Part 5

CHAPTER 4

MARKET STRUCTURE, ASYMMETRY AND PRICE TRANSMISSION IN THE FOOD CHAINS

"Market power is like the wind. You can feel it but you cannot see it"
(Kohls and Uhl 2002, p 270)

4.1 Introduction

Price is the primary mechanism by which various levels of the market are linked. The extent of adjustment and speed with which shocks are transmitted among producer, wholesale, and retail market prices is an important factor reflecting the actions of market participants at different levels. The transmission of changes in the producer price to changes in the consumer price depends, however, greatly on the type of product. Products that are perishable and undergo minimal processing such as vegetables, fruit, and fresh milk, are expected to have a relatively quick price transmission mechanism. Products that however undergo a certain level of processing and are not as perishable as fresh produce, are expected to have a slower price transmission mechanism. This is particularly noticeable for commodities such as maize, wheat and sunflower that can be stored relatively easily and are traded on the futures market, where processors can hedge against large price fluctuations. It is due to storability and hedging strategies that various time lags exist between changes in commodity prices and consumer prices.

Because of supply and demand fluctuations, prices are subject to a certain degree of variation. The more a price fluctuates from a long-term trend the more volatile a price is said to be. Volatility is also, however, also a measure of risk, that is, the more volatile a commodity price is, the higher the risk the farmers and processors are subjected to in terms of their expected returns. The main consequence of high risk is increased prices since the profit-maximizing firm is forced to hedge against large price fluctuations through hedging strategies. On the consumer side, however, increased volatility makes budgeting increasingly difficult, especially when prices increase beyond an accepted amount.

4.2 Time lags

Economic variables, mostly, do not respond instantaneously to changes in related variables. For example, the rise in fuel prices will not affect the prices of goods on that same day. The modern electronic nature of pricing and record keeping, however, implies that prices can be adjusted the following day (as opposed to monthly or quarterly adjustments). Thus, it is necessary to determine the period of input- or related price changes (lags) that affects the recent prices of goods and services. This, in turn, affects the correlation, i.e. the tendency of two or more variables to be related, positively or negatively.

The following figures indicate the relationship between the maize meal price and the SAFEX white maize nearest contract price, both in monthly averages. From the figures, it is clear that as the SAFEX price is lagged, the two graphs get closer and closer together and the correlation (percentage in the graph) between the two prices increases. This gives us an indication that the SAFEX white maize price increases (on a monthly average) will cause the consumer maize meal price to increase between three and four months later, because this is where the highest correlation values are found.

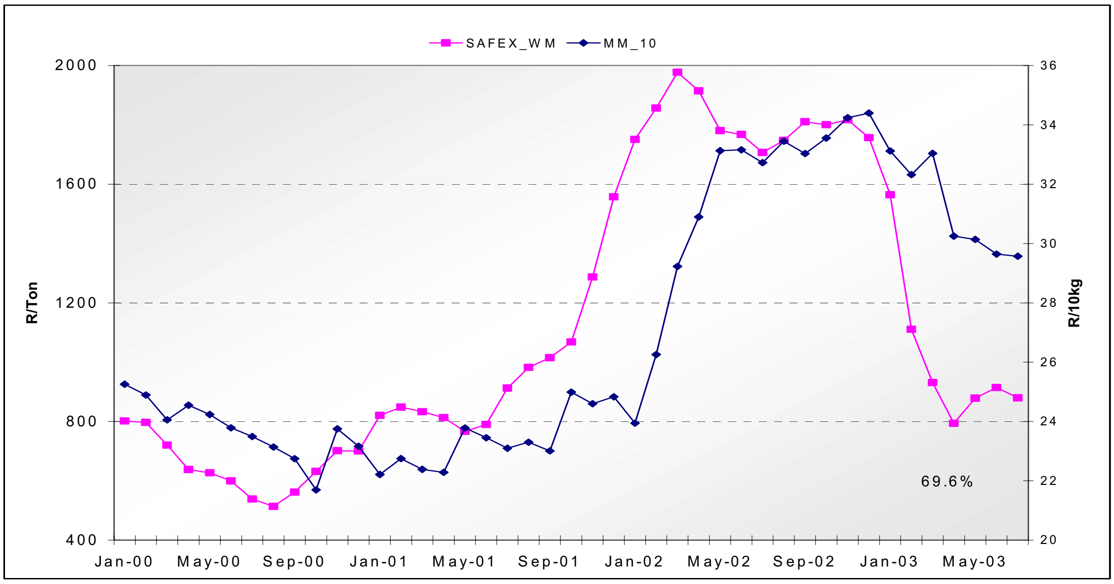

Figure 4.1: SAFEX white maize price and maize meal price, no lags

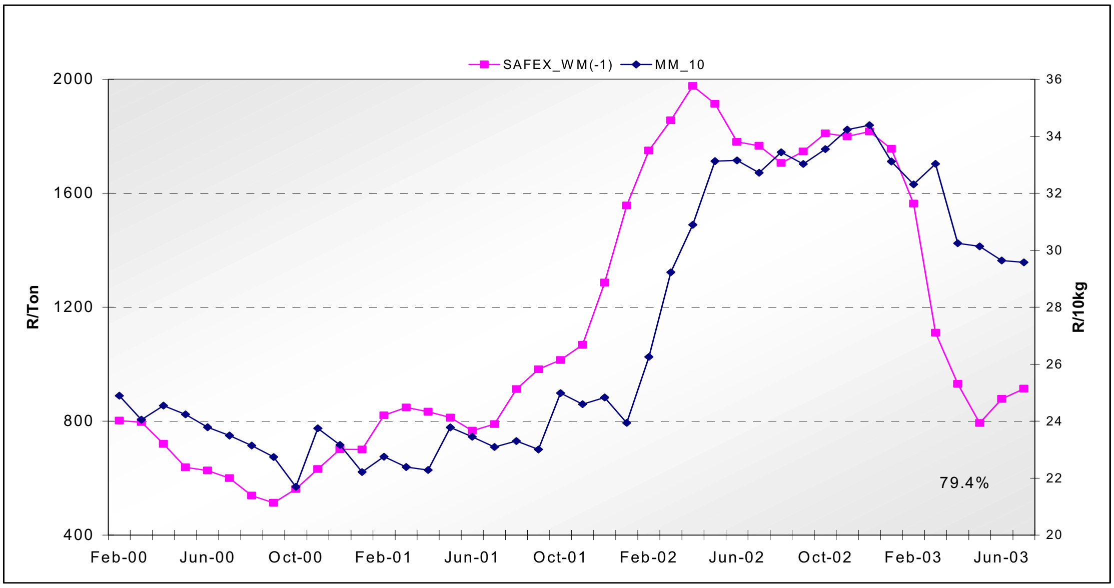

Figure 4.2: SAFEX white maize price and maize meal price, 1-month lag

Note: When a data series is lagged, it is possible to either move one series back in the graph, or the other one forward. In this case, the SAFEX price was moved forward. Thus, for example, the February SAFEX maize price is compared with the March maize meal price. As the number of lags increases, so does the gap in months between the prices being compared. Thus, when the SAFEX price is lagged by four months the February SAFEX price is compared with the June maize meal price.

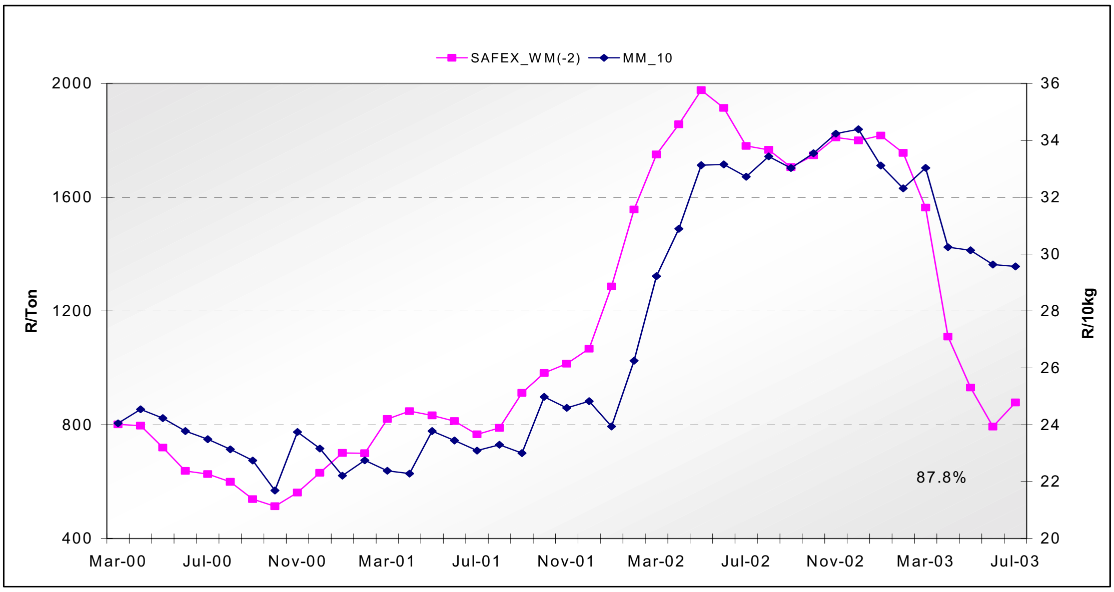

Figure 4.3: SAFEX white maize price and maize meal price, 2-month lag

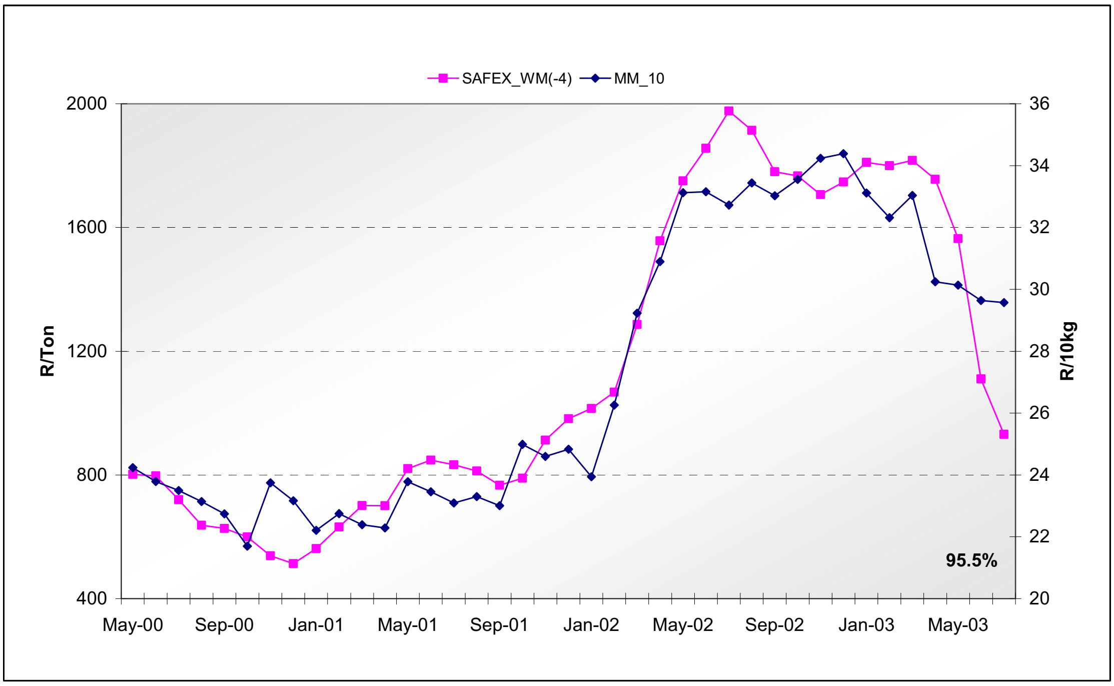

Figure 4.4: SAFEX white maize price and maize meal price, 4-month lag

The above process was repeated for wheat and bread prices, and for sunflower seed and cooking oil prices. The correlation between the wheat and bread prices is the highest when the SAFEX wheat price is lagged 4 months. The correlation between sunflower seed and cooking oil prices is the highest when sunflower seed prices are lagged 3 months.

4.3 Volatility

Prices naturally increase and decrease; however, these fluctuations usually occur around an average price. The volatility of prices is a measure of the uncertainty of a price. This means that the higher the volatility the more uncertain the price is because of a higher degree of variation around the mean. Volatility can be measured daily, weekly, monthly and annually depending on the data available and the price being studied. Here monthly data were used to calculate the annual volatility using the Black-Sholes-Merton differential equation method of calculating volatility. The tables below indicate the volatility of the consumer price and that of the commodity price closely related to it.

Table 4.1: Maize volatility

	Maize Meal	SAFEX white Maize
Jan00-Dec00	12.5%	32.80%
Jan01-Dec01	12.40%	29.40%
Jan02-Dec02	15.40%	18.30%

From the above Table it is clear that maize meal prices have remained fairy stable in terms of their level of volatility, with volatility increasing slightly for the year 2002. The commodity price (SAFEX white maize), however, has had a decreasing volatility year-on-year. Although it is generally expected that the consumer price volatility decrease when commodity price volatility decreases. This was not the case.

The bread price volatility remained around 9% for the three years under study. The SAFEX wheat price volatility showed much variation year-on-year. Again, commodity prices showed varying volatility while the consumer price volatility stayed the same. This indicates that there is little correlation between the volatility (or degree of variation) of the commodity price and the consumer price.

Table 4.2: Wheat and bread volatility

	Brown Bread	SAFEX Wheat
Jan00-Dec00	9.32%	13.26%
Jan01-Dec01	9.62%	24.42%
Jan02-Dec02	9.80%	18.26%

Table 4.3: Sunflower seed and cooking oil volatility

	Cooking Oil	SAFEX Sunflower Seed
Jan00-Dec00	6.15%	14.03%
Jan01-Dec01	13.70%	17.76%
Jan02-Dec02	19.41%	19.83%

Sunflower seed and cooking oil, however, present a different picture. Both the commodity price and the consumer price saw year-on-year increases in volatility. Thus, there appears to be a certain degree of correlation between the volatilities of the two prices. However, consumer price volatility may also be caused by exchange rate fluctuations as cooking oil can, and is, competitively imported.

In the case of the analysis of beef prices, we used the method known as Generalized Autoregressive Conditional Heteroscedasticity or GARCH[2] to measure the price volatility. This method distinguishes between the predictable and unpredictable components in the price series, and allows for measuring volatility on the bases of only the unpredictable components in the price series. The conditional standard deviation[3] or price volatility as defined for beef prices is shown in Figure 4.5.

The information presented in Figure 4.5 satisfies two of the conditions for the presence of price volatility, i.e. presence of discrete spikes and the secular increase of such spikes. It is clear that there is an increase in the frequency of the occurrences of discrete spikes and that they occurred more often since the latter part of 1999. The volatility since 2001 can largely be explained by the volatility in the exchange rate.

[2] When constructing econometric models, it is assumed that the variance of the error term is constant (i.e. homoscedastic or time invariant). To test whether this assumption holds, the Autoregressive Conditional Hetroscedasticity (ARCH) method was used in this study and it was found that the homoscedasticity assumption is violated, hence the use of the GARCH process instead of an Autoregressive Integrated Moving Average (ARIMA) model.

[3] Unlike the common measure of volatility (unconditional), the calculation of the conditional volatility is based on the assumption that "producers can distinguish regular features in a price process such as seasonal fluctuations and the ex-ante knowledge of the conditional distribution of commodity price" (Almayaz, et al. 2003).

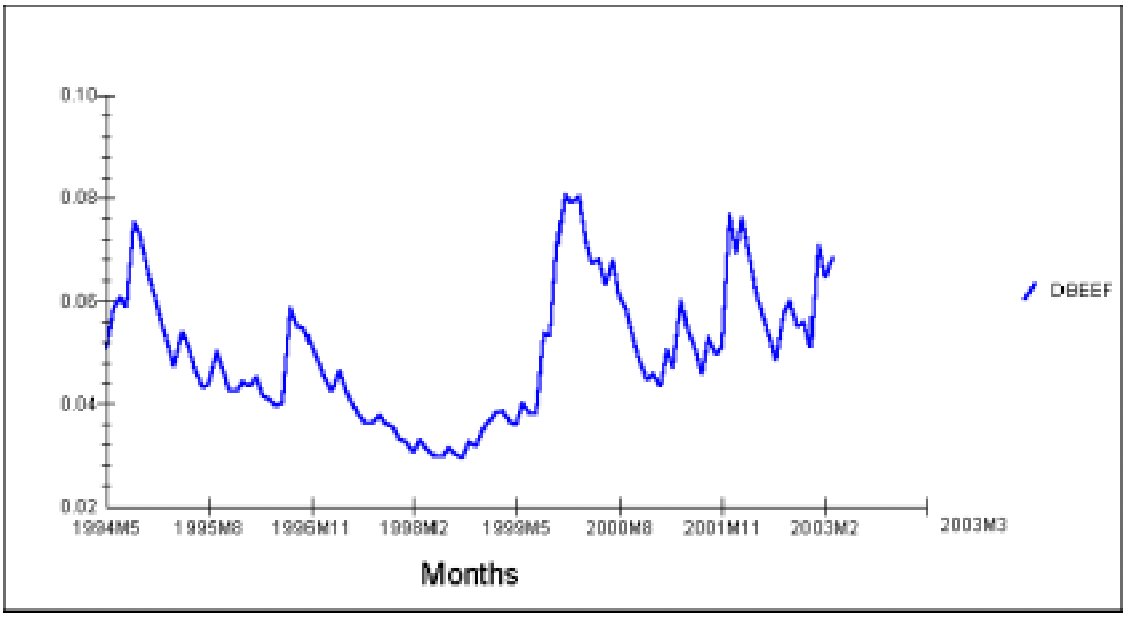

Figure 4.5: Conditional standard deviation of the beef producer price (May 1994 to July 2003)

4.4 Asymmetric Price Transmission

Over the past several decades producers, consumers, food industry interest groups and legislators have been concerned about the efficiency and equity of price transmission of agricultural and food products. Both casual and empirical research indicates that there are several asymmetries in price transmission in food marketing chains (e.g., Von Cramon-Taubebel, Bunte and Peerlings, Miller and Hayenga, Goodwin and Holt, Azzam, and Abdulai). It was found that (1) changes in farm and wholesale prices are either not fully, or they are more than fully transmitted to consumer prices; (2) changes in consumer prices are not related to short-run changes in farm prices and follow medium- and long-run changes in farm prices with a time lag; (3) downstream changes in consumer prices show a longer time lag than upstream changes do.

Several possible explanations can be put forward to explain this asymmetry depending on the market structure and the nature of the product. Of the three asymmetries, the one that appears to be of particular interest in the asymmetry in the adjustment process, is the one dealing with the issue whether retailers pass on price increases, while decreases in price are not completely transferred to the consumer. From the studies stated previously, it appears that this is in fact the case, in particular with agricultural products. One of the reasons price increases are passed on to the consumer faster than decreases, is that firms will react faster to decreases in profit margins than increases. Another reason for the asymmetric price adjustments is the presence of search costs in locally imperfect markets. For example, grocery stores and other retailers may enjoy local market power because of the absence of similar firms in a given neighbourhood. Although customers may have a finite number of choices, they may not be able to gather full information about prices offered by other firms because of the cost of the search. In particular, consumers may observe a price increase at one local retail outlet but they may be uncertain whether others have also increased their prices. Given this scenario, firms can quickly raise prices as upstream prices rise and slowly decrease prices as the upstream prices decline.

Another possible source of asymmetric price transmission is market power. Stephan Von Cramon-Taubadel (1997) suggested that asymmetry in the German pork market was caused by market power and inventory holding. Griffith and Piggott (1994) suggest that well-documented increases in the concentration in the pork, beef and lamb processing and marketing sectors has led to increasing levels of asymmetric price transmission. In general, supply chains for food products are less concentrated at the farm level than at higher levels since economies of scale may limit the number of viable role-players in a market. Oligopolistic processors might, for example, react collusively more quickly to shocks that squeeze their profit margins than to shocks that stretch it. The same can happen if individual firms believe that competitors will match increases in output prices as input costs increase, but do not respond in the same way as input costs decrease.

There are a number of different methods available to the researcher when testing for asymmetric price transmission. The choice of method depends on the data available, the available budget, and the types of questions that need to be answered. The most widely used method for testing market power and asymmetric price transmission in agricultural economics literature is the time-series model. This model is based on the assumption that the agricultural product included in the production process is the largest cost component of the final consumer good. This is an important assumption because the higher the cost component the more direct the effect of increases and decreases of farm prices on retail prices, since few other cost components come into play. Thus, the question being investigated is whether increases and decreases in farm prices are reflected in or transmitted to selling or retail prices. To do this, tests for asymmetric price transmission that are consistent with cointegration are applied to the transmission of commodity prices to retail prices for several goods.

The products investigated in this report include maize meal, bread, cooking oil, fresh milk, long life milk, and cheddar cheese. The prices used in this study are based on the SAFEX white maize nearest month contract, the SAFEX sunflower nearest month contract, the SAFEX wheat nearest month contract, the milk producer price as reported by the National Department of Agriculture, and all consumer prices gathered from the AC Nielson data base. As stated previously, the cost of the primary input as a percentage of the total cost is important in order to determine the degree of price transmission. The Table below reports the average percentage of total cost of the primary input for each of the above products. It is important to note that these are average percentages as commodity prices fluctuate more than the cost of other inputs.

Table 4.4: Main input percentage of total cost of selected consumer goods

	Percentage of total cost
Wheat Flour cost per loaf of Bread	45%
Maize cost per 10kg bag of maize meal	75%
Sunflower seed cost per 750ml cooking oil	60%
Cost of milk per litre of fresh milk	72%
Cost of milk per litre of long life milk	60%
Cost of milk per Kg of Cheddar cheese	80%

Note: These are average costs for the period January 2000-July 2003

Following the percentages listed above it is clear that the costs of raw material are major factors in the production costs of the final consumer good. This was also confirmed by many of the food manufacturers the Committee interviewed. From this it is possible to test for asymmetry in price transmission. The estimation procedure for the asymmetric error correction model for each product can be summarized as follows:

1. Granger causality tests were performed to test that farm prices “cause” retail prices (Granger, 1969).
2. Augmented Dicky-Fuller (ADF) and Philips-Perron tests were performed on all the time series to determine the order of integration. This is important because the series need to be integrated at the same level for the error correction model to be possible.
3. A long run cointegration equation was estimated with retail price as the dependant variable and commodity price (with various lags in some cases) as the independent variable.
4. The error term of the above model needs to be stationary for a cointegrating relationship to exist, thus ADF tests were performed on the error terms.
5. The errors from the cointegrating relationship were divided into two series (ECT+ and ECT-), one for positive errors and one for negative errors
6. The generated series were used to define the error correction terms, and the error correction model was then estimated using the Engel-Granger two-step approach using ordinary least squares.
7. The results of the above model were used to estimate an impulse response function.
8. First, a 10% increase in the commodity price, in an arbitrary month, was run through the model and a new series of expected retail prices was estimated.
9. The difference in the “shocked” price and actual price was calculated and plotted on a graph.
10. Steps 8 and 9 were repeated for a 10% decrease in the commodity price in the same month.

The reader should note that ECT+ indicates that the retail price is “too high” compared to the commodity price, i.e. the profit margin is above its long run equilibrium value. The opposite holds for ECT-. If the coefficient of the ECT- is greater in absolute terms than

ECT+, the retail price reacts faster when the profit margin is squeezed than when it is expanded. The reader should also note that only commodity prices were used to estimate the models and no other costs were included, as they would affect the ECT+ and ECT- terms.

From the above models, it is possible to calculate the price elasticities for each product, that is, how much the retail price (in percentage terms) should increase given a 1% increase in the commodity price. The elasticities for the various goods are reported in the table below.

Table 4.5: Commodity price elasticities

	Price Elasticity
Wheat (-4)* To Bread Price	0.431
Maize (-4)* To Maize Meal Price	0.339
Sunflower Seed (-3)* To Cooking Oil Price	0.739
Milk To Fresh Milk Price	0.849
Milk To Long Life Milk Price	1.022
Milk To Cheddar Cheese Price	0.803

**Note: the number in brackets indicates the number of months the consumer price lags the commodity price.*

Maize meal

The Figure below shows the effect of a 10% upward and downward "shock" to the SAFEX nearest month contract. The 10% increase in the SAFEX price resulted in a R2.42 increase per 10kg bag of maize meal. Assuming all factors returned to normal after this shock, the retail price of maize should gradually return to normal after approximately 8 months. The 10% decrease in the SAFEX price resulted in a R0.95 decrease in the 10kg maize meal retail price, which returned to its normal levels in only 5 months. Thus, price increases were passed on to the consumer much more consistently than the price decreases.

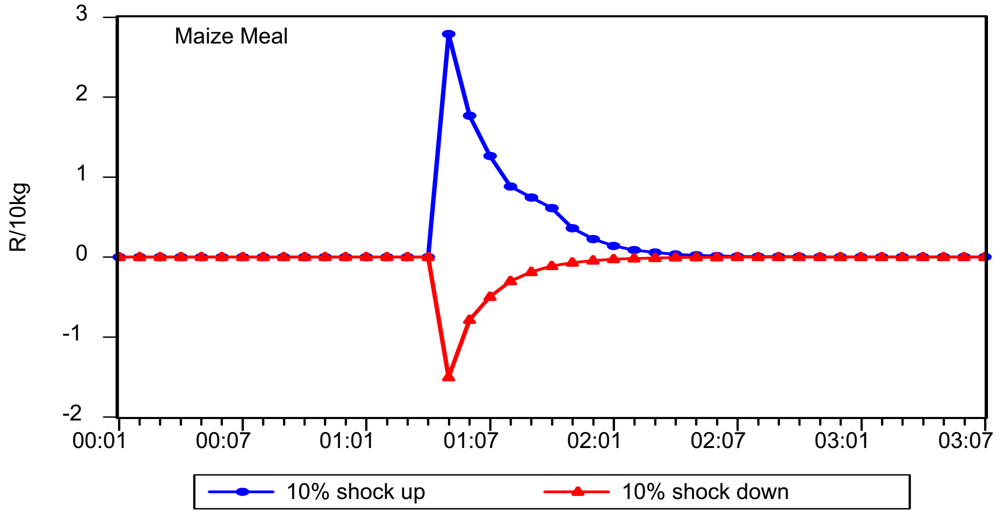

Figure 4.6: Maize meal price change given a 10% up and downward shock

It is difficult to state categorically the reason for this asymmetric price transmission. Several facts need to be taken into account, however. Firstly, 75% of the cost of producing maize meal is maize itself. In other words, the other cost factors only make up 25% of the total cost and, therefore, have little influence on the retail price. Secondly, 75% of the maize meal produced in South Africa is produced by 4 companies. Thus, asymmetric price transmission could be caused by concentration and the resulting market power of these four companies.

Bread

Similar to maize, an impulse response was estimated for a 10% upward and downward shock to the price of the SAFEX nearest month contract for wheat. The results indicated that the bread price was expected to increase by R0.53 for one month, after which it should go down to an increase of R0.14. It was expected that it would take more than 12 months for the increase to reduce itself to zero. The 10% decrease in the SAFEX wheat price would result in a R0.38 drop in the bread price for one month after which the drop in price would be a mere R0.03.

From the results, it became clear that the bread price increase overshot the increase in wheat price for one month after which it returned to more plausible levels of price increases (5.2%) and decreases (1.2%). Although the baking industry is just as concentrated as the maize milling industry, the cost of wheat only makes up 45% of the cost of producing a loaf of bread. Thus, the price transmission is not as direct as that of maize. It does, however, take longer for changes in price levels to run themselves out.

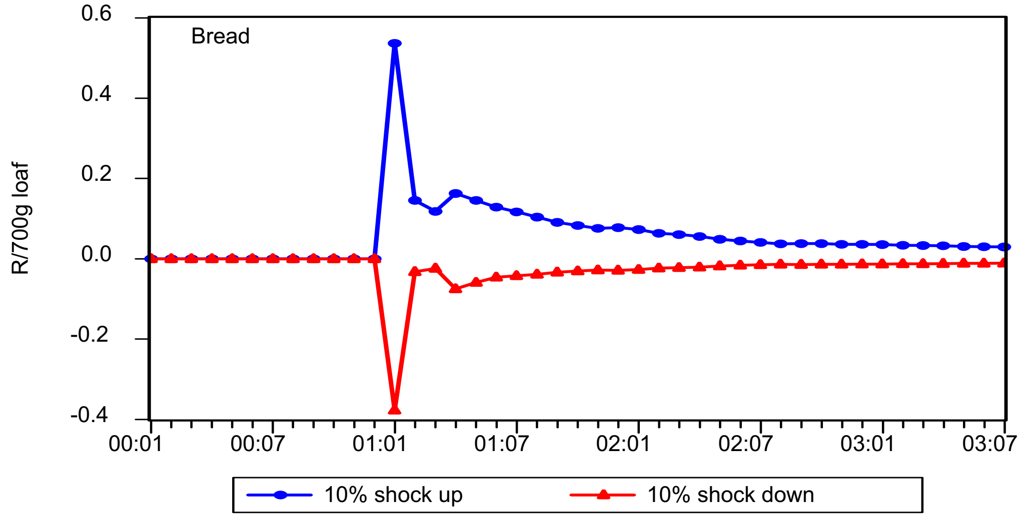

Figure 4.7: Bread price change given a 10% up and downward shock

Dairy

The price transmission of three dairy products was studied. These products are fresh milk, long life milk, and cheddar cheese. All the consumer prices are estimated as a function of the milk producer price, as fresh milk is the primary input for these products.

Fresh milk's asymmetric price transmission displays an interesting difference between upward and downward price effects. Fresh milk is a highly perishable product. Consequently, it could be expected that producers and retailers would avoid increasing their prices since goods may, then, not be sold and thus perish. The Figure below however indicates something completely different. A 10% increase in the producer price of milk results in a R0.17/litre increase in the consumer price of fresh milk. The same downward price change would, however, result in only a R0.04/litre retail price decrease. The decrease in price would work itself out of the system over a period of 8 months while the price increase would take well over 12 months to work itself out.

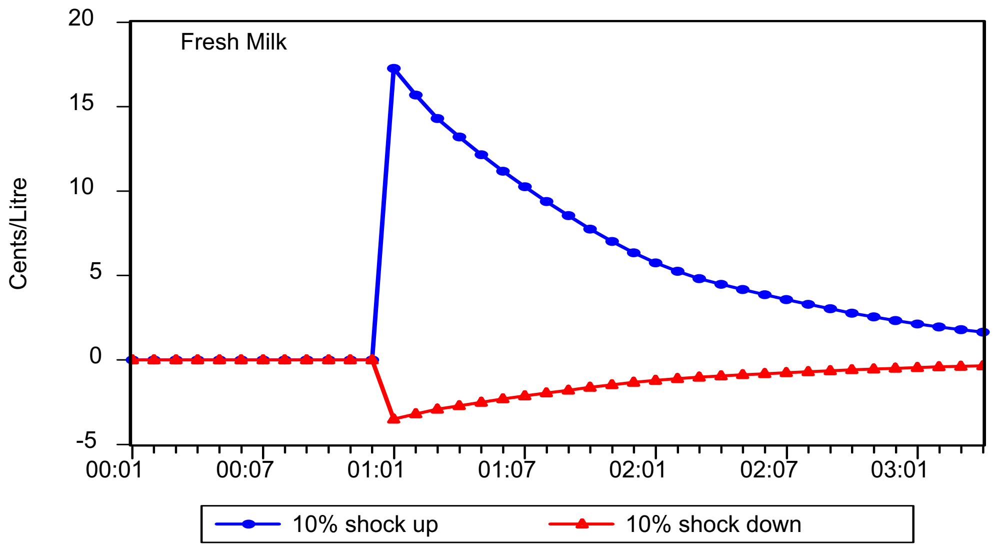

Figure: 4.8: Change in fresh milk prices given a 10% up and downward shock

This large disparity in upward and downward price transmission can help to explain why the consumer prices of dairy products increase almost linearly and why price changes take so long to wear themselves out. Decreases in producer prices have little or no effect on the retail price while increases in producer prices have quite a marked effect. The reason for the existence of such asymmetry in price transmission on such a perishable product could largely be attributed to the oligopolistic dairy manufacturing and distribution system. This makes it possible for these manufacturers (and eventually retailer) to pass price increases through to the consumer. Consumers are not normally aware of producer prices for milk and manufacturers could potentially use this ignorance and the fact that consumers get used to a specific price overtime not to lower prices – one of the reasons then for the downward stickiness of retail prices

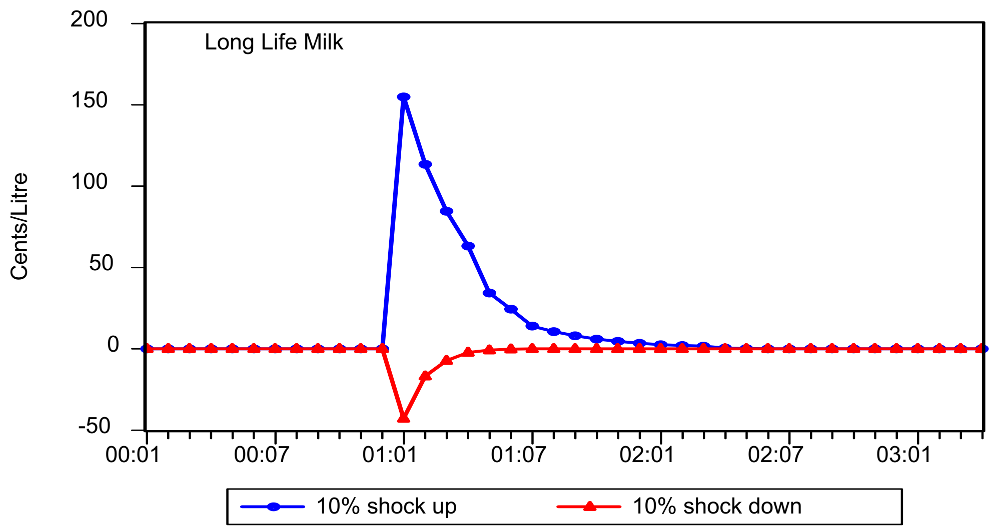

Figure 4.9: Changes in price of long life milk price change given a 10% up and downward shock

Similar to fresh milk, long life milk also displays a large asymmetry in price transmission. A 10% increase in the producer price of milk resulted in a R1.54 increase in the price of long life milk, which would take approximately 12 months to run itself out. Similarly, a 10% price decrease resulted in a R0.43 decrease in the price of long life milk and would take only four months to run itself out.

The final dairy product studied is cheddar cheese, which compared to the previous two products displays a more symmetrical price transmission. A 10% increase in the producer price of milk resulted in a R5.80/kg increase in the retail price of 1st grade cheddar cheese. A decrease in milk price, however, resulted in a R4.90/kg decrease in the retail price of 1st grade cheddar cheese.

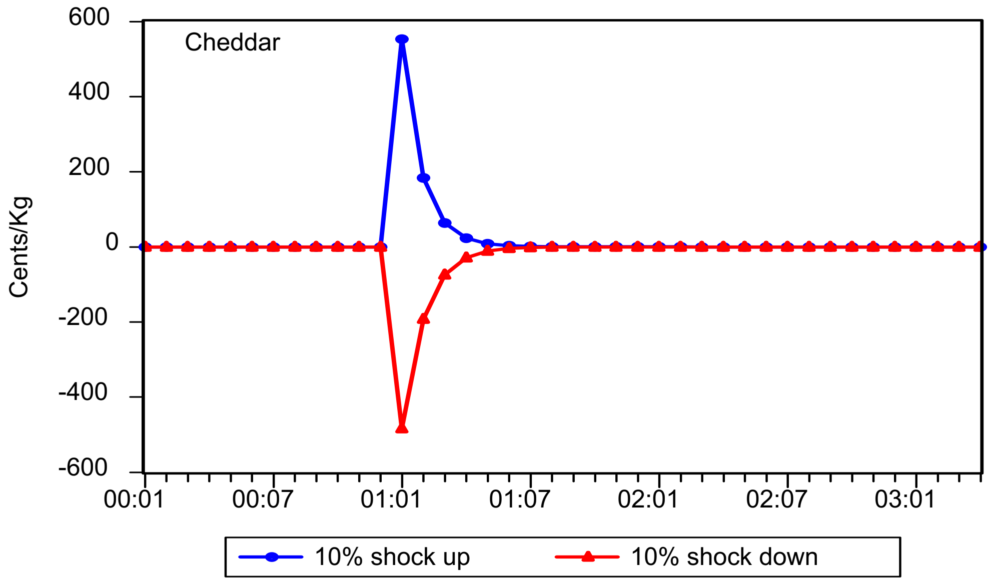

Figure 4.10: Change in prices of cheddar cheese given a 10% up and downward shock

There are approximately 5,000 dairy farmers whose output is sold in an oligopolistic market. There are 2 main dairy processors, namely Clover SA and Parmalat, who are the price leaders when it comes to purchasing milk. A similar situation exists at the retail level where most dairy products are sold through supermarkets and hypermarkets. Thus, there is oligopolistic competition at both the retail and processing level of the market. For a more in-depth discussion on the dairy supply chain and the imperfect competition, the reader is revered to Chapter 5 in Part 4 of the Report.

Given, however, the existence of imperfect competition at both the production and retail level, asymmetric price transmission is likely to be caused by market power within the sector.

Cooking Oil

A similar test was performed for the price transmission from sunflower seed to cooking oil. The results differ from those of the other products because the downward price changes are transmitted by almost the same amount as upward price changes. In fact, both up and downward SAFEX price changes resulted in a R1.27/750ml increase and decrease, respectively. It is interesting, however, that price decreases take longer to return to normal than price increases, which is opposite to the findings re all the other goods.

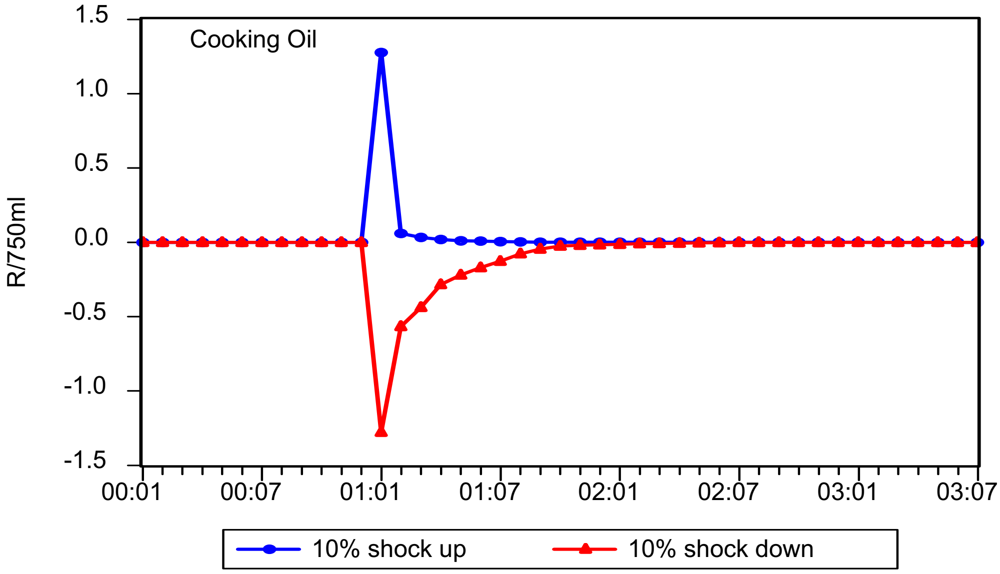

Figure 4.11: Change in price of cooking oil given a 10% up and downward shock

It is difficult to say why the asymmetry in price transmission of sunflower seed to cooking oil is different to that of the other industries. Generally, the more concentrated a market the more asymmetric the price transmission, as was found for the other products discussed here. Although the oil crushing industry is concentrated with only a few role players, cooking oil is imported in bulk, thus decreasing the level of concentration in the cooking oil wholesale market and creating more competition.

Conclusions

Firms incur costs when re-pricing items and will thus only re-price items when the gains from changing the prices (up or down) exceed the costs. There is a range of farm price changes, therefore, which retailers may choose not to re-price. This results in less frequent adjustments both upward and downward. This can be seen in the earlier Section on volatilities. The implication is that pricing rigidity in retail prices during periods of falling farm prices, which draw more attention than rigidity during rising farm prices, may be due to re-pricing costs.

Given the large number of possible variations between commodities, retailers, and consumers, it remains very difficult to determine the cause of observed price asymmetries within a commodity group, and it is not easy to argue that market power and market structure play the main or only role in the manner that prices are transmitted to the retail level.

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