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Asymmetry in Price Transmission of the Czech Wheat Agri-food Chain

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Anotace

Tento článek je zaměřen na posouzení symetrie, resp. asymetrie cenové transmise ve vybraných dílčích vertikálách pšenice potravinářské v České republice, konkrétně hladké mouky, světlého pečiva a konzumního chleba. Asymetrie cenových přenosů je zkoumána ve vztahu cena zemědělských výrobců-cena průmyslových výrobců a cena průmyslových výrobců-spotřebitelská cena. Vlastní analýza je založena na pojetí symetrického a asymetrického chování, kdy je zkoumán vliv kladných a záporných změn cen na jednotlivých úrovních vertikály na navazující úrovně, dále potom na symetrii a asymetrii cenových přenosů mezi navazujícími cenovými úrovněmi. Pro naplnění cíle jsou použity upravené Vector error correction modely a impulse-response analýza. Analýza je založena na časových řadách jednotlivých cen obsahujících měsíční údaje v období leden 1999 – říjen 2011. Vlastní analýza ukázala, že některé vztahy mezi cenami na jednotlivých úrovních zkoumaných výrobkových vertikál vykazují symetrickou povahu, zatímco jiné dílčí vazby jsou povahy asymetrické. Z komplexního hlediska lze však vertikály považovat za asymetrické a asymetrii lze označit jako tzv. „upward asymmetry“. Z analýzy je dále zřejmá pomalá reakce cen na jednotkové cenové šoky, avšak i přes délku období je po vychýlení z rovnovážného stavu dosaženo nové rovnovážné úrovně.

Klíčová slova

Cenová transmise, VECM, impulse-response analýza, asymetrie, zemědělsko-potravinářský trh, výrobková vertikála, pšenice.

Abstract

This article focuses on the assessment of the symmetry or asymmetry of price transmission in selected partial verticals of foodstuffs wheat in the Czech Republic, specifically of smooth flour, white baked goods and consumer bread. The asymmetry of price transmissions is examined in the relationship of agricultural producer price – industrial producer price and industrial producer price – consumer price. The analysis itself is based upon the concept of symmetrical and asymmetrical behavior, where the effect of positive and negative changes in prices on individual levels of the vertical to connecting levels is examined, as well as also symmetry and asymmetry of price transmissions between connecting price levels. For the fulfillment of the objective, adjusted vector error correction models and impulse-response analysis are utilized. The analysis is based upon time series of individual prices containing monthly data within the period of January 1999 – October 2011. The analysis itself showed that some relationships between prices on individual levels of the analyzed product verticals show a symmetrical nature, while other partial relationships are of an asymmetrical nature. However, from a comprehensive standpoint, verticals can be considered to be asymmetrical and the asymmetry can be called “upward asymmetry”. Further, the analysis shows a slow reaction of prices to unit price shocks, but even despite the length of the period, a new equilibrium level is reached after deviation from a state of equilibrium.

Key words

Price transmission, VECM, impulse-response analysis, asymmetry, agri-food market, product vertical, wheat.

Introduction

The analysis of price transmissions has a steadily greater significance when examining markets, and not only agri-food markets. Peltzman (2000) analyzed the nature of price transmission within selected product verticals in the USA. That extensive research was conducted on the example

of 282 commodities, of which 120 were agricultural commodities. On the basis of the conducted analysis, it was established that price transmission can generally be considered to be asymmetrical, which does not confirm the general economic theory, which according to the author erroneously assumes symmetrical price transmissions.

Asymmetrical behavior can be caused by various factors. Imperfectly competitive markets and transactional costs, and further also political interventions, asymmetrical information or management tend to be mentioned as the most frequently indicated causes of asymmetrical behavior. In agri-food verticals, imperfectly competitive markets, primarily in terms of the agricultural initial producer and consumer, as the first and final segment of the given vertical, usually tend to be considered to be the cause of asymmetrical price transmission. Von Cramon-Taubadel, Meyer (2000) state that in political discussions, the main cause of asymmetrical price transmission is considered to be primarily abuse of market strength on the part of certain segments of the chain. In this regard, Vavra, Goodwin (2005) state that imperfectly competitive market structure can serve as a significant factor for explaining asymmetrical price transmission, but nevertheless this relationship cannot be considered to be causal. The reason is that asymmetry in price transmission can be expressed both in the case of perfect competition, as well as in the case of imperfectly competitive markets. Thus, it cannot be associated only with imperfect competition and abuse of market strength. For example, Azzam (1999), McCorriston et al. (2001) and Weldegebriel (2004) also reached the same conclusion. For example, Jensen, Møller (2007) and Meyer, von Cramon-Taubadel (2004) indicate transactional costs as one of the main causes of asymmetry in price transmission. Gardner (1975), Kinucan, Forker (1987) and Serra, Goodwin (2003) see the cause of asymmetrical price transmission primarily in state interventions, for example in the form of the support of agricultural producer prices or the introduction of production quotas. Von Cramon-Taubadel, Meyer (2000) further state that even despite the existence of many possible causes of asymmetrical price transmission, the problem of an impossibility of differentiation and identification of the individual causes of asymmetry arises in the case of empirical analysis.

From a theoretical standpoint, the issue of symmetry and asymmetry in price transmission was dealt with, for example, by Frey, Manera (2007) and Meyer, von Cramon-Taubadel (2004).

The objective of this article is to establish, on the basis of quantitative analysis, whether the product vertical of foodstuffs wheat can be considered, in terms of price transmissions, to be symmetrical or not. On the basis of knowledge of the functioning of agri-food markets, it can be assumed that an increase and decrease in prices on individual levels will not be transmitted to a further level in the same manner. However, it can be assumed that the vertical of foodstuffs wheat is characterized by asymmetrical behavior in terms of price transmissions.

Materials and methods

The view of symmetry and asymmetry within price transmission can be various and differs within the interpretation of various authors. The fulfillment of the objective of this article is based primarily upon the general, frequently utilized definition of asymmetry in price transmission. This concept of asymmetry is set out, for example, by Stigler, Tortora (2011) - “asymmetric price transmission” is the situation where the response of a price to another price’s change depends on whether the change was positive or negative. When a price increase is better transmitted than a price decrease, it is said “positive” or “upward” asymmetry, the opposite case being called “negative” or “downward” asymmetry.

Symmetry or asymmetry in price transmission can be analyzed by way of various approaches and models. Frey, Manera (2007) indicate four types of models appropriate for the analysis of asymmetrical price transmission, specifically the Autoregressive Distributed Lag model (ADL), the Partial Adjustment Model (PAM), the Error (or Equilibrium) Correction Model (ECM), and the Regime Switching Model (RSM). Acquah (2008) indicates three types of approaches, or models, for the analysis of asymmetrical price transmission, specifically the Houck approach, the adjusted VECM model, and the TVECM model.

On the basis of a theoretical model according to Frey, Manera (2007), the adjusted vector error correction model (VECM) is defined for the analysis of asymmetrical behavior in price transmission in the following manner:

$$\Delta y_t = \mu + \sum_{h=1}^{r} \beta_h \Delta y_{t-h} + \sum_{i=0}^{s} \alpha_i^{+} \Delta x_{t-i}^{+} + \sum_{j=0}^{q} \alpha_j^{-} \Delta x_{t-j}^{-} + ECT + \varepsilon_t,$$

where the effect of the relevant prices is analyzed according to whether the price change is positive (+) or negative (-). Further, μ represents a constant, ε_t is the random element of the model, and ECT is the Error Correction Term.

The nature of price transmissions, i.e. the symmetrical or asymmetrical reaction of prices upon unit changes in the agricultural producer price (FP), the industrial producer price (WP) or the consumer price (CP) and a deviation of the markets from a state of equilibrium is analyzed with the utilization of impulse-response analysis and VECM model alpha vectors.

The analysis of symmetry or asymmetry in price transmission is conducted for three partial verticals of foodstuffs wheat in the Czech Republic. The analysis focuses on price transmissions between the agricultural producer price (FP), the industrial producer price (WP1) and the consumer price (CP1) within the vertical of smooth wheat flour, as well as transmissions between the agricultural producer price (FP), the industrial producer price (WP2) and the consumer price (CP2) within the vertical of white wheat baked goods, and price transmissions between the agricultural producer price (FP), the industrial producer price (WP3) and the consumer price (CP3) within the vertical of caraway consumer bread[1].

The analysis itself is based upon time series of individual variables (agricultural producer prices, industrial producer prices and consumer prices within partial verticals of foodstuffs wheat), which contain monthly data within the period of January 1999 – October 2011. The data were provided by the Ministry of Agriculture of the Czech Republic and the Czech Statistical Office. The calculations have been conducted within the Gretl econometric software.

Results and discussion

This part of the article contains the results of empirical analysis including comments explaining the behavior in the analyzed verticals. Neither a statistical standpoint nor other characteristics of the estimated models are a basis for this analysis, or its evaluation, and therefore they are not set out or commented on in the article in detail, but attention has been paid to them in estimating models. The main focus of attention in this section is on the form of estimated parameters among variables expressing positive and negative changes in individual prices, and the results of impulse-response analysis, which shows the reaction of individual prices to unit shocks on other price levels. In the following text, the results of the effect of positive and negative changes on individual prices in the analyzed verticals are set out first, and further, alpha vectors showing the reaction of prices upon deviation from a state of equilibrium and subsequently the results of impulse-response analysis are shown.

The marking of variables used in the quantitative analysis is set out in the Material and Methods section. The agricultural producer price s the same in all analyzed verticals, marked as FP. Further, the vertical of smooth flour is based upon the industrial producer price and the consumer price marked as 1, i.e. WP1 and CP1; the vertical of white baked goods marked 2, i.e. WP2 and CP2; and the vertical of consumer bread marked 3, i.e. WP3 and CP3.

The effect of positive and negative price changes on the further levels of product verticals is set out in Table 1. The table contains estimated parameters of adjusted VECM models of the relevant variables. Cases of symmetrical reactions are marked in blue (in absolute value, the parameter of the positive price change is at least approximately equal to the value of the parameter of the negative price change), while asymmetrical reactions are red (absolute values of parameters of positive and negative price changes are not equal).

The conducted analysis shows that the reactions of prices to a decline or increase in price levels of connecting articles of a vertical are, in partial verticals of foodstuffs wheat, both symmetrical as well as asymmetrical. It may be stated that the reaction of industrial producer prices to a change in the agricultural producer price is predominantly asymmetrical, in all examined verticals. That means that changes in agricultural producer prices are transmitted to the next level regardless of whether they decline or increase.

Further, it can be stated that the reaction of the industrial producer price to a change in the consumer price is symmetrical within the verticals of white baked goods and consumer

[1] The abbreviations of the models' variables are based on the following terminology: FP stands for farm-gate price, WP stands for wholesale price and CP stands for consumer price.

	ΔFP+	ΔFP-	ΔWP1+	ΔWP1-	ΔWP2+	ΔWP2-	ΔWP3+	ΔWP3-
FP			0.006865	-0.003321	0.095743	0.078987	0.002898	-0.010080
WP1	-0.044101	-0.045950						
WP2	-0.027026	-0.025326						
WP3	-0.007711	-0.000788						
CP1			0.004684	0.000893				
CP2					0.171750	0.173412		
CP3							0.010766	0.005214
	ΔCP1+	ΔCP1-	ΔCP2+	ΔCP2-	ΔCP3+	ΔCP3-		
FP								
WP1	-0.001390	-0.007598						
WP2			0.029128	0.032981				
WP3					-0.037457	-0.037075		
CP1								
CP2								
CP3								

Note: The blue color shows symmetrical behavior, while red denotes asymmetrical reactions.
Source: own calculations

Table 1: Positive and Negative Price Changes.

bread, while being asymmetrical in the case of the vertical of smooth flour.

The analysis further shows that in the case of asymmetrical reactions, the reaction to a positive change in price is almost always faster than the reaction to a negative change, which means that prices within the analyzed verticals react faster to an increase in prices within the connecting levels than to their decline, both upwards as well as downwards within the given product vertical. The asymmetry established in these product verticals can thus be considered to be "upward asymmetry". The vertical of smooth flour is an exception, whereby the reaction of WP1 to a decline in CP1 is faster than the reaction to its increase.

It is thus evident from the above that the industrial producer price has a specific position. Even despite certain exceptions, its position shows a symmetrical reaction to changes in prices on other levels of the analyzed verticals. Changes in agricultural producer prices as well as changes in consumer prices are thus transmitted into industrial producer prices in the same manner regardless of whether the change is a decline or an increase. However, this conclusion does not correspond to certain results of other authors. The fact is that previously conducted empirical studies show that generally, industrial producer prices grow much faster than agricultural producer prices and that the reactions of the prices of industrial producers is different in the case of the growth and decline of agricultural producer prices. The reaction of industrial producer prices to a decline in agricultural producer prices is not as fast or complete as in the case of their growth[2]. The differences in the conclusions can be attributed to the choice of the analyzed product vertical as well as the examined destination. The results thus cannot be positively generalized to all agri-food verticals, although partial similarities can undoubtedly be found.

Table 2 contains alpha vectors in individual VECM models, which were derived in the preceding study or the characteristics and description of price transmissions between agricultural producer prices, industrial producer prices and consumer prices within verticals of smooth flour, white baked goods and consumer bread[3]. The table contains alpha values, in each case for the first and second price within the analyzed relationship. In the FP-WP1 relationship, the alpha value for FP is thus given first, and subsequently the alpha value for WP1 is given. The same then goes accordingly for the other analyzed relationships. The higher alpha value

[2] See for example Peltzman (2000), Gauthier, Zapata (2006), Vavra, Goodwin (2005) or Kaabia, Gil (2007).

[3] The results of this analysis including complete VECM models are set out in the publication Rumánková, L.: Market Relations in the Czech Wheat Agri-food Chain.

(in absolute value) in every alpha vector is always marked in color.

Alpha values show the speed of the reaction of individual prices upon the deviation of the system from a state of equilibrium. It is evident from the calculated values that the price at a lower level of the analyzed vertical always reacts faster. However, overall, the reactions of prices are not very fast, and the attainment of a new state of equilibrium thus occurs relatively slowly. This fact indicates the presence of imperfections on the analyzed markets.

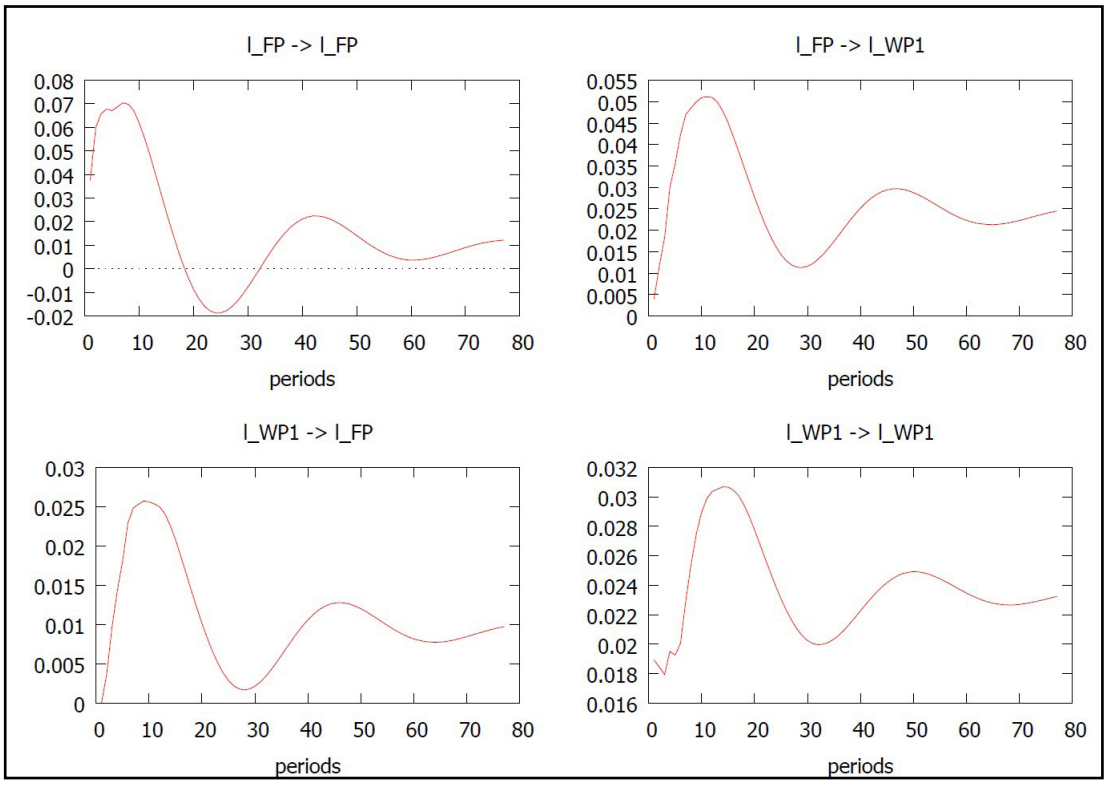
Last but not least, focus is given to the results of impulse-response analysis, i.e. the reaction of individual prices to individual unit shocks of all variables. Graph 1 contains the graphic results of impulse-response analysis for the partial vertical of smooth flour. The results for the other partial verticals then look similar. Table 3 contains an overview of the speed of the return of individual prices to a state of equilibrium after the relevant unit shock of one of the variables, i.e. of the analyzed prices.

Impulse-response analysis showed that upon a deviation of the system from a state of equilibrium caused by a unit shock of any of the prices, another state of equilibrium becomes set. Nevertheless, this is a long-term matter. However, prices head towards such a state even within the short-term. In all cases, a new state of equilibrium is established after approximately 50 periods, i.e. months. However, the speed of the reaction of individual prices slightly differs. The analysis shows that the reaction of the agricultural producer price is generally faster

	FP-WP1	WP1-CP1	FP-WP2	WP2-CP2	FP-WP3	WP3-CP3
1st price	-0.123980	-0.196060	-0.121740	-0.106640	-0.091835	-0.123860
2nd price	0.050621	-0.084875	0.027117	-0.070072	0.018970	0.028794

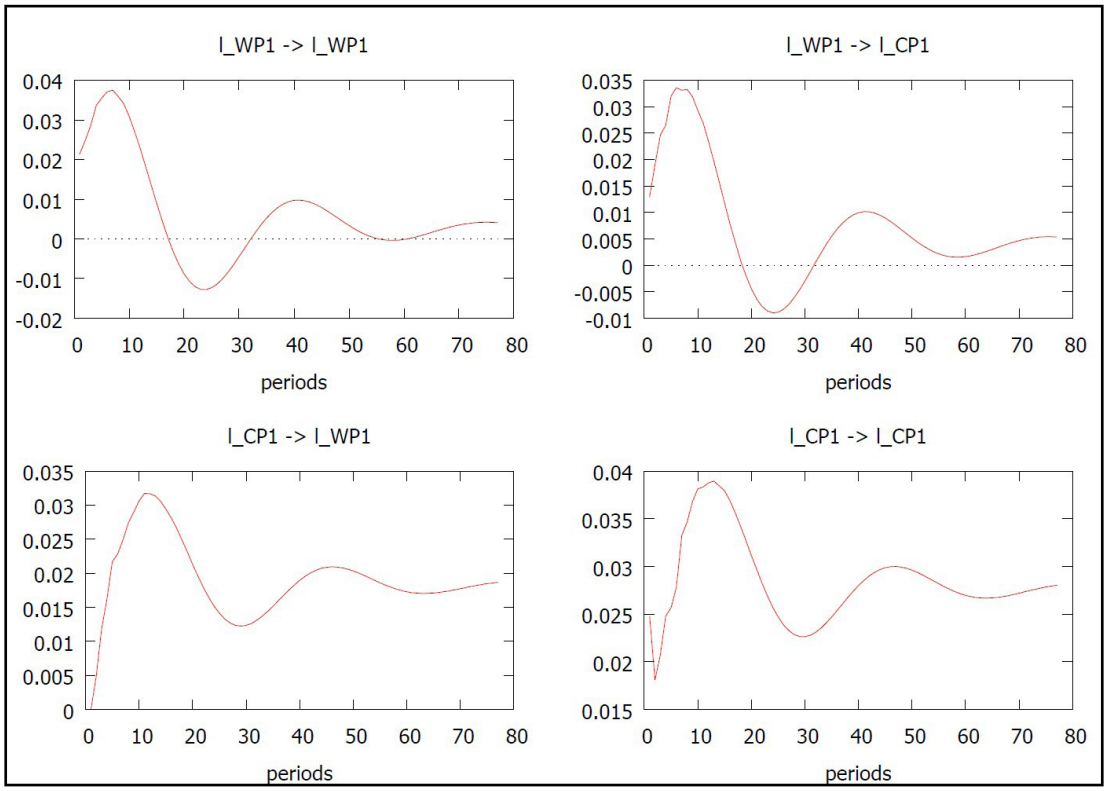
Note: Higher (absolute) values within each alpha vector are marked in color.
Source: own calculations

Table 2: Alpha Vectors.



Source: own processing

Graph 1: Impulse-Response Analysis within the Partial Vertical of Smooth Flour.



Source: own processing

Graph 1: Impulse-Response Analysis within the Partial Vertical of Smooth Flour (continuation).

FP-WP1	FP	WP1	WP1-CP1	WP1	CP1
FP shock	45	50	WP1 shock	50	50
WP1 shock	45	50	CP1 shock	50	50
FP-WP2	FP	WP2	WP2-CP2	WP2	CP2
FP shock	50	55	WP2 shock	50	55
WP2 shock	55	65	CP2 shock	50	50
FP-WP3	FP	WP3	WP3-CP3	WP3	CP3
FP shock	50	55	WP3 shock	45	45
WP3 shock	55	55	CP3 shock	50	50

Source: own calculations

Table 3: Impulse-Response Analysis.

than the reaction of the industrial producer price, both to FP shocks, as well as WP shocks. Further, it was established that industrial producer prices and consumer prices adapt to WP and CP unit shocks in relatively the same manner. It can thus be stated that the agricultural producer price reacts the best to unit shocks, but nevertheless, the reaction of industrial producer prices and consumer prices is only several periods (approximately 5 months) slower.

The results of impulse-response analysis support the results of analysis conducted on the basis of alpha vector values. If a deviation of the system from a state of equilibrium occurs, for any reason, the establishment of a new equilibrium price level is thus a long-term matter. This result once again shows the presence of imperfections within the analyzed product verticals.

Conclusion

The objective of this article was to identify, with the utilization of quantitative analysis, the nature of relationships between the agricultural producer price, the industrial producer price, and the consumer price within partial verticals of foodstuffs wheat in the Czech Republic. The analysis itself was based upon the analysis of time series of individual variables containing monthly data within the period of January 1999 – October 2011. The nature of price transmissions was analyzed with the utilization of an adjusted vector error correction model, impulse-response analysis and alpha vectors.

The conducted analysis has established that some partial links between the analyzed price levels are symmetrical, while others are asymmetrical. The analysis showed that prices within the analyzed verticals react faster to an increase in prices within connecting levels than to their decline, both in the upward direction as well as downward within the given product vertical. The asymmetry established in such product verticals can thus be considered "upward asymmetry".

Further, a specific position of the industrial producer price was identified, which was the only one to show more significant signs of symmetrical reactions. However, this finding does not change anything in regard to the established presence of imperfections within the analyzed product verticals.

The analysis further showed that prices at a lower level of the vertical react faster upon deviation from a state of equilibrium. However, the reactions of prices are not very fast, and thus a new state of equilibrium is established relatively slowly. Upon unit price shocks, it occurs after approximately 50 months. This is thus a long-term matter. In this case, the agricultural producer price reacts the fastest.

From a comprehensive standpoint, it is therefore necessary to consider the analyzed verticals of foodstuffs wheat as asymmetrical. Even despite partial symmetrical price transmissions in all verticals, asymmetrical reactions predominate. The basis of asymmetry within the analyzed verticals can generally be attributed to transaction costs, asymmetrical information as well as an imperfectly competitive environment. Price transmission within the vertical of foodstuffs wheat in the Czech Republic is also influenced, among other things, by government interventions. As stated by Syrovátka (2013), governments' interventions into the wheat market equilibrium or into wheat price level are not usually and/or regularly realized. Thus, we cannot speak about any price fixing within the Czech wheat market. This situation can thus lead to asymmetrical behavior within the analyzed product vertical, because, as has already been stated, asymmetry can be based upon an imperfectly competitive environment, which government interventions undoubtedly lead to.

Studies of market relations within the wheat vertical in other world countries also show the presence of asymmetry upon price transmissions. Several factors are considered to be the causes of these market imperfections. Agricultural producers and consumers are usually considered to be disadvantaged segments of the chain. Goychuk (2013) showed that Ukraine farmers belong among the major losers, due to the export restrictions, since the high world wheat price is not fully transmitted to them. Then, bakers are caught up in-between bread market and controlled by government and millers who are slow at passing on to them the decreases in wheat prices. Similarly, Acharya et al (2012) established that there are partial symmetrical as well as asymmetrical relationships in price transmission on the Indian wheat market.

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