possible combinations, co-movement of prices between Sargodha and Faisalabad markets appeared the strongest with a magnitude of 0.75 and between Peshawar and Faisalabad this relation remained the lowest with a coefficient of 0.04. These coefficients, as shown in the Table 2, do not support the general view that the more near two markets are, the stronger will be the co-movement of their prices. As is evident from the Table 2, some markets are having larger correlation coefficient with those markets, which are away from it than those, which are nearer to it. So it is not necessary for two markets located nearest to each other to have large correlation coefficient; and in the same vein it is also not true that two markets located far away from each other will show smaller correlation coefficient.

So what is, in fact, important is that two markets must be part of a common trading network. In that case the markets, which are even away from each other and do not have direct trading linkages, may have strong correlation coefficients. For example, if markets X and Y are both regular suppliers to market Z, they (i.e., X and Y) may be integrated just as strongly as they were direct trading partners irrespective of distance between the two (i.e., X and Y).

As is clear in Table 3, the coefficients remained in general higher during reform period compared to the coefficients during pre reform period. In 17, out of 28 possible combinations of market pairs, the correlation coefficients have increased during reform period. On average, the correlation between markets increased from 0.28 during pre-reform period to 0.30 during reform period.

Table 3: Correlation coefficients of price first differences (1987:05-2001:04)

	Faisalabad	Hyderabad	Karachi	Lahore	Multan	Peshawar	Rawalpindi
Hyderabad	0.155						
Karachi	0.323	0.546					
Lahore	0.311	0.260	0.211				
Multan	0.474	0.219	0.210	0.506			
Peshawar	0.110	0.346	0.366	0.184	0.097		
Rawalpindi	0.284	0.220	0.169	0.323	0.254	0.287	
Sargodha	0.782	0.135	0.289	0.394	0.554	0.153	0.24

Table 4: Percentage of change of reform period correlations to pre-reform correlations

	Hyderabad	Karachi	Lahore	Multan	Peshawar	Rawalpindi	Sargodha
Faisalabad	-52	-14	-15	79	192	11	4
Hyderabad		15	11	15	127	-48	70
Karachi			66	176	415	96	-24
Lahore				31	42	18	-2
Multan					-59	-13	40
Peshawar						19	21
Rawalpindi							-50

Note: change of correlation is calculated by {[(reform-period) - (Pre-reform)/reform period* 100}

Table 5: The explanatory power of other markets prices on the price of one particular market (Residual based test)

	Markets*							
Periods	Fd	Hd	Kch	Lh	Mn	Pewr	Raw	Sgh
Pre-reform								
SSR Uni (1)	3383.90	4687.20	3127.70	1913.60	4360.70	1476.80	3811.50	1666.60
SSR VAR (2)	3014.20	4411.60	3615.70	1515.00	2675.10	1766.30	2900.10	1487.90
{(1-2)/1×100}	10.92	5.87	-15.60	20.82	38.65	-19.60	23.91	10.72
Average				9.46%				
Reform								
SSR Uni (1)	10033.80	4016.10	10104.50	4127.60	6861.60	7219.10	9442.80	9197.80
SSR VAR (2)	8583.10	3116.40	8214.50	3911.80	4897.90	5747.50	6125.90	7685.00
{(1-2)/1×100}	14.45	22.40	18.70	5.22	28.61	20.38	35.12	16.39
Average				20.16%				

Note: pre-reform Period I: 1981:01---87:04; reform period: 1987:05--- 2001:04, * Indicates Fd, Faisalabad; Hd, Hyderabad; Kch, Karachi; Lh, Lahore; Mn, Multan; Pewr, Peshawar; Raw, Rawalpindi; Sgh, Sargodha

This evidence provides support to the view that there is an increased degree of linkages between markets during reform period. Further, through the examination of these coefficients it can also be concluded that the markets nearest to each other do not necessarily produce strong magnitude of price co-movements and hence could not be strongly integrated.

Table 4 depicts the percentage change of reform period correlations to pre-reform correlations. In other words this table presents whether the change in these correlations between two markets decreased or increased in relation to coefficients during reform period. Out of 28 pairs, only 9 pairs of markets showed decreased estimated coefficients during reform period. This indicates that market reforms contributed positively to market integration, as coefficients of most markets increased.

Some authors, however, attach some doubt with the results of correlation coefficients. (Harris, 1979). They argue that contemporaneous correlation test may overestimate segmentation if lags in information, delivery or contract expiration produce a natural lag in the price response between markets. Further, these simple statistics fail to recognise the heteroskedasticity common in price data of reasonably high frequency (Barret, 1996). So we used an alternative approach that is to some extent built on the previous one.

This approach is aimed at measuring to what extent the Prices in other markets can help to explain the prices in one particular market. Table 5 shows the main results of this approach. This approach consists of a comparison between the (sum of squared) residuals of a simple uni-variate autoregressive model for each market price and the (sum of squared) residuals of a Vector autoregressive (VAR) model for the eight markets prices. As all these markets operate in the trading network of wheat in Pakistan, so we can draw an implication by comparing these prices as they share common trading season within the same period. Further, the comparison between markets within the different period is made to have idea of degree of linkages.

According to Table 5, during pre-reform period, the sum of squared residuals is reduced, on average, by 9.46% when other markets prices are taken into account to explain the behavior of a specific market price. During

reform period, the reduction in the sum of squared residuals decreased, on average, by 20.16%, which is more than double of the rate witnessed during pre-re reform period. These results reveal a higher average degree of linkage between the markets considered during reform period.

The selection of number of lags for the VAR models used for the two periods (ie pre-reform and reform period) was made on the basis of Akaike Information Criteria (AIC) and a single lag was founds sufficient to eliminate any residual autocorrelation.

CONCLUSIONS

Firstly, the market reforms have been able to reduce the spatial price spread. In 21 out of 28 pairs of markets, the magnitude of the spatial price spread deceased during reform period as compared to that of pre-reform period. This suggests the evolution of inter-market arbitrage at lower cost during reform period than in the pre-reform period. This appeared to be due to the active participation of private sector in the wheat marketing activity, which resulted in the reduction of spatial price margin.

Correlation coefficients, based on first differenced prices, which eliminates spurious correlation arising from the presence of common trends, appeared in general higher during reform period relative to pre-reform era. This indicated that reform efforts contributed positively to higher degree of linkages between markets. The general view that the more near two markets are the stronger will be the co-movement of their price, did not get support from these results.

The residual based test, which computes the explanatory power of other market prices on the price of one particular market, also revealed that there is higher degree of linkages during reform period.

RECOMMENDATIONS

In the light of the above conclusion, less intervention is needed to enhance market integration and thus the market efficiency. More liberalized the marketing system is, the more integrated the markets. More integrated markets will also benefit the consumers and producers alike. In more liberalized and integrated markets correct price signals are assumed to be transmitted down the marketing channel and consequently will encourage farmers to specialize according to their comparative advantages.

In highly integrated markets where there exists interdependence of price changes across spatially separated markets in the long run, the government can limit the extent of its market intervention through price stabilisation activities. Since the impacts of market injections on price formation process will be transmitted quickly among these markets, the duplication of market intervention can be avoided if price stabilisation process is initiated in some well-chosen reference markets. Further, by encouraging the private sector to participate in the trading activity as much as possible in the integrated markets, government can achieve its food security and social stability objectives without having high costs. Government agencies, therefore, in light of these results should concentrate on building buffer stock required for food security and social stability and should reduce its other commercial operations like price ceiling and ban on intra-district movement of wheat. Price ceiling discourages market integration and also hurts the producers and affects their wheat production in the following years.

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