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From farm to retail: costs and margins of selected food industries in South Africa

by

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Thomas Funke

Pretoria

November 2006

Declaration

I declare that

"From farm to retail: costs and margins of selected food industries in South Africa"

is my own work, that all the sources used or quoted have been indicated and acknowledged by means of a complete reference, and that this thesis was not previously submitted by me for a degree at another university.

T. B. Funke Date

Abstract

From farm to retail: costs and margins of selected food industries in South Africa

Degree: MCom: Agricultural Economics

Department: Agricultural Economics, Extension and Rural Development

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This dissertation highlights the need for a formal methodology to be developed in order to unpack complicated supply chains and to publish information that explains how the farm value or farm to retail price spread of certain products can be calculated and how these results are to be analysed.

It is for this reason that the study reviews and applies the methodology used for the calculation of price spreads and farm values. It applies the methodology to five food supply chains of maize, fresh milk, beef, poultry and sugar. The analysis of farm values and spread has already been developed in an international context but it has not of yet been applied in the South African context. It is therefore the aim of this dissertation to illustrate how this methodology can be applied here and how this can be done on a continuous basis.

The main objectives of the study are:

- To review and apply the methodology used for the calculation of price spreads and farm value, as well as to analyse trends of five agricultural commodities in the food sector.
- To understand not so much on what is behind the previous rise in food prices, but rather on why; when the farm or producer prices fall, do retail

prices on certain goods not fall by the same margin? The question that needs to be asked is who or what is responsible for this? A detailed analysis of the supply chain of various products could prove invaluable in the process of understanding price movements.

- To investigate the degree of transparency of information in the South African food sector is investigated by looking at the market share that the various supermarket chains hold. Since competition and concentration of role players within this sector of the economy plays such a vital role in the determination of the market's fairness, it is important that the size and the percentage of market share that the retailers hold in the market is researched and understood. A special section focuses on the market share that some retailers hold as a percentage share of the entire supermarket retail sector.
- To discuss the estimation of the specific cost incurred, at various levels, within the maize-to-maize meal and beef-to-beef products supply chains, in detail. This involves designing a framework for the continuous analysis of food prices and costs contained within these two supply chains and understanding the costs incurred by the different role players.

In applying the methodology to estimate farm value and farm to retail price spread it is determined some of the commodities such as beef, milk and sugar experienced a slight widening of the farm to retail price spread, while the opposite occurred with the price spread of maize meal and broiler meat. A widening farm to retail price spread shows that farmers' share in terms of the retail price is declining and as a result their share of the final product has become less. Farmers in the beef, milk and sugar sectors experienced this while maize and chicken farmers experienced the opposite, in other words a narrowing spread and as a result they are earning more of the final product.

In applying the various econometric tests in order to test for asymmetric price behaviour in the various supply chains it was found that in four of the five supply chains the transmission of increases in producer prices where not smoothly and timely transmitted to the retail price. The models that fared worst in the analyses were those of the sugar, beef, fresh milk and a part of the maize supply chain. The inabilities of the models to show any form of significance, even when tested economic theory is applied indicate that something is amiss within the supply chains. Asymmetric price transmissions, a lack of accurate data or unjust market behaviour by role players within the supply are some of the factors that could be responsible for this. The analysis in chapter 5 is based on these findings. A proposed framework for an in depth analysis of such a supply chain is documented there.

The detailed analysis of costs and margins in the maize to maize meal and beef supply chains, have shown that there are many stages along the supply chain, where various costs and profits can have severe influences. In chapter 5 a detailed analysis has been done on this with the objective of developing a framework that can be applied to an industry. This chapter lends specific detail as to where the influences of such costs can be the greatest.

The results point out that, of the five supply chains, only two of them, namely chicken and maize (from farm gate to miller), adhered to some form of economic theory, whereas the other three either suffered from insignificant/unrepresentative data or actual price transmission asymmetry. On the basis of this, the supply chains of both super maize meal and the five selected beef cuts were unpacked with the profit margin and the role player's cost of formation at the different levels within the value chains. A conclusion can be made that parts of the maize supply chain (milldoor to retailer), the beef supply chain, the sugar supply chain and the dairy supply chain all suffer from asymmetric price transmissions or alternatively, a data discrepancy. This conclusion is drawn from the fact that the Error Correction Models ECMs for these specific industries failed most of the diagnostic tests and contained some insignificant variables. The diagnostic tests did not only test for misspecification but included a standard procedure, using the Jarque Bera test for normality, the ARCH LM test for heteroscedasticity, the White test for heteroscedasticity as well as the Breusch Godfrey test for serial correlation. The fact that the ECMs of these supply chains had these problems does give rise to a concern as to the transmission of prices within some of the supply chains within the South African food industry.

The applied methodology used in unpacking of the supply chains, was applied with the aim of developing a framework that can be adapted and used for similar analyses in future. The aim of this methodology was solely on developing and applying a methodology to two of the five supply chains, partly based on the results in chapter 4 but also on the importance of the commodities in the South African food industry, and to illustrate, by using real data, how this framework can benefit future research.

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Abbreviations

ADF	Augmented Dickey Fuller test
BTT	Board of Tariffs and Trade
CC	Competition Commission
DLN_A2BEEF	Differenced national weighted average A2 quality beef price
DLN_A2BEEFLAG	Differenced and 1 month lagged national weighted average A2 quality beef price
DLN_CHKPP	Differenced chicken producer price
DLN_FGPRWM	Differenced farm gate producer price of white maize
DLN_FMPP	Differenced fresh milk producer price
DLN_MDPWM	Differenced milldoor price of white maize
DLN_SGCPRSALAG	Differenced and lagged sugar cane price for South Africa
ECM	Error Correction Model
ERS	Economic Research Service, at the United States Department of Agriculture
FPMC	Food Price Monitoring Committee
LN_AMDPSG	Log of the average milldoor price of sugar
LN_A2BEEF	Log of the national weighted average slaughter price of A2 quality beef
LN_CHKPP	Log of the chicken producer price
LN_FGPRWM	Log of the farm gate price of white maize
LN_FMPP	Log of the fresh milk producer price
LN_WDPWM	Log of the milldoor price of white maize

LN_SGCPRSA	Log of the sugar cane price of South Africa
MPOSA	Milk Producers Organisation of South Africa
NDA	National Department of Agriculture
PP	Phillips Perron test
RESID_BEEFLAG	Lagged residual generated from the beef co-integration equation
RESID_CHKLAG	Lagged residual generated from the chicken co-integration equation
RESID_MDFGCOINTL	Lagged residual generated from the farm gate to milldoor co-integration equation
RESID_NEWMILKLAG	Lagged residual generated from the fresh milk co-integration equation
RESID_RETMDPLAG	Lagged residual generated from the milldoor to retail co-integration relationship
RESID_SUGARLAG	Lagged residual generated from the sugar co-integration relationship
RMAA	Red Meat Abattoir Association
RV	Recoverable Value
SADC	Southern African Development Community
SAFEX	South African Futures Exchange
SAMIC	South African Meat Industry Company
USDA	United States Department of Agriculture
SHIFT 04	Shift introduced in 2004 as the source of the retail prices changed

Chapter 1

Introduction

1.1 Background

The study follows a report released by the Food Price Monitoring Committee and their investigation into the sudden rise in food prices as a result of the strong depreciation of the Rand against all major currencies during the end of 2001. The literature review will specifically focus on research that has been conducted on price transmission, as well as on the unpacking of supply chains in the South African food sector. The main analyses in this regard have been done as a result of investigations into unjustified food price increases. None of the research activities undertaken by the Food Price Monitoring Committee have attempted to establish a framework for the South African context which can be used on a continuous basis.

Previous investigations that were undertaken in order to understand the reasons for food price hikes in South Africa include the Board on Tariffs and Trade (1992), *An investigation into the Price Mechanisms in the Food Chain*, Report No.3273. The BTT was given the task of investigating the price mechanisms of the food chain and to make recommendations with specific reference to the price gap between producer and consumer prices; in other words, price spread, the nature of the trend in this gap and the reasons therefore. The other points under review include the nature and influence of structures in the production, processing, distribution and marketing of food products and the possible influence of vertical integration in the production, processing, distribution and marketing of food products.

Another report that focuses on the 2002 price hikes in South Africa is a report written by the Competition Commission of South Africa (2002). The commission was called upon by Minister Erwin to investigate the upsurge of food price within the South African economy. The report, with the title *Inquiry into Food Price Rises,* found that six of the seventeen chosen products experienced price hikes due to reasons unrelated to production price increases.

The investigation into the food price rises, by the Competition Commission in 2002, led to the formation of a Food Price Monitoring Committee (FPMC). The committee was established in terms of Section 7 of the Marketing of Agricultural Products Act, No 47 of 1996 and it decided to monitor the prices of a basket of 26 basic food items in order to investigate any sharp or unjust price increases, to further investigate price formation mechanisms in selected supply chains, to review the effectiveness of government monitoring and information dissemination on food prices, to establish and maintain a national food pricing monitoring database, to monitor the Southern African Development Community (SADC) food situation and finally, to investigate incidents of predatory and monopolistic tendencies in collaboration with the Competition Commission (CC).

One of the committee's recommendations was that a report containing information on retail prices and the cost of food processing should be released at least every six months to act as an 'early warning system'. The topic of this dissertation was formed as a result of this recommendation.

1.2 Problem statement

Towards the end of 2001 and the beginning of 2002, the South African Rand experienced a sharp depreciation against all major currencies in the world. The weak currency, together with rising commodity and food prices, triggered processes which sent inflation spiralling out of the target range of 6%, which had been set by the country's monetary and fiscal authorities (FPMC, 2003).

The profitability of farmers within the South African agricultural sector is largely influenced by the producer price of their commodities. In the case of maize, the producer price influences the price of maize meal, animal feed and, as a consequence, the price of milk and other dairy products, poultry, mutton, lamb and beef. Due to this interconnectedness in the supply chain and the amount of inputs that are sourced from elsewhere, it is rather obvious why the value of the local exchange rate, as it directly influences the producer prices, is of such a major concern to the various role players within the economy. The depreciation of the Rand, therefore, made a sudden rise in food prices inevitable. The concern, however, lies therein that after the Rand's appreciation against the US Dollar, food prices showed no signs of returning to their previous levels. One of the findings which the FPMC made was that, 'while it is true that these prices came down from their peaks in 2002 and early 2003, the decline was in all cases not as large as the initial increases during 2001/2002' (FPMC, 2003).

When food prices rise and only level off thereafter, but do not decline in the same proportion as producer prices, even though all factors indicate that this should have been the case, consumers will and should complain. Consumers will blame the retailers and manufacturers for not bringing down their prices and, therefore, for making larger than necessary profits. In so doing, public pressure will mount and the government will be forced to take some form of action. Retailers and manufacturers (or processors), on the other hand, can use each other as scapegoats in order to cover up their previous actions. If the retailer is blamed, he could shift the blame to the manufacturer and stand by his story that he is maintaining a constant mark-up on all of his products. The manufacturer, on the other hand, can argue that he is producing at his lowest possible cost and, therefore, cannot bring his prices down any further. The manufacturer could then shift the blame to the retailer again and say that the retailer is practicing unethical behaviour by charging such high prices.

Most products are ordered in advance, for example, a miller will hedge himself and, thereby, reduce the risk he is running in the case of a price increase or decrease. If there is a sudden change in price it will then take a while before the effect of the change filters through the supply chain and reaches the final consumer. This delayed change might cause the consumer to believe that unjust market practices are taking place, while in fact the price change is only taking some time to filter through the entire system.

Diamant (October 2003), Managing Director of Diamant's Quality Products, makes a good point in his article by saying that,

> "We have no consumer watchdog to champion our cause as consumers. The media is very limited, as it has to protect advertising revenue. Nor is the government doing much. No wonder that the food prices are out of control. And we don't complain, we don't write letters nor do we boycott those offending products and stores. By keeping quiet we consent to unreasonably high prices and unfair practices."

Furthermore, he states that the consumers innocently assume that the retail price in the supermarket is the cost price plus a 'reasonable mark-up' for the manufacturer, distributor and retailer. Diamant summarises the result of a complicated supply chain, a complicated supply chain being a supply chain with intricate relationships and functions at various levels, by arguing that, 'it is more complicated than what meets the eye and, therefore, it is a lot easier to get away with unethical strategies.'

A problem that exists within the supply chains is that the prices of most commodities are only published on producer and retail level. These prices are also referred to as observable data. What is needed to make supply chains more transparent are price publications at both the retail and processor level, as well as the format of a cost structure that gives various interested parties in the industry an idea of what costs and prices within the supply chain are made up of and to what extent they contribute to the retail price of the commodity. Without transparency of costs and prices contained within a supply chain, it cannot be unpacked and analysed.

This dissertation highlights the need for a formal methodology to be developed in order to unpack complicated supply chains and to publish information that explains how the farm value or farm-to-retail price spread of certain products can be calculated, as well as how these results are to be analysed.

1.3 Objectives of the study

The objectives of this dissertation are to review and apply the methodology used for the calculation of price spreads and farm value, as well as to analyse trends of five agricultural commodities in the food sector. This dissertation will also give examples illustrating how this methodology can be applied and how it can help to analyse abnormal movements in the price spreads of food products, as well as define at which levels these costs actually play a significant role. The analysis of farm values and price spread has already been developed in an international context, but it has not of yet been applied in the South African context. It is, therefore, the aim of this dissertation to illustrate how this methodology can be applied and how this can be done on a continuous basis.

The focus of this dissertation will not be so much on the reasons for the previous rise in food prices, but rather on why food prices rose; in other words, when the farm or producer prices fall, do retail prices on certain goods not fall by the same margin? The question that needs to be asked is, 'Who or what is responsible for this?' A detailed analysis of the supply chain of various products could prove invaluable in the process of understanding price movements.

Furthermore, the methodology used in the various calculations concerning the dissecting of the different food supply chains of maize, fresh milk, beef, poultry and sugar, is focused on specifically. These calculations include the estimation of the farm value, the farm-to-retail price spread and the retail value. This dissertation also entails a detailed description of what the marketing margins of these food items represent.

The degree of transparency of information in the South African food sector is investigated by looking at the market share that the various supermarket chains hold. Since competition and concentration of role players within this sector of the economy plays such a vital role in the determination of the market's fairness, it is important that the size and the percentage of market share that the retailers hold in the market is researched and understood. A section of this dissertation especially focuses on the market share that some retailers hold as a percentage share of the entire supermarket retail sector.

The final objective of this dissertation is to discuss the estimation of the specific cost incurred, at various levels, within the maize-to-maize meal and beef-to-beef products supply chains, in detail. There are a few other reasons for this decision. Firstly, maize meal is the staple food of South Africa and, therefore, the occurrences that take place within the chain play an important role in issues such as food security. The reason why beef was chosen as the second supply chain to be analysed is that it is one of the most important protein sources in the South African food industry and, as a result, also plays an important role in the nutrition of the nation. The objective involves designing a framework for the continuous analysis of food prices and costs contained within these two supply chains, as well as understanding the costs incurred by the different role players. The various costs and price structures of the maize-to-maize meal and beef-to-fresh beef products supply chains are identified. These costs and prices at various levels of the supply chain and their possible composition are also discussed in detail.

In short, this dissertation aims to clearly represent information needed to understand a shift in food prices and the resultant effects on the rest of the economy. Furthermore, it aims at developing a sound methodology to calculate and define the farm values, farm-to-retail price spreads and retail values of a specific group of commodities. The final aim is to ensure a greater understanding by the consumers of the dynamics of food prices within the maize-to-maize meal and beef-to-beef products supply chain.

1.4 Justification

Up to this point in time there has been a lack of information with respect to the analysis of farm values and price spreads of agricultural commodities in South Africa. More specifically, there have not been any formal reports analysing and applying the type of methodology utilised in this dissertation to the South African food industry on a continuous basis. The information contained in this dissertation aims to complement the South African Food Cost Review which has recently been released by the National Department of Agriculture and the National Agricultural Marketing Council. This dissertation aims to refine and formally document the methodology used in this report and secondly, to define methods and means which could, in future, give the writers of the report some additional tools to work with.

1.5 Methodology and data

The methodology applied in this dissertation is to a large extent based on work done by the United States Department of Agriculture (USDA) and its employees. Hahn (2004), an economist within the Market and Trade division of the Economic Research Service (ERS) at the USDA, developed the methodology for these calculations which forms the basis of the context of this thesis.

The methodology used for testing the five food value chains for any variations in the expected price transmissions is based on the work done by David A. Dickey and Wayne A. Fuller (1979), as well as Robert F. Engle and Clive W.J. Granger (2003), on the characteristics of time series analyses and various econometric procedures.

The data used in this study is secondary in nature and consists mainly of retail, producer and wholesale prices. The data sources vary amongst the products, ranging from the data firm ACNielsen to the National Department of Agriculture and the central statistical service, Statistics South Africa, as well as various producer organisations. The producer prices have, to the largest extent, been collected from the respective producer organisations and represent the product's monthly national average price. The retail prices have been collected from the data firm ACNielsen, the National Department of Agriculture and Statistics South Africa. These retail prices represent the monthly national weighted average price for every product. The final retail price is made up of weighted average retail prices from 1500 supermarkets nationwide. The prices are weighted according to the quantity of certain branded products sold. If more products of a certain brand are sold, then that retail will receive a greater weight of the final price than a brand which sells less products.

1.6 Outline of the study

This dissertation is organised into six chapters. Chapter 2 gives a general overview of the current agricultural and food market structure and trends in food prices. The third chapter discusses the methodology regarding the calculations of the different measures (the farm value, the farm-to-retail price spread and the retail value) which express the costs involved in the production of the various food items (maize, fresh milk, beef, poultry and sugar) and their values at different levels of their individual food supply chains. The fourth chapter contains a detailed description of five dissected food supply chains, with specific focus on the different role players within every sector. In Chapter 5, two of the five supply chains are unpacked and analysed. The sixth and final chapter focuses on future recommendations to the various role players in the economy, as well as some final remarks on the study and a conclusion.

Chapter 2

An overview of the South African food industry

2.1 Introduction

A sound understanding of how the political, economic and climatological environments influence the price formation of various food items along the different supply chains is of the utmost importance. Without such an understanding, the different role players within this sector of the economy are bound to have difficulties in judging whether the prices are at acceptable levels or whether they have been artificially manipulated. Before an analysis of prices can be conducted, however, it is necessary to determine the structure and composition of the food industry in South Africa.

Sections of the South African food sector will now be discussed. The primary producers of raw materials for the food sector are the farmers. These products are required for the processing of food items into products that are eventually found on the shelves of the supermarket and grocery stores. The food manufacturers and food processors undertake the processing of these raw materials into food items. In most instances, the processors sell their products to the retailers, who in turn supply the market. The retailer distributes, markets and sells the final product to the consumer. Retailers mostly sell branded products, which they receive from the food manufacturers, but in some instances, also sell products of their own brand to consumers.

The objective of this chapter is to present a general overview of the South African food sector with a fair amount of detail regarding the different price determinants within this sector. By so doing, the different roles of players in the supply chain are observed and analysed.

This chapter is organised into two main sections. It begins with a general overview of the South African agricultural sector, with specific focus on the history of and the concentration within this sector. The second section of this chapter specifically focuses on the market structure of the South African food sector. This section draws attention to the food manufacturing and food wholesale sectors, as well as the retail food sector in South Africa.

2.2 The current structure of the South African agricultural sector

Apart from wheat and rice, the South African agricultural sector is self-sufficient in virtually all major agricultural products. The agricultural sector also plays an important role in the South African economy in that it provides one million jobs and at primary level contributes approximately 2.4% to the Gross Domestic Product (AFRINEM, 2005).

The structure, in terms of the market, has expanded to such an extent that the sector now boasts with around 1000 primary agricultural cooperatives and agribusinesses and 15 central cooperatives (SAOnline, 2004). The deregulation process during the 1990s has seen the primary structure of the South African agricultural sector change. Many cooperatives have changed to a private company structure and, as a result, the focus of these companies has shifted to become more profit orientated.

The number of farms in the commercial agricultural sector had the following influx pattern. During 1952 the commercial farming sector accounted for approximately

119 556 and then declined to reach 59 960 by 1983 (World Bank, 1994). In 1996 there were around 60 938 commercial farming units, but according to the 2002 census, the number of agricultural farming units are estimated at 45 818 (Statistics South Africa, 2005).

The number of farming units and their respective gross farming income per province is represented in the table below. The table clearly indicates that the highest concentration of commercial farming units is located in the Free State, followed by the Western Cape and the North West Province. Interestingly enough, the farming units in the Western Cape account for the highest percentage of gross farm income, followed by the Free State and Kwazulu-Natal. The smallest number of commercial farming units is located in Gauteng and the farming units with the lowest gross farming income are those in the Eastern Cape.

Table 2.1: Farming units and gross farming income per province, 2002

Province	**Commercial farming units**	**Gross farming income**
	Number	**R '000**
Free State	8531	8 797 838
Western Cape	7185	11 637 553
North West	6114	3 671 553
Northern Cape	5349	4 883 597
Mpumalanga	5104	5 765 736
Eastern Cape	4376	4 097 970
Kwazulu - Natal	4038	6 473 296
Limpopo	2915	4 247 864
Gauteng	2206	3 753 332
South Africa	**45818**	**53 329 068**

Source: Statistics South Africa, Agricultural Census, 2002.

Table 2.2 represents the different types of ownership found in commercial farming enterprises and the percentage of the total gross farming income for which each of these types of farming enterprises account. The enterprises range from sole proprietorships to public companies and government enterprises. The table clearly presents how the various types of farming enterprises are distributed in terms of number and how the gross farming income of these commercial farming units is distributed throughout the sector.

The sole proprietorships account for the largest percentage share of the gross farming income, followed by the private companies and close corporations. Individual or sole-proprietorships form the largest proportion of the commercial farming sector, followed by private companies, close corporations, partnerships and family businesses. Types of enterprises that are not very common in the agricultural sector are government enterprises, public companies, public corporations and co-operative societies. The reasons for this are that these types of companies are better suited in structure to be located at different levels of the supply chain.

Table 2.2: Different forms of commercial farming enterprises in South Africa

Type of ownership	Commercial farming units	Gross farming income
	Number	% of Total
Individual (sole proprietorship)	34848	50.67
Private	3347	31.32
Close Corporation	3095	7.48
Partnership	2461	6.95
Family	2044	3.04
Government Enterprise	10	0.01
Public Company	5	0.47
Public Corporation	5	0.06
Co-operative society	5	0.01
Total	**45818**	**100**

Source: Statistics South Africa, Agricultural Census, 2002.

Production animals and animal products have always accounted for the largest share of total agricultural production. The gross value of this product category has constantly increased from 1990/1991 up until 2002/2003. Field crops have also increased in gross value, except for 2003/2004 when the gross value had declined slightly from that of the year 2002/2003. Horticultural products have also followed a similar trend, increasing constantly and then levelling off towards 2002/2003.

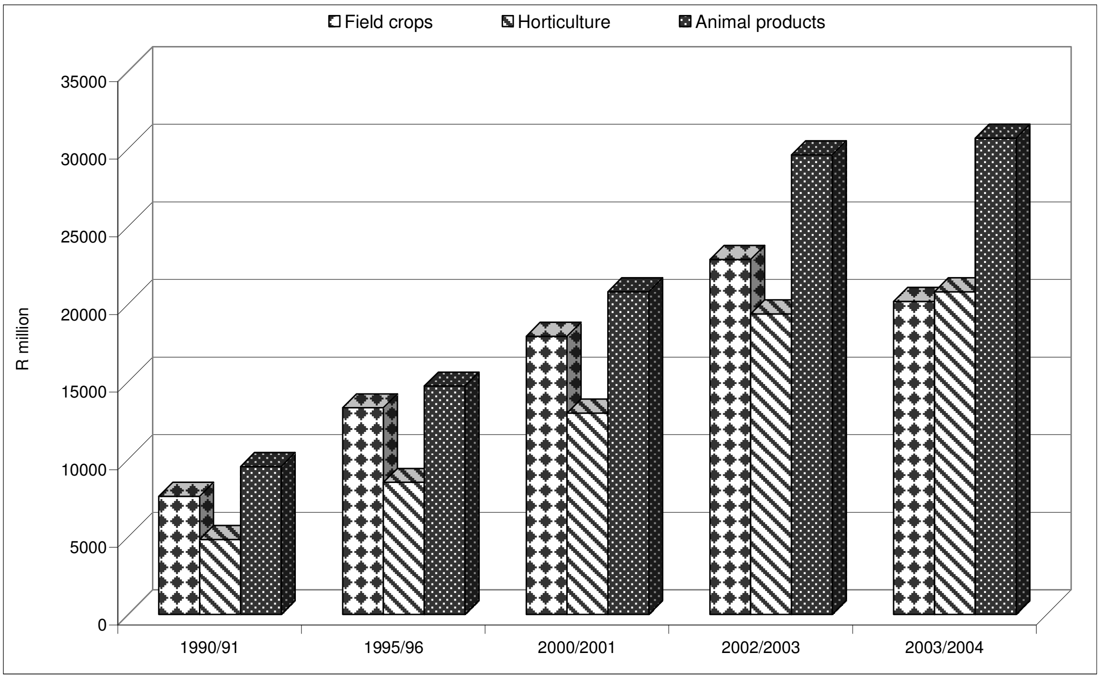

Figure 2.1: The gross value of production per main branch, 1990 - 2004.

Source: Statistics South Africa, Abstracts of Agricultural Statistics (2005) and Agricultural Census, (2002).

2.3 The structure of the South African food manufacturing sector

The food manufacturing sector consists of 11 downstream sub-sectors. These sub-sectors include meat processing, dairy products, preservation of food and vegetables, grain mill products, sugar mills and refineries, cocoa, chocolate and sugar confectionery, prepared animal feeds, bakery products and other food products. The industry produces high-quality commodities and is a strong and competitive sector at both the local and international levels. In general, the food processing industry is largely self-sufficient and closely linked to the agricultural sector, benefiting from being a major producer of numerous agricultural commodities (Louw, Kirsten & Madevu, 2004).

There are more than 1800 food production companies in South Africa alone (Economic Intelligence Unit, 2004). The ten largest companies in the food industry together produce approximately 68% of the total industry's output. Some of these companies include Tiger Brands (SA), Unilever (UK/Netherlands), Nestlé (Switzerland) and Danone (France) (Louw *et al*, 2004). The food manufacturing sector has a high concentration of large firms. The four largest firms control about one – third of the market which, in any market's terms, is a high share. A definite trend is that international firms are entering the South African market and are, therefore, forcing South African firms to become more productive and efficient (Esterhuizen, 2006).

2.4 The structure and the concentration of the South African food retail sector

The South African food retail sector is oligopolistic in nature, meaning that a few large companies dominate the market. In South Africa it is commonplace for retailers, even though they trade under a variety of names, to be owned by the same parent company. Shoprite, for example, owns stores such as OK grocer, Checkers, Sentra, Megasave and Value (Planet Retail, 2006). This might obscure the degree of concentration within the retail sector.

The South African retail sector consists of four main supermarket groups and the different market shares have been calculated according to total sales at retail level. In 1999, the Shoprite group was the dominant supermarket group with a 31% market share of all retail sales. This changed and in 2004 the market shares of the Shoprite group declined to approximately 26.3% of all retail sales. In 2005, Shoprite's market share declined further to 26.2%. The Pick 'n Pay supermarket group boasted a market share of 21.9% during 1999 and, like some of the other chains, managed to increase their market share to 24.7% in 2004. This improved even further to 25.3% in 2005. The Spar group, which incorporates Kwik Spar, Spar and Super Spar stores, had a 15% share of the market during 1999. This also increased slightly in 2004. It reached 15.2% in 2004 and 15.3% 2005. The niche market sector is being served by the high quality and high price store, Woolworths, which had a market share of 10.4% during 1999. As consumer trends and preferences changed, so did the market share of Woolworths. During 2004 and 2005 the group claimed 10.4% and 10.1% of the market, respectively. The rest of the market share belongs to the Metcash, Massmart and Forecourt groups and their combined market share is represented in the last row of table 2.3 (Planet Retail, 2006).

Table 2.3: Market share and turnover of various South African supermarkets.

Supermarket chain	**Owned by**	1999		2004		2005	
		Market share (%)	**Retail banner sales (USD / million)**	**Market share (%)**	**Retail banner sales (USD / million)**	**Market share (%)**	**Retail banner sales (USD / million)**
Spar	Tiger	15	$ 1 600	15.2	$ 2 576	15.3	$ 2 809
Pick 'n Pay	Pick 'n Pay	21.9	$ 2 345	24.7	$ 4 175	25.3	$ 4 638
Shoprite / Checkers	Shoprite	31.0	$ 3 312	26.3	$ 4 452	26.2	$ 4 796
Woolworths	Wooltru	10.4	$ 1 115	10.4	$ 1 759	10.1	$ 1 857
Others	-	21.7	$ 2 316	23.4	$ 3 970	23.1	$ 4 208
Total		**100**	**$ 10 688**	**100**	**$ 16 932**	**100**	**$ 18 308**

Source: Planet Retail, 2006.

Based on the market share information above, even though it differs to some degree, it can be assumed that a few large players dominate in the retailing industry. In general, the biggest retailer seems to be Pick 'n Pay, followed by Shoprite and the Spar group.

Even though a number of different sub-stores belong to the main supermarket groups and even though these can be acquired by means of signing a franchise agreement, it is possible that these stores can compete directly with one another for the same customers even though they carry similar names. Each store will, therefore, practice its own pricing strategies in order to gain a bit more of the market. This relates directly to the standard geographic market definition.

The Competition Commission (2002) found evidence that smaller grocery stores, speciality shops and alternative format stores are affecting the way in which supermarkets position themselves strategically and how they price their products. Therefore, perhaps Binkley and Connor were correct in their 1985 article, *An alternative view of pricing in retail food markets,* when they came to the conclusion that the degree of supermarket rivalry is no longer the only competitive force in the food retail sector, but that the competition from new store formats, which include fast food outlets and small niche sellers such as Woolworths Food stores, is a part of the new factors affecting grocery prices.

It can be concluded that the retail food sector is concentrated and, therefore, high barriers exist within the market at entrance points. Even though this is the case, a dual situation between concentration and competition still exists.

2.4.1 Retail pricing strategies

The retail food chain industry in South Africa generally uses more than one retail pricing strategy. This is mainly due to the competitive prices among retail food chains and the fact that pricing is one of the central aspects in the sector (Competition Commission, 2002). The pricing strategies that are generally found within the sector include third degree price discrimination. This strategy entails charging different prices to different consumers for the same goods or service and, furthermore, indicates that differentiation is not severe. Commodity bundling is another strategy. This strategy entails the bundling together of several different products and then selling them at a single 'bundle price'. Block pricing is a strategy in which identical products are packed together, which forces the customer to make an 'all or nothing' purchasing decision.

The final two strategies that will be looked at in this section are price matching and national price setting. The idea behind the 'price matching' strategy is that the retailer challenges the public to bring them a quote of a lower price on the same product or service and they promise that they will match, or even beat it, by offering a lower price. Some retail chains prefer the strategy of national price setting because it creates a very uniform and, therefore, simpler system (Competition Commission, 2002). By so doing, the retail chain can advertise nationally and can, therefore, use a single advertisement for all the stores under the same name.

An example will be the difference in pricing strategies between a 'Kwik Spar' and a 'Super Spar'. The Kwik Spar, as it operates longer hours and, therefore, offers more convenience to various consumers, is able to charge a higher price for its products as the consumers are willing to pay for the convenience that the store offers. The Super Spar on the other hand, is bigger in size and, therefore, offers a greater variety in products. As the inventory turnover ratio usually increases with the size of the store, the Super Spar is able to sell its products at a lower mark-up and, therefore, it is able to compete with the main super stores such as Pick 'n Pay and Checkers. The difference is that the operating hours of the Super Spar are a lot less than those of the Kwik Spar and is, therefore, viewed as less convenient to the consumers.

2.5 Factors in the food supply chain resulting in possible inefficiencies and eventually higher retail prices

This section of the chapter discusses a set of factors that could make food supply chains inefficient and, therefore, result in higher costs and higher prices. This section in this chapter is relevant because it deals with these situations and strategies that role players, in various supply chains, use and deal with on a daily basis. This section gives some insight and some background as to what might be behind a widening farm-to-retail price spread that is further discussed in Chapter 3.

There are a few main factors and practices within the supplier-retailer relationship that can cause conflict and friction within the supply chain. The result of such conflicts may eventually be extra out of bounds costs and inefficiencies, which will ultimately result in a price increase that the consumer has to bear.

Factors of influence include confidential rebates, returns on no-sales and in-store breakages and losses, poor management of the cold chain for perishables, poor care and management of supplier packaging materials and losses, as well as long periods before payment and price are the only issues in the relationship (FPMC, 2003).

2.5.1 Confidential rebates

A confidential rebate is a discount negotiated between the supplier and the retailer and is usually based on the volume of goods traded between them. The confidential rebate is meant to cover the support that retailers offer in terms of advertising, shelf space and listings, for example. Most retailers believe that the current practice of confidential rebates is both a sound and ethical practice and should not be tampered with. They also believe that a reduction in the confidential rebate will not save any money as it is already so integrated within the value chain (FPMC, 2003).

The argument, that surrounds the use of these confidential rebates, focuses on the smaller supplier's situation. An example would be a situation in which a small supplier delivers to a large retail store. The large retailer will demand a rebate and, since the supplier has little negotiating power, the supplier could be forced to give up whatever profit he could have made and, as a result, may find it difficult to stay in business. Confidential rebates can, at maximum levels, sometimes be as high as 12% – 15% (FPMC, 2003).

2.5.2 Returns and losses

Another point of concern is the policy of retailers regarding returns and losses. Generally there are a number of main forms of 'return policies' These are the 'sell-or-return' policy, the 'no-return' policy and the 'return on no-sales' policy. The 'sell or return' policy requires the supplier to carry all of the costs of the damaged or expired product. According to the Food Price Monitoring Committee's final report (2003), manufacturers and suppliers are of the opinion that a 'sell or return' policy is the better option, as it allows retailers to cut their additional mark-ups on all items since they do not need to cover the additional costs resulting from damaged or expired goods. Suppliers are then in a position to recover a portion of the lost revenue by repacking and reselling the goods to the lower income market segments. A 'no-return' policy is completely different, as it forces the retailer to carry the entire cost of the damaged and/or expired goods. This means that the retailer adjusts his price accordingly and, therefore, charges a higher retail price. The 'return on no-sales' policy is distinguished from the other policies, as items that are not sold can be returned to the manufacturer. This can result in abuse of the retailers as they may be inclined to over order and then return the balance as 'no-sales' (FPMC, 2003).

2.5.3 Management of the cold chain

The management of the cold chain is another factor that may influence the retail price of certain commodities. The cold chain refers to the supply chain of a product that needs to be kept below a certain temperature from the point when it is harvested until the point when it reaches the shelf in the supermarket. A study conducted by Diamant (2003) reveals that temperatures in fridges were consistently 9^{o}C when they have to be below 3^{o}C. A similar situation is revealed in the frozen foods section. Temperatures are found to be varying between +3^{o}C and – 15^{o}C, generally too warm to keep food frozen.

Higher temperatures in the cold chains can lead to increased spoilage and, as a result, increased returns, as well as customer dissatisfaction. Some suppliers have pointed out that poor receiving areas, as well as congestions occurring in these areas, are to blame for these problems. One possibility of improvement could include delivering during the night, which will result in fewer delays and, as a result, a cheaper and more efficient delivery service, ensuring better quality products on the shelves and fewer out-of-stock situations (FPMC, 2003).

2.5.4 Relationships

In the past, relationships between retailers and manufacturers would have been described as a cut-throat business. Both retailers and manufacturers were trying to benefit as much as possible from the situation and, in the process, neither really cared what happened to the other party. Today, the relationships are described as being different. Suppliers constantly point out that the relationships between manufacturers and their market retailers and wholesalers have matured into practical relationships governed by a more open and constructive atmosphere, dealing with many more issues than just the price and credit terms. Suddenly retailers and wholesalers are recognising that a sound relationship with their supplier is in their best interest (FPMC, 2003).

A general problem, however, is that the suppliers are still at the mercy of the retailers regarding the delivery of goods. If a supplier does not fulfil the needs of the retailer, then he runs the risk of being de-listed. Such behaviour is not beneficial to either one of the parties and results in conflicts and disagreements. The eventual outcome is a higher price and an ever-increasing trend in which retailers attempt to secure the supply chain and, in so doing, gain full control over it. By so doing, they can monitor the costs involved in the production process of a commodity more easily and, therefore, regulate the price of the commodity more easily. This can eventually lead to higher profits for the retailer. The retail price of the commodity will not necessarily be higher though.

2.6 Summary

The South African agricultural sector has experienced some difficulties over the past few years and is still experiencing some of these difficulties. The sector moved away from a high level of protection to a relatively free market in which the market forces play an enormous role and sometimes cause havoc. The problem then arises if the market reacts unexpectedly and the prices fluctuate, causing a severe shift in profits. The role players, in this particular sector, need to be very competitive in order to absorb such price fluctuation and remain profitable thereafter.

The food retail and manufacturing sectors, on the other hand, are somewhat different. It does not necessarily matter to the sectors whether prices on either end of the supply chain fluctuate widely or not. These sectors possess the ability to 'pass the buck' onto the consumer. If there is a substantial fluctuation in the prices of farm products, they simply adjust their prices at the retail level to cancel out this change. The importance of building a sound relationship within the supply chain has definitely gained in weight. This is important, as a constant supply of goods is a necessity in an industry that needs to keep consumers satisfied. What needs to be understood is that even though both sectors have different roles to fulfil in the industry, both have one thing in common: they need consumer satisfaction to survive. Prices that are too high and unsatisfied consumers affect both sectors equally.

Chapter 3

A methodological note on estimating the farm value, the retail value and the farm-to-retail price spread of food products

3.1 Introduction

Consumers seldom purchase food or food products directly from farmers. Every product that is sold in a retail store undergoes transformation as it moves up the supply chain. The price the consumer pays for food is almost invariably higher than payment received by the farmers. This is because the product has to move along a so-called value chain. The supply chain is the process during which the product loses mostly physical mass, but always gains in value as it is processed and extra costs, such as packaging and distribution, are incurred. In brief, the farm value represents the value of the farm products equivalent to foods purchased by or for the consumer at the point of sale.

The farm-to-retail price spread, on the other hand, represents the difference between what the consumer pays and what the farmer receives. Price spreads do, however, not always behave as they should and often fluctuate greatly from one month to the next. Short term fluctuations are termed ‘dynamic price adjustments’. This means that it takes some time before the price adjusts to the economic conditions. Dynamic price adjustments tend to temporarily move price spreads higher or lower than what they ought to be (Hahn, 2004).

To calculate the price spread of a product, the farm value needs to be subtracted from the retail value. The farm value can be seen as a measure of the return, or payment, farmers received for the farm product equivalent of retail food sold to the consumer, while the retail value is the average cost per kilogram of rebuilding the commodity with products contained within the retail store.

This chapter focuses on identifying and reviewing the methods needed for estimating all these values. The first section of this chapter focuses on the definitions of the values and spreads, as well as the idea behind defining them. Furthermore, attention is given to the theory behind these methods of calculation, as well as the flaws which are experienced with respect to the documentation and calculation of these values within the South African food sector.

3.2 Methodology for estimating the values and price spreads within a food supply chain

The adjustment to price shocks along the supply chain from producer to wholesale and on to retail levels, and vice versa, is an important characteristic of the functioning of markets. As such, the process of price transmission through the supply chain has long attracted the attention of agricultural economists and policy makers (Vavra, 2005). From 2002, the subject of price transmissions in the supply chain, within the South African food sector, has been increasingly linked to the discussion on higher retail food prices and the widening of marketing margins. The ongoing argument is that a reduction in the farm price of a certain commodity may not be immediately or fully transmitted to the final consumer. Role players need to ask themselves why this is the case. A delay or non-transmission of a change in the farm price leads to a widening of the spread. Certain measures have been developed to measure the widening of spreads and, in particular, the change in earnings which the farmer receives. These measures are referred to as the farm value and the farm-to-retail price spread.

3.2.1 The farm value

In theory, the farm value can be seen as a measure of the return, or payment, farmers receive for the farm product equivalent of retail food sold to the consumer. The farm value is calculated by multiplying the farm price by the quantity of farm product equivalent of food sold at retail level. The farm value usually represents a larger quantity than the retail unit because the food stuffs that farmers produce lose weight through storage, processing and distribution (Elitzak, 1997).

The Economic Research Service (ERS) of the United States Department of Agriculture (2002) defines the farm value share as *K*, which is equal to $\theta(P_f / P_r)$, and the farm-to-retail price spread as *S*, the spread being equal to P_r - θP_f. In both equations, P_f is the market's average farm price and P_r is the market's average retail price, while θ denotes a fixed farm-input-food-output coefficient. The fixed farm-input-food-output coefficient is an estimate of the production ratio on the farm. This estimate is frequently revised by the ERS when publications are updated. The ERS found that this estimate of the farm share does not reflect the changes in consumer demand for marketing services for the products that they purchase. They then decided that a new set of estimates should be established which, unlike the previous set, relaxes the assumption of a fixed input-output coefficient. This new formula of the farm value has its roots in the following equation:

$$M = P_r - (F / Q)P_f$$

M denotes the new farm-to-retail price spread, *Q* denotes the composite consumer demand (for a particular industry's output) and *F* denotes the industry's demand for farm inputs. What this new equation implies is that $M / P_r = [1 - K]$ where the farm share *K* is defined naturally as $(P_f F_f / P_r Q)$.

Jayne and Traub (2004) use a slightly different approach in their article, as they specifically focus on the estimation of the marketing margin. Their article defines an equation which can be used to calculate the monthly maize marketing margin. The equation which is used in the article is as follows:

$$MM_t = X_t^{*}\beta_i^{*} + U_t$$

MM_t is the difference between the retail price of maize meal and the millers' purchase price of maize grain in month t, modified by the grain-to-meal extraction rates. This margin is referred to as the 'wholesale-to-retail' margin. X_t^{*} includes all the exogenous variables affecting this marketing margin and U_t is an identical and independently distributed error term (Jayne & Traub, 2004). The article illustrates some adjustment to the formula so that it compensates for the lack in observable data. The term $X_t^{*}\beta_i^{*}$ is rewritten as $X_t^{*}\beta_i^{*} = X_t\beta_i + H_t\alpha_i$, where X_t contains the observable data and H_t the unobservable data. In other words, the data generating process can be defined as:

$$MM_t = X_t\beta_i + V_t$$

$$where$$

$$V_t = H_t\alpha_i + U_t$$

V_t is a world representation of the stochastic component of $H_t\alpha_i$ and U_t (Jayne & Traub, 2004).

Jayne and Traub (2004) define an equation with which they can calculate the marketing margin of maize in South Africa. It is difficult to compare this approach to the equation used by the ERS, as they are both used to measure different things. Nonetheless, both may come in handy when a supply chain needs to be unpacked. In the following chapters, a similar approach is followed in order to calculate and analyse the values and spreads in the South African context.

3.2.2 The farm-to-retail price spread

The farm to retail price spread is the difference between the farm value and the retail price. It represents the payments for all the assembling, processing, transporting and retailing charges added to the value of the products after they leave the farm gate. Price spreads are sometimes confused with marketing margins. Marketing margins represent the difference between the sales of a given firm and the cost of goods sold. There is often a time lag between the receipts and the final sale of commodities involved in the calculation of this figure. Spreads, on the other hand, represent the difference between the retail and farm prices of a specific product at a given point in time (Elitzak, 1997).

Price spreads are often divided into three different stages. Data firms and government departments often collect prices at three different stages along the supply chain. The points of collection are very often at farm level (the farm gate price), at wholesale level (the packing plant) and at retail level (the grocery store). These different prices are then used to calculate the different price spreads for different products. These price spreads include the farm-to-wholesale, the wholesale-to-retail and the farm-to-retail price spread. This section focuses only on the farm-to-retail price spreads. The reason for this is that data on prices at the wholesale level are not readily available.

The farm-to-retail price spread has the function of helping producers measure the efficiency and equity of the food marketing system and, as a result, improve their knowledge of what consumers want from their producers, for example, meat. The main concern that the producers have is to get their fair share. When looking at the true definition of the price spread, it can be seen as similar to the costs and profits of the marketing system that moves the farm product from the farm to the consumer and processes it along the way to its final form (Hahn, 2004).

It is rather common that high or increasing price spreads, as was the case during late 2002, often lead to controversy. Farmers and producers often blame low farm gate prices on high price spreads. At the other end of the scale, consumers blame high retail prices on high price spreads. It is a fact that increasing price spreads can both inflate retail prices and deflate farm prices (Hahn, 2004).

It is important to understand why this is the case. Adding value to products will result in a lower percentage of the consumer food Rand being passed on to farmers. Therefore, a higher demand for value added products and a lower farm share of the consumer food Rand will not generally lead to decreases in farm prices (Hahn, 2004). In general, it is said that food price spreads fluctuate greatly from month to month. This repetitive fluctuation is termed a dynamic price adjustment. This means that price spreads can be temporarily higher or lower than what they should be. The price adjustment dynamics will then tend to adjust prices so that price spreads move towards the levels where they ought to be (Hahn, 2004).

3.3 Estimating the farm values and farm-to-retail price spreads for selected food products in South Africa

This section attempts to apply the theory discussed above to five food items in South Africa. The food items that were chosen vary in nature, but their industries are related in some aspects. The food items include: super maize meal, five beef cuts, fresh full cream milk, white sugar and fresh whole chicken.

3.3.1 Maize

3.3.1.1 Farm value of maize

The farm gate price of maize is equal to the spot price that is traded on the South African Futures Exchange, less the transport differential and storage costs. The reason for having a transport differential is that grain is produced in many locations throughout South Africa, but is traded and priced in Randfontein. The transport differential is, therefore, subtracted from the producer price to give a purchaser an idea of what it would cost him to transport the maize, which he purchased from anywhere in the country, to Randfontein. The storage costs are subtracted as, in the most likely event, the farmer will not have the capacity to store his produce on his farm and, as a result, will have to make use of the cooperatives storage facilities. Factors such as the demand for maize, the supply thereof (in the current season and the carry-over stock) as well as the number of contracts traded, the world market condition and the exchange rate, together determine what the eventual spot price will be. The spot price is quoted at Randfontein, close to Johannesburg. The Food Price Monitoring Committee found that a four month lag exists between the average SAFEX spot price, the price that is used in this analysis, and the average monthly retail price of maize meal. The Committee proved that SAFEX white maize price increases will cause the consumer maize meal price to increase between three and four months later, due to the correlation being highest in these months (FPMC, 2003).

This section only focuses on two of the four variations of maize meal which are consumed by South Africans, namely super and special maize meal, as these are the most popular products. The other variations, which include sifted and un-sifted maize meal, are not discussed in this dissertation. The basic difference between the two types of meal is the rate of extraction. Super maize meal is more refined and, therefore, has a lower extraction rate of around 63%, whereas the extraction rate of special maize meal is closer to 79% (National Chamber of Milling, 2006). What this means is that super maize meal is finer than special maize meal and, therefore, takes more maize grain to produce the same quantity than is the case with special maize meal. As a result of this, the farm values of the two products will differ significantly. The figure below sketches the farm value calculation graphically.

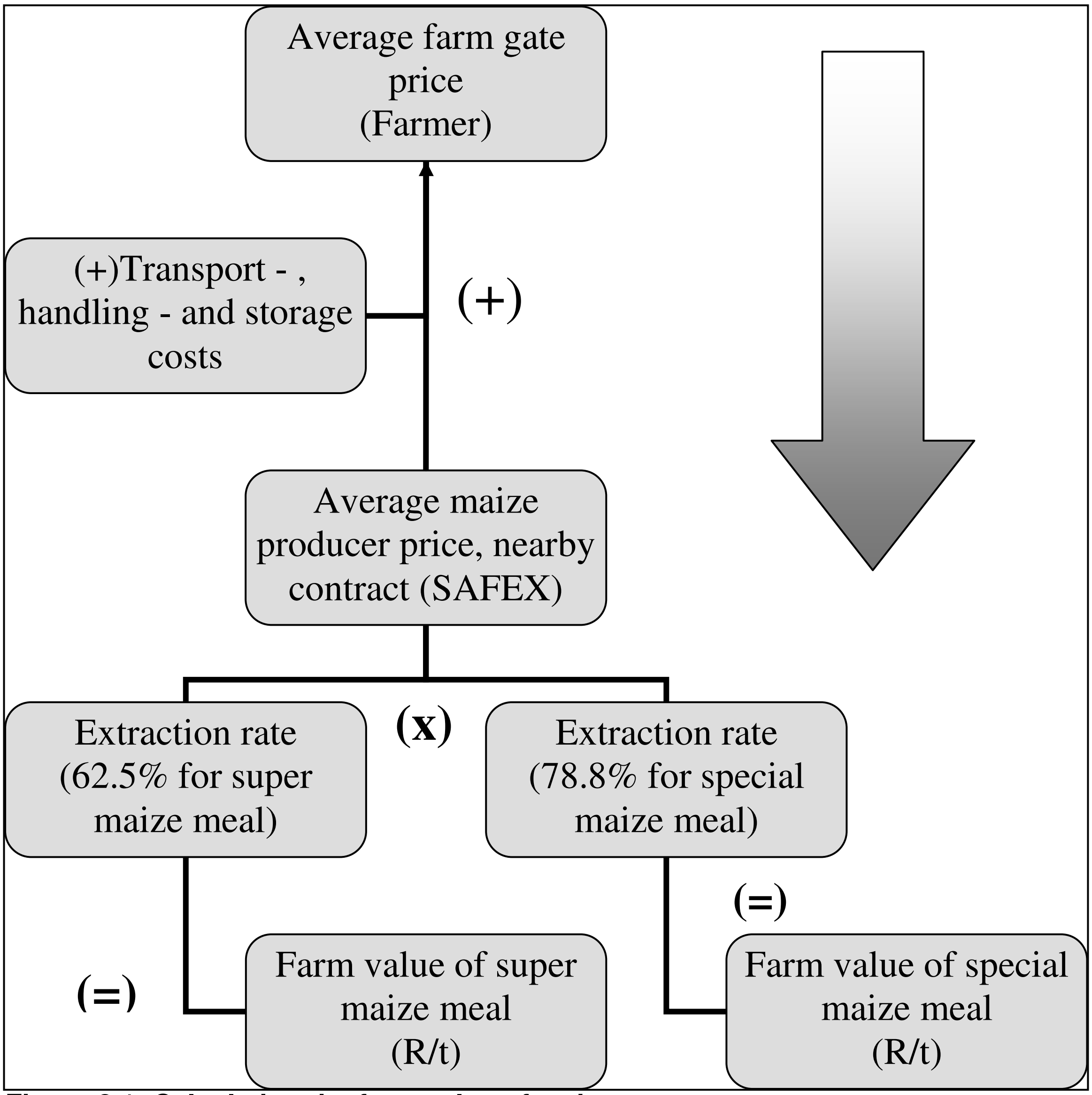

Figure 3.1: Calculating the farm value of maize

Figure 3.1 represents the core fundamental analysis behind the estimation of the farm value of maize meal. The farm value is the measure of return, or payment, farmers receive for their product equivalent of retail food to the consumer (Elitzak, 1999). The magnitude of the farm value differs among the different maize meal types. This is mostly due to the extraction rate. As can be seen in Figure 3.1, super maize meal has a lower extraction rate than special maize meal, meaning that more maize grain is required to produce one ton of super maize meal compared to that required to produce special maize meal. The farm value of super maize meal is, therefore, expected to be higher than the farm value of special maize meal.

3.3.1.2 Farm-to-retail price spread of maize

Even though South Africa is a reliable surplus producer of maize, its downstream marketing system has managed to keep prices of maize meal above levels obtained in other countries despite the fact that mean wholesale grain prices in South Africa are relatively low compared to its regional neighbours (Jayne & Traub, 2004). Findings from Jayne's study further indicate that the maize sub-sector's milling/retailing margins rose from 20% to 40% in the first four to five years after deregulation and that there appears to be a rising trend in the size of the margin over time (Jayne & Traub, 2004).

The milling/retailing margin, referred to in the above paragraph, is the difference between the retail price of maize meal and the price at which millers purchase maize after accounting for the extraction rates and the value of by-products produced in the milling process (Jayne & Traub, 2004). The retail/milling margin differs from the farm-to-retail price spread in that the farm-to-retail price spread of maize involves a complete analysis of the farm-to-retail supply chain. This involves an analysis of the prices paid and costs incurred at all the different stages of the supply chain. The farm-to-retail price spread of maize describes the entire value adding process that maize undergoes before it ends up on the shelves of the retail store.

Once the maize is harvested on the farm, it needs to be transported to and stored on the premises of the storage facility or silo. When the farmer delivers his/her maize for storage in the silo, it is unknown whether this maize has been sold or not as the sale of grain takes place by means of a ‘silo certificate’. After the delivery of the maize to the silo, the farmer is issued a silo certificate and it is up to him/her whether or not he/she is going to sell the certificate. As maize prices fluctuate widely, the farmer is exposed to a price risk. This risk can be minimised by means of a hedge. It is important to understand that the silo owner does not take possession of the maize, but merely provides a service and then charges the farmer for it by means of a storage and handling fee at a specific cost per month (FPMC, 2003). The actual farm gate price that the farmer then receives is the price for which he sells the silo certificate less the transport, which he had to cover, and the storage and handling costs, which he had to pay to the silo owner. The resultant price is known as the farm gate price.

Once the maize is at the silo, the miller comes into the picture. The assumption is made that the miller purchases the maize from the producer and not the silo owner. The silo owner merely acts as the agent of the buyer of maize, who in this case is the miller or processor. The buyer determines the price, the quality of the grain and where and when the stock will be utilised. Thereafter, the silo owner only acts as the supplier of storage and handling facilities (FPMC, 2003). Once the maize has been purchased and the buyer has decided how it needs to be utilised, the maize is transported to the mill and these costs, as well as the storage costs at the mill, need to be accounted for by the miller. One of the by-products of the milling process is hominy chop. The miller sells the by-product and receives additional revenue.

The retail price represents the weighted average price at which maize meal sells in retail stores. In the supply chain, the retail price is represented as a nationwide average price for which one ton of maize meal retails. The farm-to-retail price spread then constitutes the difference between the farm gate price, the price at which the farmer sells his maize after his transport and storage costs have been subtracted and the weighted annual average retail price.

The retail prices are collected by the data firm ACNielsen from over 1500 retail stores across the country. The data is collected by every retail store by means of a scanner system. Every item that is sold is deducted from the retail store's inventory system and this, together with the price at which the product was sold, is then registered on the stores computer system. The information is then gathered by the data company and a national average price for a certain product is then calculated by taking the amounts and the different prices at which the product was sold at different locations into account.

The observable price data, in other words the producer and retail price data, was obtained from the Food Cost Review program at the University of Pretoria for use in this dissertation. The transport and storage costs have been obtained from the South African Futures Exchange and the National Chamber of Milling, respectively. Both costs serve as an estimate of the national average. The transport cost from the farm gate to the silo was calculated as the SAFEX transport differential to all major maize silos. The storage cost per ton also differs from silo to silo, but again experts were consulted to give a rough estimate of their average handling and storage day tariffs per ton.

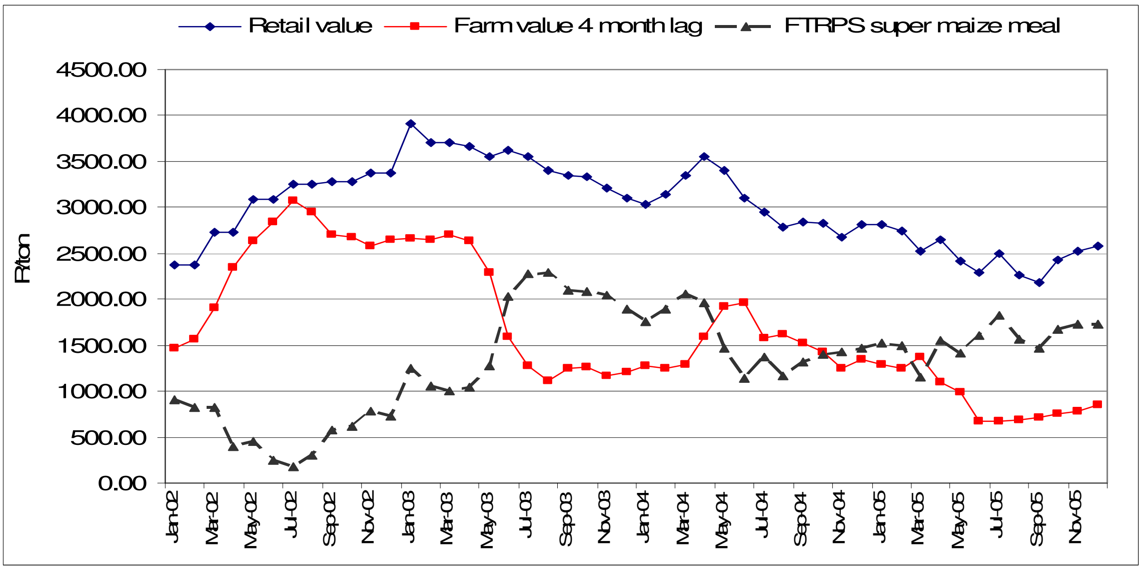

Figure 3.2: The difference between the retail value and farm value of super maize meal, 2002 – 2005.

The figure above represents an example of what the price spread of maize meal looked like during the past four years.

This figure indicates the increases in the price spreads during September 2003, which, in turn, was the result of food price investigations being launched. The retail value, represented by the top line, increased and reached its peak during January 2003. The farm value, represented by the solid line, followed a similar trend at first, but levelled off towards the end of 2002 and then declined sharply thereafter. The figure depicts the exact argument raised in Chapter 1, namely that farm prices levelled off and even declined, but retail prices did not. Jayne and Traub (2004) found that margins accruing to millers and retailers had risen from 29% to 42% between 1997 and 2003. Furthermore, they found that there is a rising trend in the margin size over time. From these findings, one can conclude that some degree of asymmetric price transmission does exist within the maize-to-maize meal supply chain and that further investigations are needed to explain this.

3.3.2 Beef

3.3.2.1 Farm value of beef

A beef carcass is basically made up of five 'quarters'. Two front quarters, two hindquarters and the 'fifth quarter' that is comprised of the skin, hide, off cuts, fat, hooves and some bones. What makes the calculation of beef's farm value so complicated is the fact that every different cut of the beef carcass sells at a different price in the retail store. In order to simplify this problem, it is necessary to devise a method by which such terminologies are simplified and standardised. The aim of having a farm value and a farm-to-retail price spread is to be able to compare price spreads which are consistent for a standard animal over time and not price spreads for each individual period's most representative animal (Elitzak, 1997).

An explanation for the current methodology, which has been designed and applied by Hahn (2004), for the calculation of the various values of beef, follows. As previously mentioned, the entire carcass is divided up into five 'quarters'. The front two quarters of the standard carcass are made up of the hump, neck, shin, bolo, chuck, flat rib, brisket, prime rib, thin flank and wing rib. The two rear quarters of the carcass are made up of the loin, rump, fillet, topside, silverside, aitchbone and thick flank. The fifth quarter represents the trimmings, fats, kidneys and bones. Now that the cuts are known, each one is allocated a certain percentage, representative of their weight in the entire carcass (SAMIC, 2005). The percentage that is allotted to the various cuts is known as the percentage mass. In order to calculate the farm value, an average representative retail price needs to be allotted to each one of the cuts. This retail price is then multiplied by the percentage mass of every cut and the result of this is the farm value for the specific cut. Current retail pricing methods, which are used by the meat industry role players, define the percentage cut factor, which is calculated by dividing the retail price with the total value of the carcass (SAMIC, 2005).

The calculation of the farm value, based on a number of assumptions, includes that a standard carcass is cut up in a standard way and sold, in a standard form, in the retail store. The important assumption is that a carcass in South Africa should have a standard weight assigned to it. This weight will obviously vary from species to species, but it is important that some consensus is reached. The Red Meat Abattoir Association has set the standard average weight of a carcass at 220 kg. The 220 kg carcass is made up of the cuts discussed previously, with the exception of the fifth quarter. The cuts that are analysed in this dissertation are part of the country's most important beef products, as monitored by Statistics South Africa. The cuts in the food basket include rump steak, which makes up about 16.72 kg of the total weight, sirloin steaks, which make up 11.22 kg, topside beef at 16.94 kg, chuck at 23.09 kg and brisket at 17.6 kg (RMAA, 2004).

As mentioned before, the standard definition of the farm value is the measure of the return, or payment, which the farmers receive for the farm product equivalent of the retail food sold to the consumer (Hahn, 2004). When calculating the farm value of the beef products contained in the food basket, one needs to take the average weight of all of these products into account. This weight is then representative of the 'extraction rate' which is multiplied by the average auction price. The formula below represents how this methodology can be applied in the case of rump steak:

$$FV \sim Rump = 16.72\,kg\,(AW) \times R14.11 / kg\,(ASP) = R235.92 / kg\,(FV)$$

AW is the abbreviation for the average weight of the cut, which is then multiplied by the average slaughter price, denoted by *ASP***.** The result of this calculation then represents the actual farm value, *FV,* for that selected cut. The same methodology applies to the other selected cuts which are mentioned above. It is important to note that each cut makes up its own unique percentage of the entire carcass.

3.3.2.2 Farm-to-retail price spread of beef

The farm-to-retail price spread constitutes the difference between the farm value, which is calculated with the help of the given formulas in section 3.3.2.1, and the retail price of the selected cuts at a number of retail stores throughout the country. It should be noted that there is a clear distinction between the farm-to-retail price spread of beef and the gross margin of beef. It is true that the gross margin and the farm-to retail-price spread are related and that increases in the gross margins are likely to cause increases in the price spreads. The simplest definition of the farm-to-retail price spread is that the price spread is the difference between the value of an animal at the farm and its value at the grocery store (Hahn, 2004). The formula for calculating the farm to retail price spread can be denoted by the following:

$$FTRPS = RV - FV$$

where *FTRPS* represents the farm-to-retail price spread, *RV*, the retail value and *FV*, the farm value. In order to calculate the spread one needs to know exactly what is meant by the value at the grocery store or the retail value. Hahn (2004) defines the retail value as average price per pound of all the cuts an animal produces. In other words, the retail value is the average cost per kilogram, rebuilding the animal with meat parts only from the grocery store. This rebuilding process would include the assumptions with respect to the average weight of a carcass and the average weight of the respective cuts.

The farm-to-retail price spread in the beef sector, as is the case in many other industries, is mainly influenced by three factors. These factors, as stated by Gardener (2003), are the shifts in retail demand, the shifts in farm commodity supply and the changes in the marketing input supply. In a South African context, this will definitely be the case. A change in the farm commodity supply will cause a shortage of supply in the market. The result of this is a higher price and, consequently, a narrowing of the farm-to-retail price spread. A shift in the retail demand will have a similar effect. If the demand for the commodity increases, the prices at retail level will also rise and, with that, a widening of the farm-to-retail price spread takes place. The variable factor, which is of concern to this dissertation, is to what extent the farm-to-retail price spread widens or narrows and, more specifically, why this occurs.

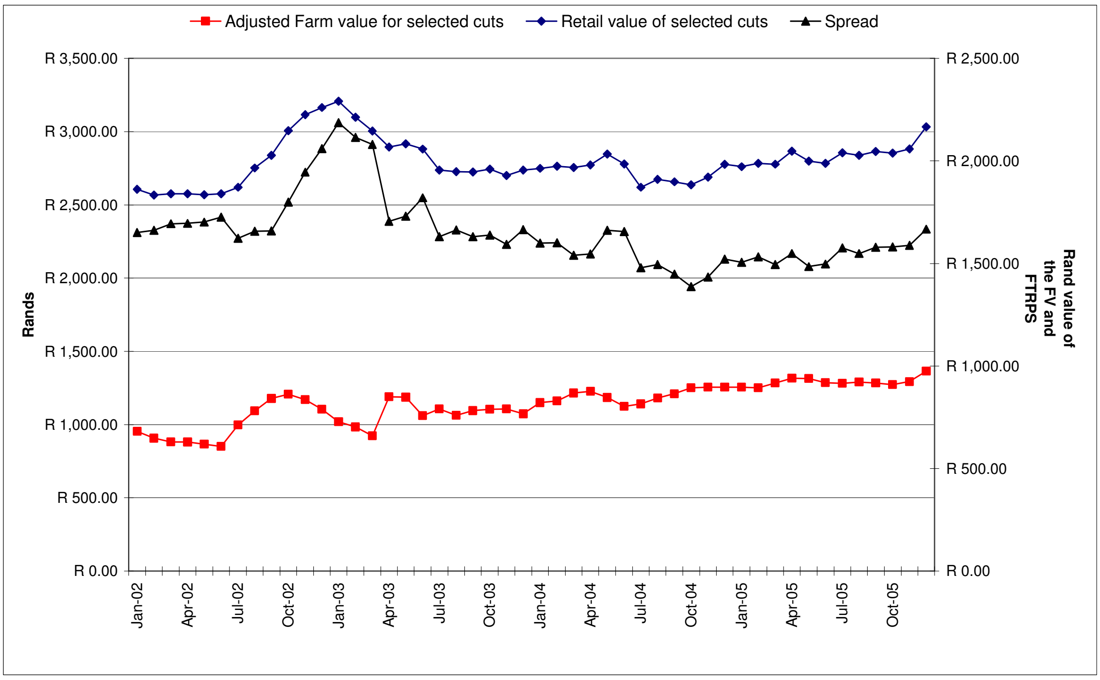

Figure 3.3: The difference between the adjusted farm value, the farm-to-retail price spread and the retail value of the selected beef cuts, 2002 – 2005.

The figure above represents the price spread for the selected cuts contained within the food basket. The farm and retail values have been calculated according to methodology previously discussed.

The retail value of the selected cuts rose steeply towards the end of 2002, but then levelled off thereafter. The farm value followed a similar trend, which is related to the retail value. The spikes in the farm value during 2002 were not as severe as in the case of the retail value, but they did occur shortly after each other, signalling a degree of price transmission. The farm-to-retail price spread also spiked during this period, but then declined at a steady pace during 2004 and levelled off between R2000 and R2500 per selected carcass cuts.

3.3.3 Milk

3.3.3.1 Farm value of milk

The farm value of milk, as is the case with beef, is rather complicated to calculate. The reason for this is that fresh milk is used in numerous production processes of other commodities such as cheese, butter, yoghurt, cream, ice-cream and many more. The farm value of milk will differ for each one of these products depending on the so-called extraction rate or original percentage that remained in the product after processing.

The methodology used for calculating the farm value of milk is based on information gathered directly from the United States Department of Agriculture (USDA) and the Milk Producers' Organisation of South Africa (MPOSA). Milk, at retail level, is by law required to contain a certain percentage of milk fat and skim solids. Milk fat content at retail level is, therefore, regulated at around 3.3%, while skim solids average around 9%. Unprocessed or raw milk usually contains around 3.67% milk fat and approximately 9% skim solids (MPO, 2006; USDA, 2006).

In order to obtain the conversion factor or extraction rate, the full cream milk fat percentage is divided by the milk fat percentage of raw milk. The result or conversion factor on a milk fat basis will thus have a factor of around 0.9, given the calculation of 3.3/3.67 (USDA, 2006). The same principle applies to low fat milk, which, in South Africa, has a milk fat basis of 2% and will thus have a factor of 2/3.67 or 0.545.

$$CF = \frac{MF\%}{RMF\%}$$

In the formula, the conversion factor is calculated by dividing the milk fat percentage, denoted by *MF%*, and by the raw milk fat percentage, denoted by *RMF%*. Interestingly enough, it is not the pasteurisation process or other heat treatments that lead to this result, but rather what percentage of skim milk and fat solids the processors decide should be in the final products. The fat that may be taken out during the processing of fluids is then added to other products, where the producer receives some value for it. This indicates that the farm value will differ noticeably between the different dairy products.

3.3.3.2 Farm-to-retail price spread of milk

The farm-to-retail price spread of dairy products differs from product to product. As discussed in the farm value section of this chapter, the extraction factor differs among the different types of dairy products, such as full cream and low fat milk, depending on the degree of processing through which the product goes before it reaches its final, desired form. As a result, the farm value differs from product to product. This section only focuses on the farm-to-retail price spread of both fresh full cream and low fat milk.

The retail prices that are used in this dissertation were collected by the data firm ACNielsen from a total of 1500 stores nationwide. The retail products that are included in the database are the standard one litre full cream and low fat fresh milk sachets.

The farm-to-retail price spread can then be calculated by subtracting the farm equivalent value of milk from the retail price. In other words, the farm-to-retail price spread of milk is calculated by subtracting the farm value from the retail value

$$FTRPS = RV - FV$$

As in the previous section, the farm-to-retail price spread is represented by *FTRPS*, the retail value by *RV* and the farm value by *FV*. The figure below represents the difference between the farm value and retail price of full cream milk. It is important to note that a different set of retail prices has been used from 2004 onwards. The reason for this is that the retail prices from the data company ACNielsen have been collected from a greater number of stores and, therefore, give a more representative picture. Unfortunately, this data only ranges from 2004 onwards and, therefore, the STATSSA data series had to be used before then. The econometric analysis in Chapter 4 takes this structural break into account by imposing a shift variable.

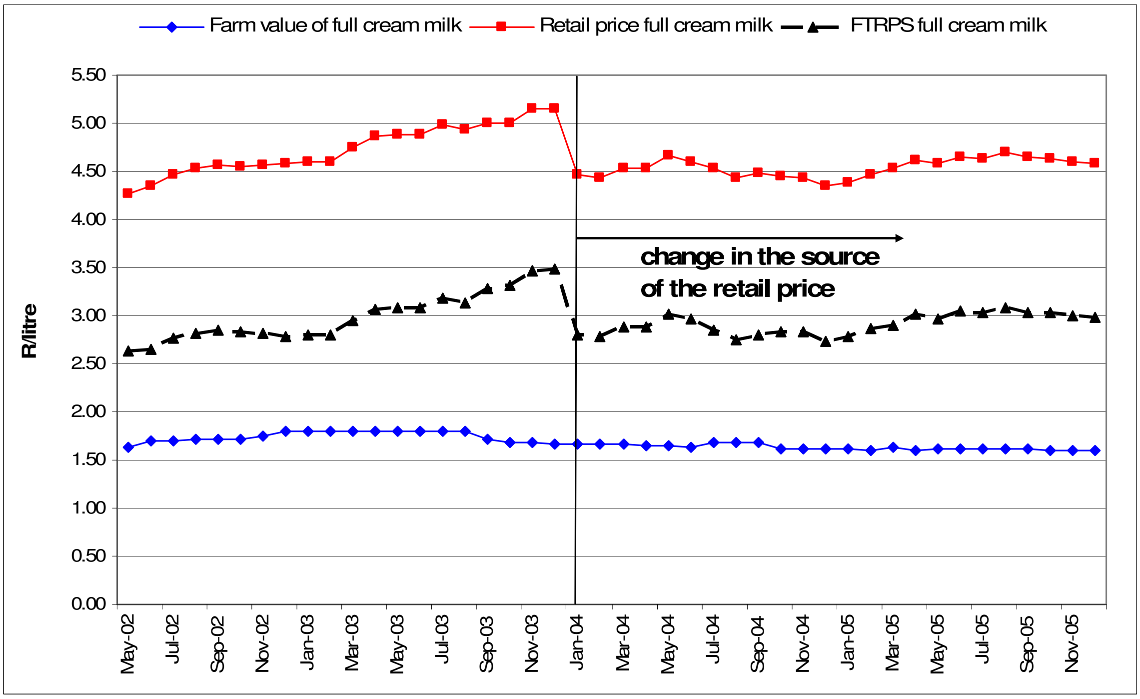

Figure 3.4: The difference between the farm value, the farm-to-retail price spread and the retail price of full cream milk, 2002 – 2005.

The graph displays a relatively constant farm value over time, compared to a constantly increasing retail price and a resultant increase in the farm-to-retail price spread.

3.3.4 Sugar

3.3.4.1 Farm value of sugar

The farm value of sugar is calculated by multiplying the price that the farmer receives by the extraction rate of sugar. The price that the farmer receives is referred to as the *RV* or the recoverable value. The South African Sugar Association accounts for the total sales of sugar and molasses in both the local and international markets. After all the industrial charges have been deducted, the net divisible proceeds are shared between the grower, millers and refiners in terms of a fixed division of proceeds provided for in Clause 166 of the Sugar Industry Agreement. A provisional recoverable value price is then declared on a monthly basis and this recoverable value is applied to all of the cane that is delivered during that specific season. A final *RV* price is declared during March of every season (SA Canegrowers, 2005).

RV is to the advantage of processors because it recognises the effect of sucrose percentage cane, non-sucrose percentage cane and fibre percentage cane on sugar production. The *RV* percentage that determines the *RV* price is calculated using the following formula:

$$RV\% = S - dN - cF$$

S is the sucrose percentage cane delivered, *N* is representative of the non-sucrose percentage cane delivered and *F* is the fibre percentage of cane delivered. The coefficients ‘d’ and ‘c’ stand for the relative value of sucrose lost from sugar production per unit of non-sucrose, taking into account the value of molasses recovered per unit of non-sucrose and the loss of sucrose from sugar production per unit of fibre, respectively. In South Africa, the 'c' value is calculated based on a three season moving average, while the 'd' factor is calculated monthly and is based on a three season rolling average and current sugar and molasses price estimates (SA Canegrowers, 2005). The individual sugar cane farmer, therefore, cannot influence the *RV* price directly, but can improve his income by making sure that the cane which he delivers is of a high *RV* percentage or quality. The *RV* price is quoted per ton of recoverable value or *RV*. The price may pose a problem in Chapter 4 as it only exists in an annual time series. The *RV* value is plotted in Figure 3.5 below.

Research has indicated that the conversion rate or the extraction rate, in other words the amounts of sugar cane required to produce one ton of sugar, is between 8.78 and 8.33. It is recommended that an average of 8.5 is used in the calculations (Moor, 2005). This means that on average, every ton of sugar cane delivered to a sugar mill produces approximately 117.6 kg of sugar. The farm value of sugar can thus be calculated by applying the following formula:

$$FV = RV \times ETR$$

FV represents the farm value of sugar, *RV* the recoverable value and *ETR* the extraction rate.

3.3.4.2 Farm-to-retail price spread of sugar

The farm-to-retail price spread of sugar is the difference between what consumers pay for sugar at retail level and what the farmer receives for an equivalent amount of sugar cane at farm level, namely the *RV* price times the extraction rate. As pointed out in section 3.2.1.4, the farm value of sugar is directly influenced by the *RV* price that the cane-growers receive. The farm value is, therefore, calculated by multiplying this *RV* price with the extraction rate.

The farm-to-retail price spread shows the price of all utility-adding activities and functions performed by middlemen such as the sugar millers, the transporters, the wholesalers and the retailers. The farm-to-retail price spread also includes the profits that have been earned by these middlemen (Kohls & Uhl, 1998). The formula below depicts how the farm-to-retail price spread is calculated:

$$FTRPS = RV - FV$$

FTRPS represents the farm-to-retail price spread, *RV* represents the retail value and *FV* is representative of the farm value. Figure 3.5 indicates the trend of the farm-to-retail price spread of sugar from 2002 up until the end of 2005. As the figure indicates, it followed a slightly increasing trend from 2002 up until 2003. The trend, however, seemed to level off from April 2003 onwards.

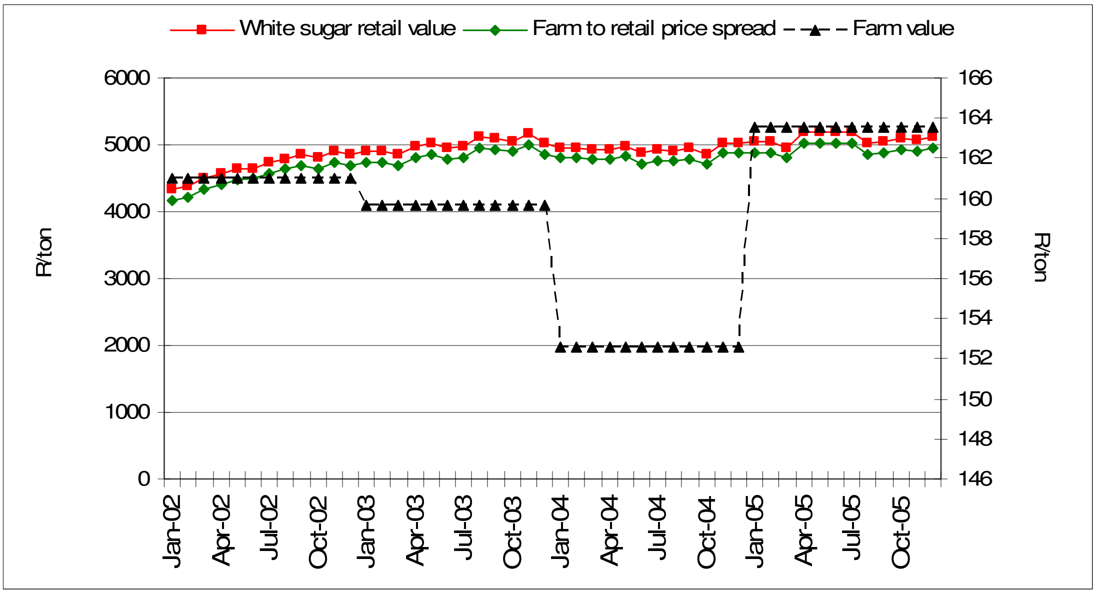

Figure 3.5: The farm to retail price spread of white sugar, 2002 – 2005.

The farm value has a peculiar pattern. The reason for this pattern is that the farm value is partly made up of the *RV* price and, due to the annual estimation of the *RV* price, it will remain constant for one year at a time. In the following year, the *RV* price is estimated and adjusted as the season closes. Once the final ton of sugar cane is harvested and tested for it sucrose and fibre content, the *RV* price is finalised.

3.3.5 Broiler meat

3.3.5.1 The farm value of broiler meat

A number of assumptions regarding the standard broiler carcass need to be made. Firstly, the standard weight of a broiler carcass has to be defined. After consultation with both the USDA and South African industry experts, it seems that a representative weight of a standard carcass size of a slaughtered chicken can be set at approximately 2.5 kg. The second assumption that needs to be made, so that a farm value can be calculated, is how much of the carcass weight is contained in the food basket. In the case of broiler meat, this is quite simple to answer, since whole fresh and whole frozen birds are included in the food basket. The procedure of calculating the farm value is, therefore, a lot simpler than in the case of beef, as a chicken, in this instance, is not divided into five ‘quarters,’ but is instead sold as a fresh whole bird, as well as a frozen whole bird. Various chicken pieces, such as drumsticks, fillets and wings, are also retailed, but these are not analysed in this dissertation.

The farm value of a chicken carcass is then calculated by multiplying the slaughter price of a standard frozen and fresh whole broiler with the average standard weight. The result will be the so called farm value, which, in turn, represents what the farmer earns, or what the measure of his return is, given the farm product equivalent of retail food sold to the consumer. The farm value calculation is represented by the following formula:

$$FV = SP \times CW$$

FV represents the farm value, *SP* the slaughter price per carcass and *CW* the weight of a standard carcass.

3.3.5.2 The farm-to-retail price spread of broiler meat

The farm-to-retail price spread of broiler meat represents the spread between the retail value and the farm value of broiler meat, of which the calculation is explained in section 3.3.5.1. It is rather obvious that the farm-to-retail price spread differs from the other products that are analysed. In this case, one hopes to see that the farm-to-retail price spread of a frozen broiler is somewhat lower than the farm-to-retail price spread of a fresh broiler. The reason for this is that the retail price of a frozen broiler, which is sold as a lower quality and, therefore, cheaper product, should be less than the retail price of a fresh whole bird.

Of all the commodities, the trend in producer and retail prices of broiler meat seemed most similar. This is graphically displayed in the figure below. A detailed analysis of this follows in Chapter 4.

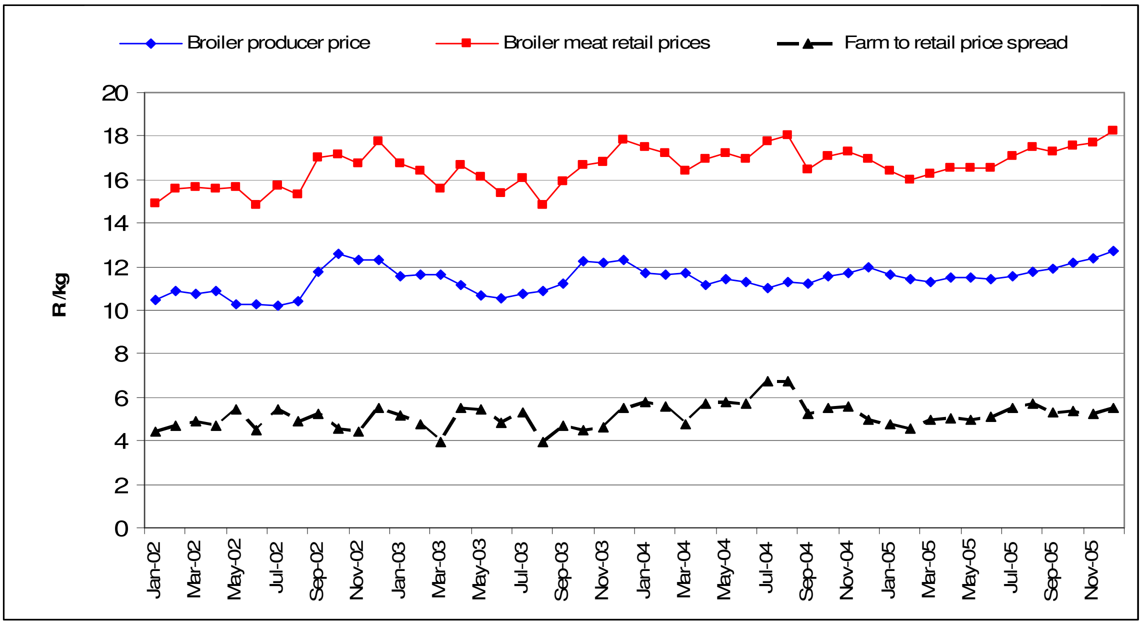

Figure 3.6: The difference between the producer price, farm-to-retail price spread and the retail price of fresh broiler meat, 2002 – 2005.

3.4 Summary

A methodology defining values and price spreads along the supply chain is important in order to define and quantify the different role players within the chain. Without such a methodology it would be difficult to, for example, substantiate claims, as well as to know how farmers are performing and whether their share of the food basket has declined. This chapter, in light of the above, attempted to define the different farm values and farm-to-retail price spreads of five products, as well as to discuss methods and formulas which can be used to calculate these values and spreads.

Chapter 4

Testing for asymmetric vertical price transmission in agricultural supply chains

4.1 Introduction

After discussing a set of procedures in Chapter 3 which could aid individuals interested in calculating the values and price spreads in the supply chain, more advanced empirical techniques can now be applied to conduct an in-depth analysis of price movement on different levels in the chain. The figures in Chapter 3 indicate that in most cases it is expected that the retail prices can, to some degree, be explained by the producer prices. In other words, a change in the producer price should to some degree be transmitted to the retail price and this price should adjust accordingly. However, in some cases, it appeared as if some abnormal behaviour occurred in this regard and that asymmetric price transmission could be more common that what it is generally believed to be.

All over the world economists have long been concerned with the transmission of market shocks through the various stages of agricultural supply chains. Vertical price relationships are typically characterised by their magnitude, speed and nature of adjustments through the supply chain after market shocks that are generated at different levels of the marketing process (Vavra & Goodwin, 2005).

In the context of this definition, the underlying links across agents at different levels of activity, from production to consumption and vice versa, may be summarised in a single set of measures that define the speed and size of the impacts of a shock in prices at one level on the prices up- or downstream. An example of this would be if a positive shock in the raw commodity market at the farm level induces an upwards shock to the farm price. What then are the size and the timing of any impacts on the wholesale and retail prices? The size of effects that are transmitted across levels is typically of central concern, although the speed of adjustment is equally important. The speed at which markets adjust to shocks is determined by the actions of market agents who are involved in the transactions that link market levels, including, for example, wholesalers, distributors, processors, retailing firms and the like (Vavra & Goodwin, 2005). The issue of asymmetric price transmission is taking on renewed prominence due to its potentially important welfare and policy implications. Meyer and von Cramon-Taubadel (2004) observe that a possible implication of asymmetric price transmission is that consumers are not benefiting from a price reduction at the producer's level, or producers may not be benefiting from a price increase at the retail level.

Thus, under asymmetric price transmission, the distribution of welfare effects across levels and among agents, following shocks to a market, will be altered relative to the case of symmetric price transmission. These aspects, as identified by Vavra and Goodwin (2005), can be restated as four fundamental questions:

- How great is the response at each level due to a shock of a given size at another level? (magnitude)
- Are there significant lags in adjustment? (speed)
- Do adjustments, following positive and negative shocks at a certain marketing level, exhibit asymmetry? (nature)
- Do adjustments differ depending on whether a shock is transmitted up or down the supply chain? (directions)

It should be noted that asymmetries can occur within any aspect of the adjustment process. Price transmission may be asymmetric in its speed and magnitude and could differ depending on whether the price shock is positive or negative and whether it is being transmitted up or down the chain (Vavra & Goodwin, 2005).

This chapter uses a methodology developed by Dickey and Fuller (1979), which was later refined by a number of other authors, among which are Vavra and Goodwin (2005). The main objective of this chapter is to compare and test the prices of the various commodity supply chains for price transmission characteristics on different levels of the chain and to identify if these are contrary to general economic principals. The results of these tests are then used to draw conclusions and shed some light on the findings of Chapter 3.

4.2 Causes of asymmetric price transmissions

Ball and Mankiw (1994) noted that in the presence of inflation and nominal input price shocks, the use of menu costs by agents may lead to more resistance to lower prices than to increase them. Bailey and Brorsen (1989) also pointed out that asymmetries in price adjustments may be caused by asymmetries in the underlying cost adjustments. Alternatively, retailers selling perishable goods may be reluctant to raise prices in line with an increase in farm level prices, given the risk that they will be left with the unsold, unspoiled product (Ward, 1982). This would, in turn, cause asymmetries in price changes that are beneficial for suppliers and consumers, but detrimental for retailers. Blinder (1994) and Blinder, Canetti, Lebow and Rudd (1998) found that merchants often believed themselves to be disciplined by the fear of being 'out of line' with their market competitors when costs rose, implying asymmetric responses to cost increases and decreases. Other authors, argue that asymmetric price transmission, the phenomenon where prices at the one end of the supply chain do not change at the same pace as prices at the other end of the supply chain, is the rule rather than the exception (Peltzmann, 2000).

Response may also be asymmetric due to inventory management strategies. Retailers may reduce their prices more slowly compared to the pace of reduction in farm-level prices, so as to avoid running out of stock (Reagan & Weitzman, 1982). Balke, Brown and Yücel (1998) showed that accounting methods, such as FIFO (first in first out), could cause asymmetric adjustments to price shocks. Wohlgenant (1985) also demonstrated that lags between the retail and the wholesale food prices can be explained by the inventory behaviour of retailers. The argument that stock building and the non-negative constraint on inventory could lead to asymmetric price responses, was also put forward by Blinder (1982).

Gardener (1975) pointed out that, in addition to other causes, farm-to-retail price asymmetries may be the result of government intervention to support producer prices. Although these and other explanations have been discussed and even demonstrated theoretically or empirically, it is the presence of non-competitive behaviour in the market place that is often identified as, or claimed to be, the culprit for asymmetric price transmission. However, the discussion of asymmetric price adjustments has taken place in the shadow of widespread suspicions that agents in concentrated industries are pricing in a manner to capture profits for themselves rather than behave in a competitive manner and allow price signals to pass up and down the chain unmolested. Likewise, when observers consider interaction between highly concentrated processors and 'stereotyped' small farmers, the common belief is that processors may be more likely to pass down-stream price decreases than down–stream price increases to these farmers. In both cases, asymmetric price transmission results from the concentrated agents' exploitation of their perceived market power. Zachariasse and Bunte (2003) note that market power may explain why prices are not fully transmitted, while oligopolistic and oligopsonistic interdependence may give rise to lags in price adjustment. They argue that the risk of invoking a price war may make firms reluctant to lower prices, leading to an asymmetry in the price reaction of positive versus negative price shocks.

4.3 A price transmission estimation method

Von Cramon-Taubadel and Fahlbusch (1994) were among the first to incorporate the concept of co-integration into models of asymmetric price transmission. Varva and Goodwin (2005) suggest that in the case of co-integration between non-stationary time series, an error correction model (ECM), extended by the incorporation of asymmetric adjustment terms, provides a more appropriate specification for testing asymmetric price transmission. This method allows for asymmetric adjustments by distinguishing between positive and negative shocks in error correction terms. Meyer and von Cramon-Taubadel (2004) do, however, argue that as the co-integration and the ECMs are based on the idea of a long-run disequilibrium, which disallows individual prices to drift apart in the long-term disequilibrium, it is only possible to consider asymmetry with respect to the speed of the price transmission and not the magnitude. In addition, the presence of asymmetries may invalidate the standard tests, such as the Dickey and Fuller tests for stationarity or the Johansen test for co-integration. Finally, their methods are based on linear error correction, whereby a constant proportion of any deviation from the long-run equilibrium is corrected regardless of the size of this deviation. That means that this model requires functional relationships underlying the price transmission process in order to be fundamentally linear.

4.3.1 Stationarity, unit roots and random walk

Stationarity is defined as a quality of a process in which the statistical parameters of the process do not change with time. It follows that a non-stationary time series or stochastic process evolves over time. It may, however, have trends in its mean or variance. A variable that contains unit roots is said to be non-stationary, thus the terms non-stationarity, random walk and unit root can be treated as synonymous (Gujarati, 2003). Many economic time series are non-stationary and some transformation, such as differencing or detrending, is needed to transform them into stationary time series (Vavra & Goodwin, 2005). As Granger and Newbold (1974) found, a problem of non-stationarity may be spurious regression. This phenomenon appears to have a significant relationship among variables, but the results are in fact without economic meaning. If a time series is differenced once and the differenced series is stationary, the series is then integrated of order 1 or denoted by I(1). It is, therefore, imperative that every time series, which is to be used in the following price transmission analyses, is tested for the presence of unit roots by means of the Augmented Dickey-Fuller tests (ADF) and the Phillips-Perron test (PP):

$$Y_t = \beta y_{t-1} + \varepsilon_t$$

If β equals 1, the model is said to be characterised by a unit root problem and that it is a series containing non-stationary characteristics. In order for the series to be stationary, β must be less than unity in absolute value. Hence, stationarity of a variable requires that $-1 < \beta < 1$.

4.3.1.1 The Dickey-Fuller unit root test (DF), the Augmented Dickey-Fuller test (ADF) and the Phillips-Perron (PP) unit root test

One needs to start with an explanation of the function when explaining the Dickey-Fuller unit root test: $Y_t = \beta Y_{t-1} + u_t$, where $-1 \leq \beta \leq 1$ and where u_t is a white noise error term. The general idea behind the unit root test is to regress the term Y_t on its lagged value Y_{t-1} and then to find out if the estimated term β is statistically equal to 1. When this is the case, then the term Y_t is non-stationary (Gujarati, 2003). The calculation of this process is as follows:

$$Y_t - Y_{t-1} = \beta Y_{t-1} - Y_{t-1} + u_t$$
$$Y_t - Y_{t-1} = (\beta - 1) Y_{t-1} + u_t$$
$$\therefore \Delta Y_t = \delta Y_{t-1} + u_t$$

δ = (β -1) and Δ are the first difference operators. The test works in such a way that the $\Delta Y_t = \delta Y_{t-1} + u_t$ is estimated and the null hypothesis is tested for δ = 0. If this is the case, then β =1, which again means that we have a unit root and, as a result, the time series under consideration is termed to be non-stationary (Gujarati, 2003). There is, however, one shortcoming of the DF test - that the error term u_t is assumed to be uncorrelated. This chapter will make use of the more improved version of the Dickey Fuller test, namely the Augmented Dickey Fuller or ADF test. This test is conducted by 'augmenting'; by adding lagged values of the dependent variable ΔY_t to the equation:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t$$

In this equation, ε_t is a pure white noise term and $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$. The number of lagged indifference terms to include is determined empirically. The idea is to include enough terms so that the error term is serially uncorrelated. In short, the ADF test also tests whether the null hypothesis of δ = 0 holds. The ADF test also follows the same asymptotic distribution as the DF statistic and, as a result, the same critical value can be used (Gujarati, 2003).

The Phillips-Perron (PP) test uses non-parametric statistical methods to take care of the serial correlation in the error terms, without adding lagged difference terms. The distribution of the PP test is the same as the distribution of the ADF test statistic (Gujarati, 2003).

4.3.2 Co-integration and the Engle and Granger test for co-integration

Chapter 3 focuses on the relationship between the farm and the retail price. Co-integration is the process where two variables have a long-term relationship between them. This process can, therefore, help in understanding the relationship between the farm and the retail price. If there are combinations of integrated variables that are stationary, then such variables are said to be co-integrated. This means that they share a common unit root and that the sequence of stochastic shocks is common to both. If two non-stationary series are co-integrated, then, by definition, the extent by which they diverge from each other will have stationary characteristics and will reflect only the disequilibrium. Therefore, co-integration captures the equilibrium relationship, even between non-stationary series, within a stationary model. Co-integration, therefore, implies that prices move closely together in the long-run, although in the short-run, they drift apart. In short, it can be stated that co-integration analysis is concerned with estimating the long-run relationship among non-stationary, integrated variables (Vavra & Goodwin, 2005).

Engle and Granger (1987) developed a rather simple procedure to test for co-integration, which comprises of estimating the static co-integrating regression and applying unit root tests, such as the ADF and PP, to estimate the residuals in order to test the null hypothesis of non co-integration $Y_t = \alpha + \beta x_t + v_t$. If y and x are I(1), then the residual t from the regression of those series would also be I(1), unless they are co-integrated. The null hypothesis of non co-integration is accepted if the residuals are distributed I(1), but if the residuals are distributed I(0), then the null hypothesis is rejected and, therefore, it can be concluded that the variables y and x are co-integrated. The requirement for the test is that co-integration needs to exist among the variables at a 5% level of significance for it to be statistically significant.

To explain the test for co-integration, the following example will be considered. Let us consider the estimation $Y_t = \beta x_{t-1} + \varepsilon_t$. The model then tests for co-integration is given by:

$$\Delta\varepsilon_t = \rho^* \varepsilon_{t-1} + \sum_{i=1}^{\rho-1} \rho_i^* \Delta\varepsilon_{t-i} + w_t$$

While w_t is the white noise term, $\rho^* = (\rho_1 + \rho_2 + \rho_3 + \rho\ \rho) - 1$ (Harris, 1995). From this, the null hypothesis is then written as follows:

$$H_0 : \rho^* = 0$$
$$H_1 : \rho^* < 0$$

The H_0 represents non co-integration and, therefore, non-stationary residuals, while the H_1 represents co-integration and, as a result, stationary residuals.

The standard ADF test specifically states that the distribution of the t statistic is non-standard, neither conforming to the t distribution, nor to the Dickey-Fuller distribution. The distribution of the t statistic is then tested by comparing the t stats with those calculated by Mackinnon (1991). Mackinnon uses the following formula:

$$C(p) = \phi_\infty + \phi_1 T^{-1} + \phi_2 T^{-2}$$

While C(p) is the p percentage critical value, T is the sample size. The ϕ's are obtained from the Mackinnon's tables, taking into account the deterministic structure and desired levels of significance. It should be remembered that one of the critical requirements for the test to work is that the variables employed in the equation are all I(1), which is the case in this exercise.

4.3.3 The Error Correction Model

The procedure followed to incorporate the concept of co-integration into models of asymmetric price transmission, was first tested by von Cramon-Taubadel and Fahlbusch (1994). In short, their approach involves a standard error correction model, which is extended by the incorporation of asymmetric adjustment terms. The procedure that is followed involves estimating the relationship between prices, in this case farm, retail and, in some instances, wholesale prices, by ordinary least squares and then performing tests of spurious regression. If the prices can be referred to as being co-integrated, the estimated coefficient of the OLS is an estimate of the long-term equilibrium relationship between them. During the second step, an ECM is estimated. The model includes the so-called error correction term which measures deviations from the long-run equilibrium between the two prices. The inclusion of this term allows the estimated price to respond to the changes in the explanatory price, but also corrects any deviations from the long-run equilibrium that may be left over from previous periods. Splitting the error correction term into positive and negative components makes it possible to test for asymmetric price transmission (Vavra & Goodwin, 2005). The ECM could possibly look like this:

$$\Delta P_t^1 = \alpha + \sum_{j=1}^{k} \beta_j \Delta P_{t-j+1}^2 + \gamma^+ v_{t-1}^+ + \gamma^- v_{t-1}^- + e_t$$

P^1 and P^2 are two vertically related prices, Δ is the difference indicator, β_j and γ are the estimated coefficients and v^+ and v^- are the positive and negative deviations from the long-run equilibrium (Vavra & Goodwin, 2005).

The ECM is then evaluated by a set of diagnostic tests and these are run in order to determine that the model fulfils its statistical requirements. The tests include the Jarque Bera test of normality, the Arch LM test of heteroscedasticity, the White test for heteroscedasticity, the Breusch Godfrey and Ljung-Box tests for serial correlation, as well as the Ramsey Reset test of misspecification.

4.3.4 The Engle-Granger two step procedure and the Engle-Yoo third step procedure

A relatively simple two step procedure was proposed by Engle and Granger (1987) in order to estimate an error correction model. The first step requires the static co-integration regression to be estimated by means of ordinary least squares. If this regression tests positive for the presence of co-integration, the function is then said to describe the long-run relationship between y and x and the parameter vector, which is also referred to as the co-integrating vector. During the second step, residuals are saved from the OLS first step estimation of the long-run equilibrium and are used in the error correction model. The only drawback is that when residuals are used, the results may be sensitive to the normalisation rule. This means that the results could indicate that the variables are co-integrated. This is so when one variable is used for the normalisation, but is not so when another variable is used for the normalisation. In this case, it is possible that only sub-sets of variables are co-integrated.

The Engle-Yoo third step procedure requires the making of a new residual series, originating from the ECM. This is then regressed by multiplying the variables that were used in the proposed co-integration procedure with the coefficient of the lagged residual series, as generated in the ECM. The results of this regression are then used to calculate the value of the new coefficient of the lagged residual value, as well as the value of the new t stat. The Engle-Yoo third step procedure is performed in order to adjust the long-run coefficients and associated t–statistics for initial bias. This procedure then allows for accurate statements regarding the magnitudes and the statistical evaluation of the long-run coefficients. As mentioned previously, the step is performed by regressing the independent variables from the co-integrating relationship, and then multiplying them by the error correction parameter on the residuals of the error correction model. In short, the coefficients from this regression are the corrections to the original long-run parameter estimates, and their standard errors are the standard errors associated with the corrected parameter estimates.

- Step 1 in the procedure is known as the co-integration relationship:

$$Y_t = \beta X_t + \in_t$$

- Step two represents the ECM:

$$\Delta Y_t = \delta \in_{t-1} + \phi(L)\Delta Y_{t-1} + \theta_1(L)\Delta X_t + \theta_2(L)\Delta Z_t + v_t$$

This equation includes the lagged residual represented by ε_{t-1}.

- Step three represents the Engle-Yoo third step:

$$v_t = \alpha(-\delta * X_t) + w_t$$

In the Engle-Yoo third step, the negative lagged residual's coefficient is multiplied by the independent variable of the co-integration equation to give the value of the error term.

4.3.5 The data set to be used

The phenomenon of symmetric price transmission can be described as the process in which the transmission of prices within a value chain occurs at a similar rate. In other words, an upward or downward rate of change in the prices at producer level will, to a large extent, be reflected as similar in magnitude, speed and direction of price at the retail level. The error correction model methodology, as described previously, is employed in the following section in order to test the five different commodity supply chains for symmetric price transmissions between farm and retail prices.

The data set that is analysed in the following section is also used in Chapter 3. It comprises of a complete set of national average monthly prices collected at both the retail and the farm level. The retail prices used were, on the most part, collected by the data firm ACNielsen. The producer prices were, on the most part, collected by producer organisations. The exception is the farm gate price of maize, which is calculated by subtracting the transport differential and the handling and storage fees from the four month lagged SAFEX price. The frequency of the data set for all of the reviewed products was monthly and it ranged from January 2002 up to December 2005, making up a total of 48 observations. The data sets for sugar and maize included the mill door prices, which is the price at which the commodity is sold once it leaves the mill. These prices represented a few problems, as they were mostly estimated as a proxy and, as was the case with sugar, proved statistically insignificant. As a result, the series was discarded.

4.4 The estimation procedure

4.4.1 Unit root test summary

The test for unit roots and stationarity is the first and foremost test that has to be conducted in any ECM estimation procedure. Any series that is to be used in any regression estimation needs to be stationary so that it will make significant sense. A series is said to be integrated in order d, written I(d), if after it is differenced d times it becomes stationary. This means that a variable which is stationary and, therefore, does not need to be differenced, can be denoted by I(0). The table below reveals that all of the variables need to be differenced once in order to become stationary.

Table 4.1: Summary of the unit root tests performed on the various prices

Variable	Status	Conclusion
Beef		
Ln Retail	I (0)	Non-Stationary
Δ Retail	I(1)	Stationary
Ln Farm	I(0)	Non-Stationary
Δ Farm	I(1)	Stationary

Sugar		
Ln Retail	I(0)	Non-Stationary
Δ Retail	I(1)	Stationary
Ln Wholesale	I(0)	Non-Stationary
Δ Wholesale	I(1)	Stationary
Ln Farm	I(0)	Non-Stationary
Δ Farm	I(1)	Stationary
Maize	**Status**	**Conclusion**
Ln Retail	I(0)	Non-Stationary
Δ Retail	I(1)	Stationary
Ln Wholesale	I(0)	Non-Stationary
Δ Wholesale	I(1)	Stationary
Ln Farm	I(0)	Non-Stationary
Δ Farm	I(1)	Stationary
Chicken		
Ln Retail	I(0)	Non-Stationary
Δ Retail	I(1)	Stationary
Ln Farm	I(0)	Non-Stationary
Δ Farm	I(1)	Stationary
Dairy		
Ln Retail	I(0)	Non-Stationary
Δ Retail	I(1)	Stationary
Ln Farm	I(0)	Non-Stationary
Δ Farm	I(1)	Stationary

As table 4.1 indicates, all of the variables used in the simulation process had to be differenced of order one in order to become stationary. The test results can be found in Annex A of this dissertation.

4.4.2 Co-integration relationships, the ADF test for co-integration and the error correction model

The rational behind co-integration is that if a combination of non-stationary variables is stationary, then the use of an ordinary least squares estimation is again justified. When this is the case, it can then be stated that co-integrating coefficients can be identified with parameters in the long-run relationship between the variables. It is important to remember with regard to co-integration relationships that the signs and magnitudes of the variables can be economically and statistically evaluated and that these have to make sense for the equation to be acceptable (Enders, 2004). The procedure, as explained before, will be applied to the five products under review. The sections below describe this process for each of the commodities and the consequent results.

4.4.2.1 Maize

The supply chain of super maize meal is split into two separate parts, the first being from the farm gate to the mill door and the second part being from the mill door to the retail store. The reason for this is that if asymmetry should be identified and should exist somewhere within the chain, it would be easier to identify exactly where in the chain this could be. Another reason for using this approach is that, in this instance, data is available, where this is not the case for any of the other supply chains that are being analysed.

The farm gate price is the price which the farmer receives for his maize once he has delivered it to the silo. The mill door price, on the other hand, is the price for which maize meal sells once the grain has been processed by the millers. It, in other words, is the price for which retailers purchase maize meal from the millers. The farm gate price is calculated by subtracting the transport differential, as well as storage and handling fees from the four month lagged SAFEX price, while the mill door price incorporates all the expenses which the miller has to deal with in order to produce his maize meal. The mill door price is a calculated price which is checked by industry role players in order to make sure that it is within range.

The farm gate to mill door section of the supply chain indicates that a great deal of co-integration among the farm gate and the mill door prices existed. The economic interpretation of the farm gate price is as follows. If the farm gate price of maize, of which the calculation is explained in Figure 3.1 in Chapter 3, increases by 1%, then the mill door price of maize will, according to the proposed co-integration relationship, increase with 0.92%. Statistically, the p value of the variable is also significant, below a 1% level of significance.

The mill door-to-retail price side of the supply chain, on the other hand, seemed to be less sensitive to their respective price changes and the resultant transmission thereof. Economically, the coefficients of this proposed co-integration relationship also made perfect sense. According to the co-integration relationship, a 1% increase in the mill door price of maize would result in a 0.29% increase in the retail price of super maize meal. Statistically, the p value was also significant below a 1% level of significance.

The results from the Engle-Granger test for co-integration indicate which part of the supply chain is possibly experiencing a higher degree of asymmetric price transmission. The farm gate-to-mill door supply chain passed the test for co-integration at a 1% level of significance, meaning that a co-integration among the variables definitely exists. The mill door-to-retail supply chain, on the other hand, failed the tests for co-integration at every level of significance, meaning that the chance of any form of co-integration existing among the variables contained in the model was rather limited.

The error correction model for the farm gate-to-mill door part of the supply chain gave the impression that the mill door price could be explained almost perfectly by the farm gate price and the lagged residual, which is created by the proposed co-integration relationship. With an adjusted R square of 91.8% and a number of significant variables, it seemed as if this part of the supply chain would exhibit the least problems.

The diagnostic tests conducted on the error correction model did, however, reveal another scenario. The farm gate-to-mill door model failed all tests except White's test for heteroscedasticity, meaning that there is a huge problem with the way in which relationships among the variables were portrayed and that a perfect example of the spurious regression phenomenon may have existed. To conclude, it is fair to state that the mill door price, given the availability and quality of the data used, cannot be explained by the movements in the farm gate price and, therefore, a possible case of asymmetric price transmission may exist here.

Table 4.2: Proposed error correction model for maize (farm gate to milldoor)

Dependent variable: DLN_MDPWM

Variable	Coefficient	Std Error	t - statistic	Prob.
DLN_FGPRWM	1.080309	0.057213	18.88223	0.0000
RESID_MDFGCOIONTL	-0.146714	0.059474	-2.466848	0.0175
Adjusted R square		**0.918**		

Table 4.3: Proposed error correction model for maize (milldoor to retailer)

Dependent Variable: DLN_RETSUPMM

Variable	Coefficient	Std. Error	t-statistic	Prob.
DLN_MDPWM	0.083481	0.045628	1.829583	0.0739
RESID_RETMDPLAG	-0.168261	0.066885	-2.515663	0.0155
Adjusted R square		**0.158**		

Even though the mill door-to-retail co-integration relationship failed the Engle-Granger co-integration test, meaning that the variables are co-integrated at a level of more than 10%, the error correction model for this leg of the supply chain was constructed and interestingly enough, the variable used to explain the retail price of super maize meal was significant, even though the adjusted R square value was rather low. When the proposed series of diagnostic tests were conducted on the error correction model, it passed every single test at a reasonable level of significance. It can, therefore, be concluded that even though the variables are co-integrated at a certain level above 10% and, in variable terms, this is not great, at least some of the variation at retail level can be explained by the variation in the mill door price.

4.4.2.2 Beef

In the case of beef, the coefficient of the slaughter price of A2 quality beef, in the proposed co-integration relationship, is 0.2943. Economically, this means that a 1% increase in the farm gate price or, in this instance, the slaughter price of beef, will have a 0.29% increasing impact on the retail value of the five selected cuts of beef. The shift variable was introduced so as to compensate for the change in the retail price, which took place due to a lack of the same consistent time series. The values of the R square, F statistic and the t statistic are invalid and, as a result, they are not reported or interpreted in this section.

The co-integration relationship then needs to be tested for co-integration by using the Engle-Granger test. As explained in section 4.3.2, three different critical values need to be calculated in order to determine if co-integration exists at different levels of significance. For simplicity's sake, co-integration will be tested at a 1%, 5% and 10% level of significance. The beef model shows a form of co-integration at a 10% level of significance, meaning that the variables used in the model show very little signs of integration at 1% and 5%.

The results of the error correction model of beef indicate that the different given variables that were used in order to explain the retail value of the selected cuts (the dependent variables), which included the differenced weighted average slaughter price for A2 quality beef and the differenced weighted average lagged slaughter price for A2 quality beef, explain only to a minimal extent the trend of the retail value of the selected beef cuts. The error correction model shows few signs of significance among the variables and also boasts a relatively low R squared value of 26.8%. Interestingly enough, the model passes all of the diagnostic tests which are conducted in order to see whether some form of a problem exists, be it misspecification, heteroscedasticity or serial correlation but to name a few, with the data contained in the model.

Table 4.4: Proposed error correction model for beef

Dependent variable: DLN_RBEEF

Variable	**Coefficient**	**Std. Error**	**t-statistic**	**Prob.**
DLN_A2BEEFLAG	-0.067274	0.054379	-1.237125	0.2253
DLN_A2BEEF	0.014570	0.066387	0.219476	0.8277
RESID_BEEFLAG	-0.306875	0.080250	-3.823982	0.0006
C	-0.001671	0.003644	-0.458622	0.6497
Adjusted R square		**0.208**		

It can, therefore, be concluded that, given the available data and the proposed co-integration relationships, price asymmetry within the specific supply chain does exist.

4.4.2.3 Sugar

The proposed co-integration relationship of sugar has significant coefficients, which, as is required by the co-integration procedure, make sense both economically and statistically. Due to the regulated nature of the South African sugar sector, it was decided that both the sugar cane producer price, as well as the mill door price, should be used as variables to explain the nature of the retail price of sugar. A 1% increase in the sugar cane price will have a possible increasing effect of 2.9% on the retail price of sugar. A similar scenario counts for a 1% increase in the mill door price of sugar. As this price increases with 1%, the retail price may see an increase of approximately 1.85%.

From a statistical point of view, the proposed co-integration relationships pass the co-integration test at a 1% level of significance, meaning that co-integration among the variables at this level of significance exists. The Engle-Granger test for co-integration came up with a test variable of -3.83, which, given the calculation of the Engle-Granger critical value, cannot be rejected even at a 1% level of significance.

The error correction model for sugar again indicates a similar problem, as in the case of beef. The variables, namely the differenced mill door and sugar cane prices, contained in the model are insignificant, which, together with a low adjusted R square, means that the retail price of sugar is not explained by the mill door price, the sugar cane price nor by a combination of the two. The figure in Chapter 3 which represents the farm value, the retail value and the farm-to-retail price spread, indicates that, while the farm value remained relatively constant on a year to year basis, the retail value did not. The retail value increased continuously from 2002 onwards, consequently widening the farm-to-retail price spread.

Table 4.5: Proposed error correction model for sugar

Dependent variable: DLN_RETWSG

Variable	Coefficient	Std. Error	t-statistic	Prob.
DLN_SGCPRSALAG	0.298780	0.515547	0.579538	0.5663
RESID_SUGARLAG	-0.479985	0.151527	-3.167653	0.0034
C	0.001758	0.002534	0.693961	0.4927
Adjusted R square		**0.208**		

It can, therefore, be concluded that the existence of asymmetric price transmission within the South African sugar supply chain is rather high.

4.4.2.4 Fresh milk

The proposed co-integration relationship of fresh milk estimates that a 1% increase in the fresh milk producer price could result in a 0.62% increase in the retail price of fresh full cream milk. The relationship also passed the Engle-Granger test of co-integration at a 5% level of significance, meaning that the variables are indeed co-integrated at this level.

The resultant error correction model, as is the case with some other supply chains, displayed signs of statistical insignificance, as the p values of some of the variables are not significant. The adjusted R square is also not very high, at 22.45%. This, as in some of the other cases, again leads to the conclusion that there may be some form of abnormality within the supply chain of this specific product, be it in the form of asymmetric price transmission or unfair market practices.

Table 4.6: Proposed error correction model for fresh milk

Dependent variable: DLN_RETFFCM

Variable	Coefficient	Std. Error	t-statistic	Prob.
DLN_FMPP	-0.133185	0.235949	-0.564466	0.575
RESID_NEWMILKLAG	-0.269429	0.068833	-3.914222	0.0003
C	0.003264	0.003381	0.965315	0.3397
Adjusted R square		**0.224**		

4.4.2.5 Broilers

The proposed co-integration relationship for broilers indicates that the broiler producer price is indeed a function of the whole fresh chicken retail price. The producer price time series was supplied by industry role players. It represents the price which the producer receives once he delivers his stock to the chicken processor. The retail price of chicken has been sourced from ACNielsen and represents the weighted average retail price for fresh chickens on a per kilogram basis. The retail price was collected from 1500 stores nationwide and was weighted according to quantities sold by different stores.

The producer price is significant and has a coefficient of 0.76, meaning that a 1% increase in the producer price of broilers will have a 0.76% increasing effect on the retail price of fresh whole chicken. The relationship also passed the Engle-Granger test for co-integration at a 1% level of significance, revealing that the variables were indeed co-integrated.

The error correction model possibly suited the broiler relationship the best of all the models mentioned up until now. The broiler producer price variable was significant and, with an adjusted R square value of 43%, it can be stated that a change in the producer price of broilers has an impact on the retail price of chicken.

Table 4.7: Proposed error correction model for broilers

Dependent variable : DLN_RETCHK

Variable	Coefficient	Std. error	t-statistic	Prob.
DLN_CHKPP	0.537407	0.136676	3.931973	0.0003
RESID_CHKLAG	-0.0615570	0.132581	-4.642971	0.0000
Adjusted R square		**0.432**		

Even though there may still be a form of asymmetric price transmission within the supply chain, meaning that the change in the farm gate price is not symmetrically transmitted to the retail price, the change in producer price is significantly transmitted to a certain level. As the retail price is, to a large extent, explained by the producer price, it is rather safe to assume that this should also be so in future and if, for some reason, this should change, then one can assume an abnormality in the supply chain. This specific ECM also passed all of the proposed diagnostic tests, documented in Annex E of this dissertation. Again, it is safe to assume that there is only a minimal structural problem with the data.

4.5 Summary

Asymmetries can occur within any aspect of the price adjustment process. Price transmission may be asymmetric in its speed and magnitude or could differ, depending on whether the price shock is positive or negative and whether it is being transmitted up or down in the supply chain (Vavra & Goodwin, 2005). This chapter focused mainly on the magnitude of a positive and upward price transmission in the supply chain. With the help of the error correction mechanism, the supply chains with the highest degree of price asymmetry and/or abnormality have been identified.

The results indicate that the greatest level of asymmetric price transmission and unexplained retail prices exist within the maize, beef, sugar and dairy supply chains. In the case of maize, the mill door price is explained well enough by the farm gate price, but the explanation of the retail price in light of the mill door price, does not conform to economic theory. The ECM for beef indicates that few signs of significance between the farm gate price and the retail price exist. In other words, the model shows that the retail price cannot be explained well by the farm gate price. A similar problem exists in the case of sugar. The retail price of sugar is not explained by the mill door price of sugar, nor is it explained by the sugar cane price. The ECM that was developed to test the significance of the retail price of fresh milk and its responsiveness to the farm gate price indicated that the variables that have been used in the model have no significance and, as a result, asymmetric price transmission exists in the supply chain. The ECM developed for the broiler supply chain is the only model that conforms the most to the expected economic theory and it indicates that, within this supply chain, the producer price could best explain the retail prices.

Every one of the other four supply chains would qualify for a closer inspection, but it was decided that the maize-to-maize meal and the beef supply chains are the chains which are to be unpacked and analysed in this dissertation. The reason why these two supply chains were chosen is simple. Firstly, the empirical analysis done on the maize supply chain suggests that price asymmetry is present in a section of the supply chain. Secondly, maize is South Africa's main staple food and the activities that take place within the supply chain are of the utmost importance. As in the case of maize, the empirical evidence from the beef ECM suggests that price asymmetry takes place in the supply chain. It is also one of the most important protein sources in South Africa.

If the retail price could not be sufficiently explained by the farm gate and/or mill door price, then surely the economics within the chain are not what they should be. The aim of this chapter was to present an empirical analysis on observable price data of five different supply chains and to test whether these supply chains conform to economic theory. Chapter 5 will present two examples of how the unpacking of such supply chains can be done in order to point out at which level factors influencing the smoothness of price transmission has occurred. Chapter 5 only proposes a framework that can accomplish such an analysis. It does not constitute an actual analysis of the supply chains, as this would constitute an extensive research analysis on its own.

Chapter 5

Analysing two supply chains with observed asymmetric price transmission

5.1 Introduction

Chapter 4 discussed the use of econometric modelling techniques to identify possible asymmetric price transmission within a number of supply chains. Some of the results from Chapter 4 indicate that some form of data discrepancy or, alternatively, some form of price asymmetry within these product supply chains does indeed exist. Econometric analysis has its limits, as it only tracks the price variations at the various ends of the supply chain and not the possible price abnormalities within every actual leg of the chain itself. For this reason, one needs to look at the supply chains in closer detail and analyse those production processes which could have contributed to the abnormal behaviour within the chain.

In Chapter 4, there were some supply chains in which the empirical results indicated that price transmission does not take place. As a result of this finding, two supply chains were chosen to be analysed in Chapter 5. These are the maize-to-maize meal and the beef supply chains. There are a few other reasons for this decision. Firstly, maize meal is the staple food of South Africa and, therefore, the occurrences that take place within the chain play an important role in issues such as food security. The reason why beef was chosen as the second supply chain to be analysed is that it is one of the most important protein sources in the South African food industry and, as a result, also plays an important role in the nutrition of the nation.

In this chapter, available knowledge and information on the costs and structures within the chains is used in order to define and quantify the different profit margins within the separate levels of the supply chain. Supply chains which have been unpacked in other studies all found to have a few critical factors influencing their role player's profitability. These critical factors include retail pricing, confidential rebates, returns and losses, the management of the cold chain, packaging materials, payment terms and manufacturer/supplier–retailer relationships. A discussion of these so-called cost factors follows.

5.2 Cost factors influencing the profitability of supply chains

5.2.1 Packaging materials

Primary producers believe that consumer prices could be lower if retailers took greater care of the supplier packaging material and be held responsible for the mishandling of products in their stores. The general feeling of suppliers is that retailers seldom take good care of the supplier packaging materials. In an industry where packaging materials make up a large component of the overall cost of the product, this may be considered as inappropriate behaviour.

5.2.2 Payment terms

Payment terms, in general, vary from retailer to retailer, but they mostly vary between 7 and 90 days (FPMC, 2003). The Food Price Monitoring Committee's final report found that the general view of manufacturers is that they seldom experience problems with credit payment terms, but that it is preferred if the payment is made within a short time frame rather than within a long time frame. Most manufacturers agreed that they did, in some instances, experience problems with retailers, if the credit repayment terms were within the region of 60 days.

5.2.3 Transport costs

An investigation by the Food Price Monitoring Committee (2003) has found that retail and transport margins have a huge impact on food prices. There is also a concern that the South African Transport Policy, as currently implemented, is eroding competitiveness of South African goods, particularly because of inefficiencies in the rail transport system. The ERS confirmed this in their most recent CPI forecasts, in which they blamed the 1% increase in the consumer price index on '…retailers passing on higher energy and transportation costs to consumers in the form of slightly higher retail prices.'

5.2.4 Storage costs

The cost of storage plays an important role in the food industry, as food is of such a nature, namely perishable and bulky, that it makes it difficult to store. At some stage in the supply chain the food items need to be stored, be it in cold storage or a dry storage depot. The storage costs of maize, in most instances, are charged to and must be settled by the farmer for the time that he makes use of the storage facility. Once the maize is sold to a processor, but is still kept at the premises, the processor is then liable and needs to compensate the silo owner for his service. This cost is reflected in the retail price. Wohlgenant (1985) finds that if firms buy more raw material in a season and increase their holding stock, a downward pressure will be exerted on to the retail price and, as a result, the retail price will not rise by as much as it would in the absence of inventories.

5.2.5 Manufacturer / Supplier – Retailer relationships

In the past, relationships among the various role players in any supply chain has been characterised by hard negotiations with each of the parties at the negotiating table, pursuing their own private interests. This activity in the supply chain has, however, changed recently at an extremely fast pace and the competitive consumer goods market has caused retailers and manufacturers alike to recognise the value in developing and maintaining a sound relationship with their suppliers. In some consumer goods industries, the suppliers still feel that they are being mistreated by the big retailers and that the only choice they have is to accept the terms stipulated to them or otherwise face delisting (FPMC, 2003).

Now that the factors that have the most influence on the various prices within the supply chain have been identified and discussed, the unpacking of the chain can be addressed. Since it has been established that retail prices, confidential rebates, returns and losses, the cold chain, packaging materials, payment terms and relationships all influence the prices and potential profits within a supply chain, a detailed analysis needs to be conducted in order to determine at which points within the chain these factors will play a role. A methodology for performing exactly such an analysis is, therefore, defined. Section 5.2 and 5.3 include a detailed discussion of both the maize and beef supply chains, describing exactly how and at which level these profits and costs are calculated within the two chains.

5.3 The maize supply chain

5.3.1 Introduction

Maize is the single most important grain crop in South Africa, both in the animal feed and human staple food consumption sectors. During 2003/2004, for example, maize made the largest contribution of the field crops to the total gross value of agricultural production, with a value of R8.32 billion. Slaughtered chicken made the biggest contribution to the livestock sector, with R10.29 billion (NDA, 2005). As many industries are dependent on a healthy maize industry for their survival, the importance of tracking the movements in the farm-to-retail price spread, as well as in the farm value share of this commodity, becomes even more obvious. The farm-to-retail price spread, as mentioned in Chapter 3, represents the spread between the actual farm value of the commodity and the representative retail value of the product during the same month. The farm value share is, however, a concept which has not yet been discussed in previous chapters of this dissertation. The farm value share is calculated by dividing the farm value by consumer expenditures and it is, thereafter, reported as a percentage. Over time, the share reflects relative changes in expenditures for farm products, food marketing services and retail food products.

During 2005, the farm value share of super maize meal reached a maximum level of 54.44% in March. The farm value share, however, averaged 36.92% for the entire year and this was mostly due to a very low farm gate price towards the middle of 2005. The figure below represents the trends in the farm-to-retail price spread and farm value share of super maize meal from January 2002 up until December 2005.

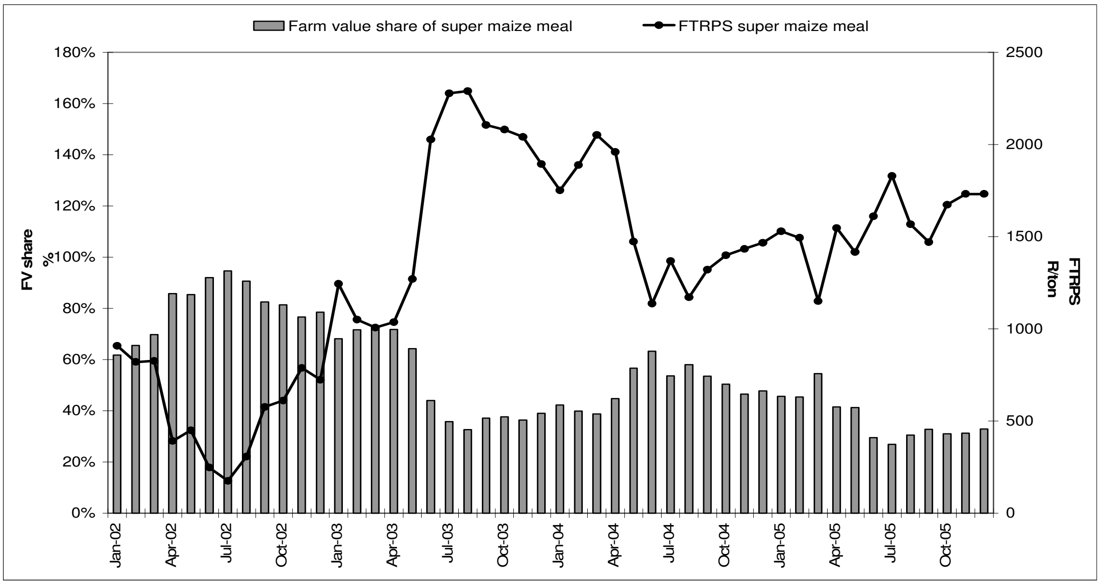

Figure 5.1: Farm-to-retail price spread and farm value share of super maize meal.

5.3.2 The maize to maize meal supply chain

The grain supply chain in South Africa consists of a number of different legs, as grains can be either exported or sold on the local market via retail stores or some sort of wholesale outlet. Figure 5.2 clearly shows what a typical grain supply chain may look like:

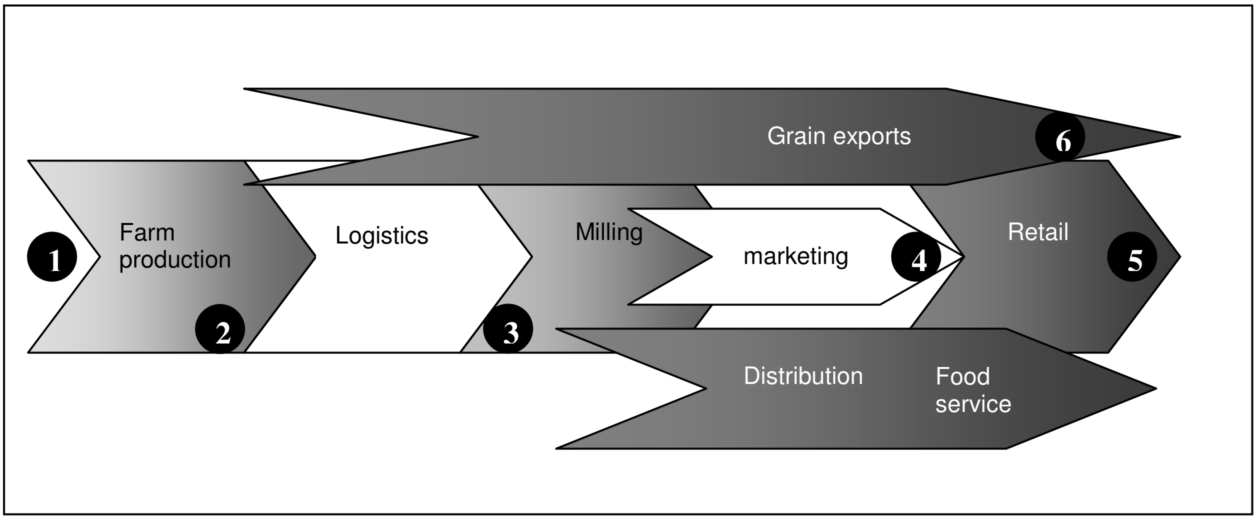

Figure 5.2: An example of the grain supply chain.
Source: Spencer, 2004.

Point 1 represents the farm gate price, which is the price the farmer earns after he has deducted his harvesting costs, his cost of transporting the grain to the silo and the cost of storing the maize at the silo from the market price, given the existing market conditions.

Point 2 represents the average market price, or the price for which white maize trades on SAFEX. In this example, the SAFEX price is trading at a four month lag as it, on average, takes millers four months to process the grain into the final product.

The Grain Silo Industry (2002) state that the entire country's storing capacity is estimated at around 17.5 million tons, of which 85% is owned by 22 silo owners. In terms of market share, there are three co-operative/companies that own 70.3% of all the domestic grain storage facilities. These co-operatives/companies are Senwes with 31.2%, Afgri with 21% and Noordwes with 18.1%.

Point 3 on the chart represents the mill door price. The mill door price is the price the miller pays for purchasing grain from the silo/farmer at the lagged market price. The miller adds the cost of transporting the maize from the silo to the mill and the cost of storing the maize at the mill, to the market price. The income which the miller makes from selling the by-product of the milling process, called 'chop' and mostly consisting of fibre and the outer shells of the grain, to the feed industry is then deducted from the overall cost and the result is the mill door price.

Point 4 in the supply chain is the wholesale price. This is the price which the miller earns after he sells the maize meal, mostly in large quantities, to the retailer. Point 5 is the retail price at which the everyday consumer purchases maize meal in the supermarket or grocery store. Point 6 represents the exporter realisation prices.

5.3.3 From the farm gate to the mill door

This first leg of the maize supply chain describes the process of value adding from the point where the grain is harvested and then transported from the field to the silo where it is eventually stored. By subtracting the costs of transport and storage from the overall SAFEX price, which is lagged by four months, one can estimate the eventual farm gate price, represented in Figure 5.3 by point 2. This is the price the farmer receives after taking all of his expenses into account. White maize then needs to be transported to the nearest mill if the mill is not within the region of the silo.

Another cost that needs to be added is the storage costs of grain at the mill. The miller earns some extra income from the chop he sells to the feed industry. After these additional storage costs have been added and the income from chop is subtracted, the result gives us an estimate of the mill door price. The mill door price is the price the miller then pays for the maize to be delivered to, and stored at the mill so that he can start processing it. The formula for this is as follows:

$$P_{md} = \left(P_{safex4lag} + C_{transport} + C_{storage}\right) - Y_{chop}$$

P_{md}, the mill door price, is represented by point 3, while $P_{safex4lag}$, the SAFEX price with a four month lag, is represented by point 1 in Figure 5.3. $C_{transport}$, the cost of transporting the maize from the silo to the mill once the miller has purchased it, and $C_{storage}$, the cost that the miller incurs when he needs to handle and store the grain at the mill, are both represented by point 4. Y_{chop}, the income that the miller receives from selling the remaining chop off to the feed industry, is represented by point 5.

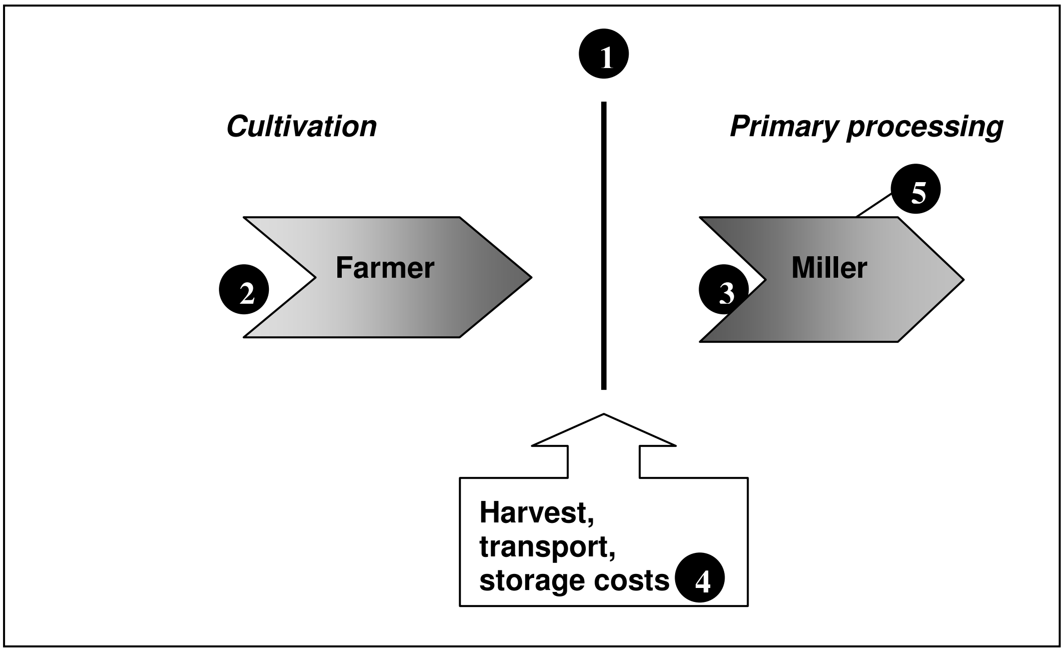

Figure 5.3: Prices and cost of the farm gate to mill door leg of the maize to maize meal supply chain.
Source: Spencer, 2004.

5.3.4 From the mill door to the retailer

Once the miller has purchased his grain, the processing will take place. The maize grain is crushed and milled to form a powdery substance, maize meal. This process varies depending on which product the miller wants to produce. As mentioned in Chapter 3, every one of the products discussed has a different extraction rate. In the case of super maize meal, the extraction rate averages around 62.5%, meaning that it takes approximately 1.6 tons of white maize grain to produce one ton of super maize meal. Apart from dealing with the extraction rate for his maize meal, the miller also needs to consider the costs that are involved when processing maize. The miller incurs costs from storing, handling and transporting maize from the silo to the mill. The miller also needs to be aware of his other processing costs, such as basic production or milling costs, his packaging, distribution, administration and other capital costs, all of which need to be met before he can carry on with his everyday operations. The total mill site costs are made up of the following:

$$C_{millsite} = C_{production} + C_{packaging} + C_{pack.mat.costs} + C_{admin,wharehouse,selling}$$
$$TC_{millsite} = C_{millsite} + C_{distribution}$$
$$TC_{Mill} = FC + FLC + TC_{millsite}$$

The total cost which the mill incurs is represented by $C_{millsite.}$ This is made up of $C_{production}$, direct production costs; the actual milling cost per ton; $C_{packaging}$, the labour cost required for packaging; $C_{pack.mat,costs,}$ the costs of packaging material and resultant losses and $C_{admin,wharehouse,selling}$, which are all the other costs involved with running the mill efficiently. The $TC_{millsite}$ cost is then the sum of the above mentioned costs plus the actual cost of distributing the maize meal to the different retailers, denoted by $C_{distribution}$. The total mill site cost of production, represented by TC_{Mill}, is a sum of all the mill site costs, such as $TC_{millsite}$ and the fixed FC, as well as floating capital costs (FLC) associated with the production of maize meal.

The second leg of the supply chain is represented by Figure 5.4 below. The miller has an option as to how he wants to distribute his product. Individual supply chains differ from miller to miller depending on the size of the mill and the mill's respective market share compared to the national market. Figure 5.4 represents, graphically, what the miller-to-consumer leg of the supply chain could look like.

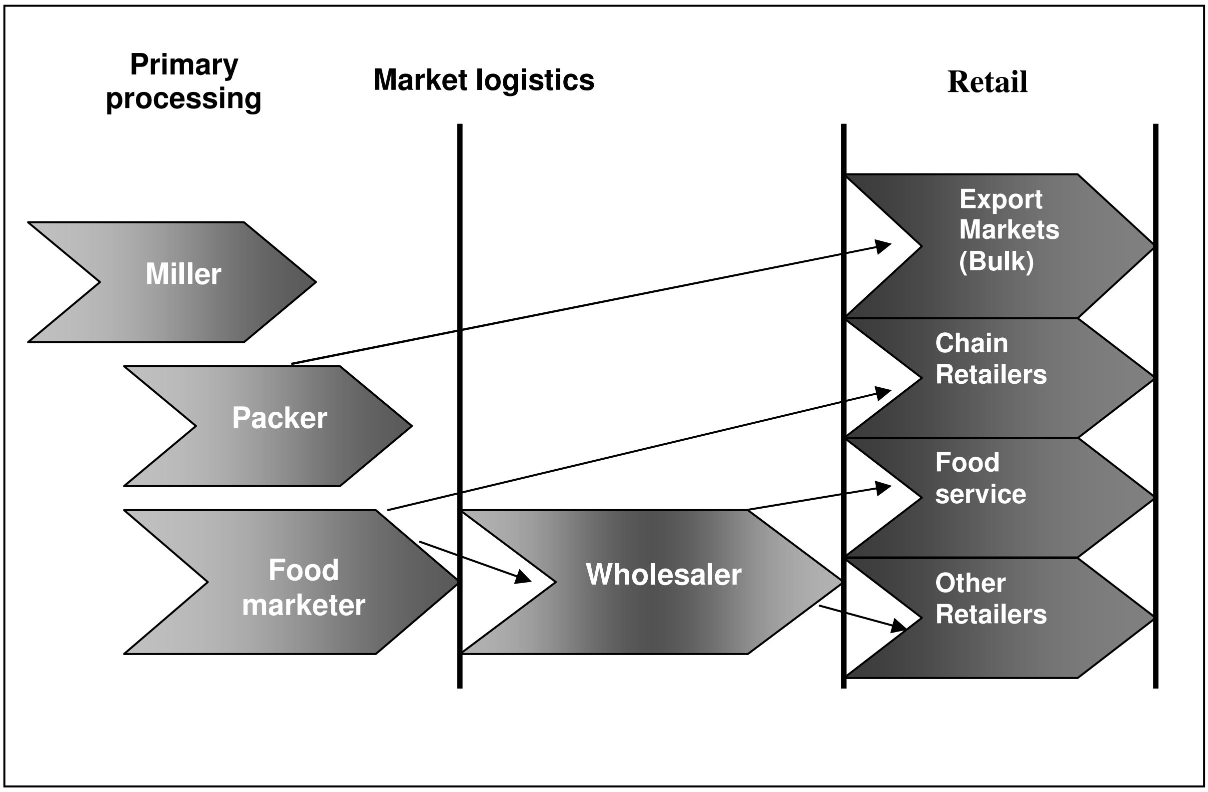

Figure 5.4: The mill door to retail leg of the maize to maize meal supply chain.
Source: Spencer, 2004.

The miller has a number of distribution channels open to him once he has milled the grain into meal. At retail level there are chain retailers, for example, the major supermarket groups, as well as some food service agencies and the individual small scale, mostly rural, retailers or spaza shops. Most of the major millers in South Africa pack their own product at the mill and then sell it off to the retailer under their own brand. This means that, in some cases, the miller controls most of the primary processing leg of the maize supply chain, as the packers and food marketers, in some instances, belong to the miller's company. Between the primary processing level and the retail level lie the wholesalers. In South Africa, the wholesalers are playing a less and less important role, as most of the major supermarket stores are sourcing their products directly from the miller. Retailers then service the consumer directly, either in bulk or in smaller quantities.

The discussion to follow focuses on the links between the miller and the chain retailer, as most maize meal is sold via this marketing channel in South Africa. As a result of this, there is one assumption that needs to be made, namely how much profit the retailer is making given an average retail price per ton.

5.3.5 Unpacking of the entire super maize meal supply chain

A number of assumptions need to be repeated in order for this section to make sense. The table below presents these assumptions:

Table 5.1: Assumptions regarding the maize supply chain.

Description / Assumption	**Calculation**
1. Producer / Farm gate price	SAFEX price – transport and handling costs
2. Transport costs	Avg SAFEX transport differential
3. Handling costs	Est avg handling costs and storage day tariffs
4. Millers	Located closer to silo than to the farmers
5. Income from sales chop	[0.99ton-(extraction rate*0.99ton)+(screenings of 0.1ton)]*[0.7*yellow maize price] [Amount of chop per ton]*[price of chop]
6. Lag	4 month lag between the average monthly SAFEX spot price and the average monthly retail price
7. Mill site costs	Annually available

Source: FPMC, 2003.

Table 5.2: The maize-to-super maize meal supply chain for August 2006.

Description	Unit	August 04	August 05
1. The farm gate price (4 month lag)	**R/ton grain**	**1010.61**	**431.95**
Transport cost: Farm to silo	R/ton grain	76.00	89.00
Handling and storage costs: Costs to farmer	R/ton grain	25.00	25.00
SAFEX White maize average nearby contract price (4 month lag)	**R/ton grain**	**1111.61**	**545.95**
Transport cost: Silo to Mill door	R/ton grain	56.00	69.00
Handling and storage cost: Costs to miller	R/ton grain	25.00	31.00
Income from sales chop	R/ton chop	**318.12**	**206.10**
2. Mill door price	**R/ton grain**	**874.49**	**439.85**
Manufacturing cost			
Production cost (milling cost)	R/ton grain	84.34	86.17
Packing cost	R/ton grain	19.85	20.28
Packing material costs and losses	R/ton grain	104.74	107.05
Administration, Warehouse and selling	R/ton grain	187.61	191.74
Mill site costs	**R/ton grain**	**396.54**	**405.24**
Distribution costs	R/ton grain	164.29	167.83
Total mill site costs	**R/ton grain**	**560.83**	**573.07**
Fixed capital costs	R/ton grain	180.00	183.97
Floating capital costs	R/ton grain	45.74	46.75
Total costs	**R/ton grain**	**786.57**	**803.79**
Cost of production of super maize meal			
Conversion costs	R/ton grain	786.57	803.79
Average cost of maize (mill door price)	R/ton grain	874.49	439.85
Total super maize meal cost	**R/ton grain**	**1661.06**	**1243.64**
Dividend by average extraction for super maize meal		0.625	0.625
Average cost of super maize meal	**R/ton meal**	**2657.69**	**1989.83**
Miller to retail margin	**R/ton meal**	130.31	269.78
3. Monthly average retail price	**R/ton meal**	**2788.00**	**2259.61**

Source: Structure from the National Chamber of Milling, 2003 but own data and estimations made.

As discussed before, the farm value is a measure of the return farmers receive for the farm product equivalent of food sold to consumers. The farm value, as given in Table 5.3 below, is calculated by dividing the farm gate price by the average extraction rate, which is assumed to be 62.5%. The August 2005 farm value for super maize meal was R691.12 per ton. This low farm value was mainly due to the low producer prices that were experienced during that period.

The farm-to-retail price spread, as discussed in more detail in Chapter 3, is the difference between the farm value and the retail price. Table 5.3 indicates a large farm-to-retail price spread. This is mainly due to the low producer prices and resultant low farm value, as well as the relatively high retail prices. The farm-to-retail price spread in August 2004 was R1171.02 per ton, compared to R1568.49 per ton in August 2005.

Table 5.3: Summary of values from the maize to super maize meal value chain

Description	Units	August 04	August 05
Farm value of super maize meal	R/ton grain	1616.98	691.12
Farm-to-retail price spread	R/ton meal	1171.02	1568.49
Farm value share of retail maize meal	%	58.00%	30.59%
Miller-to-retail margin	R/ton meal	130.31	269.78
Conversion costs as % of Retail price	%	45.14%	56.92%
Mill door price of grain as % of Retail price	%	50.19%	31.15%

The farm value share is the proportion farmers receive from the amount consumers spend on the market basket of food purchased in retail grocery stores. When calculating the farm value share, the farm value of maize is divided by the retail price of maize. For August 2005 the farm value share was 30.59%. This was again due to the low farm value and relatively high retail prices.

Figure 5.5 below presents the conversion costs and raw material costs as a percentage of the retail price. The graph reveals is that since 2004, the conversion costs in the maize meal chain have again become a greater part of the total retail price. With the producer price surges in 2002, the raw material costs made up a larger percentage of the retail price, but as the entire system ‘cooled down’, the pattern reversed itself again and in 2005, the conversion costs made up a larger part of the retail price than the raw material price.

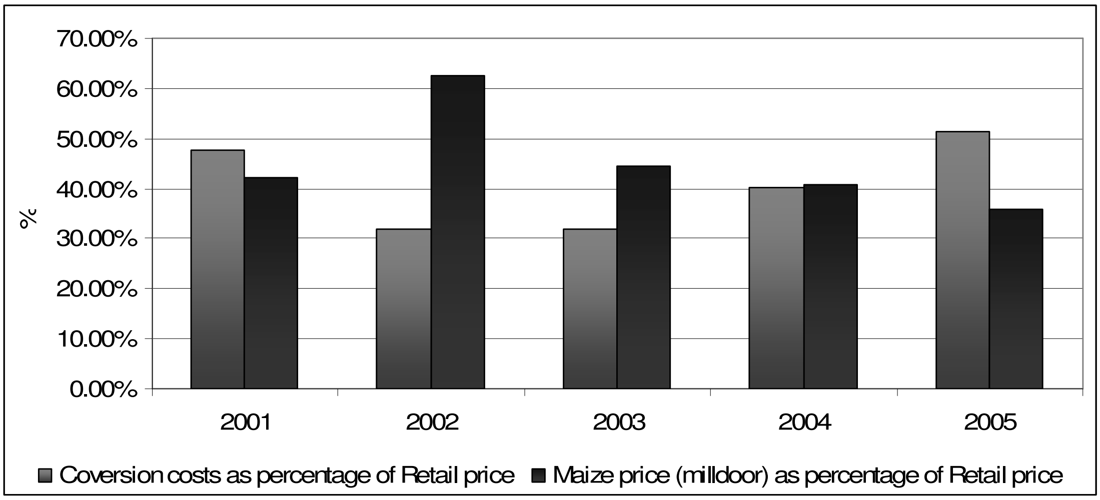

Figure 5.5: Conversion costs and raw material price (maize at mill door) as a percentage of the retail price.

5.3.6 Trends in margins and spreads

One should be careful not to confuse margins and spreads in any way. A spread is the difference between the retail price and the farm value of a product. It represents the payments for all of the value adding costs after the products have left the farm gate. Marketing margins, on the other hand, represent the difference between the sales of a given company and the cost of goods sold. In other words, the margin is representative of the profits which the industry makes given the specific market conditions.

The miller-to-retail margin represents all of the profits, costs and other expenses which occur from the time the miller purchases the maize at the silo, to the calculation of the mill door price, up to where the retailer sells the maize to the everyday consumer. This, in other words, is then representative of the entire profits which are made within the secondary industry. Figure 5.6 depicts how closely related the miller-to-retail margin is to the spot price of white maize and the average monthly retail price of super maize meal.

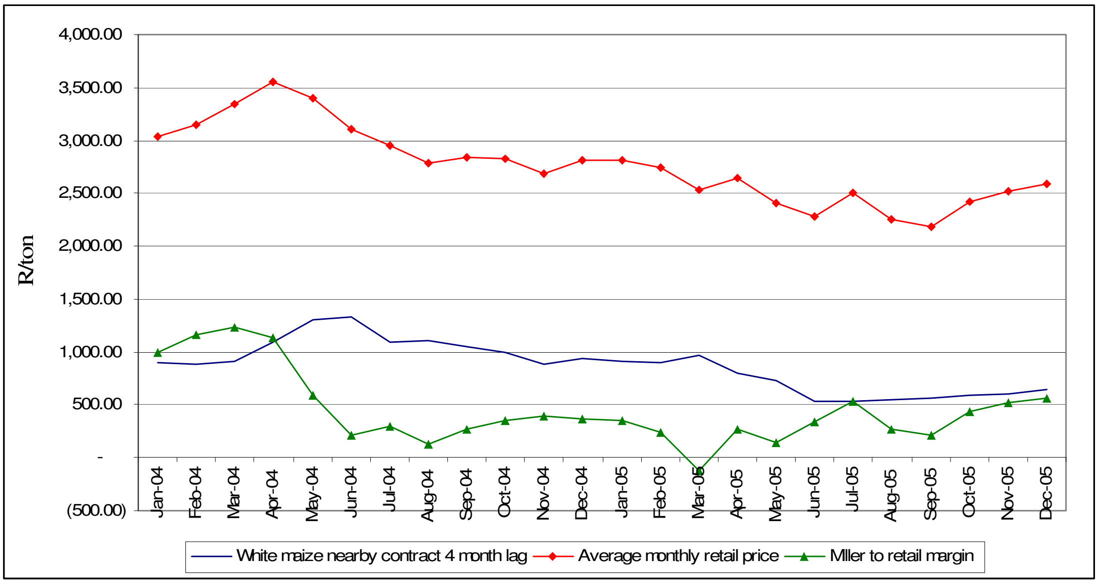

Figure 5.6: Relation between the miller to retail margin of super maize meal the SAFEX nearby contract price of white maize and the average monthly retail price of super maize meal, Jan 2004 – Dec 2005.

As Figure 5.6 points out, the margin became negative when the retail and the SAFEX white maize nearby contract prices showed peaks. This means that some of the millers actually made a loss during some months, especially when prices at both ends of the supply chain were unfavourable. As the retail price and the SAFEX price declined, the margin actually increased into positive territory.

The wholesale-to-retail margin is another important margin worth considering. The miller-to-retail margin differs from the wholesale-to-retail margin in that it takes the difference between the retail price and the price at which the millers purchase maize, after taking the extraction rates and the values of the by-products into account. The wholesale-to-retail margin does not take any processing costs, which the milling industry supplies, into account and only focuses on the inflationary increases or decreases, which are experienced with respect to the productive costs and profits.

Due to the fact that the margin is calculated in real terms, and that inflationary impacts are excluded from the margin, it can, therefore, be interpreted and explained using different reasons.

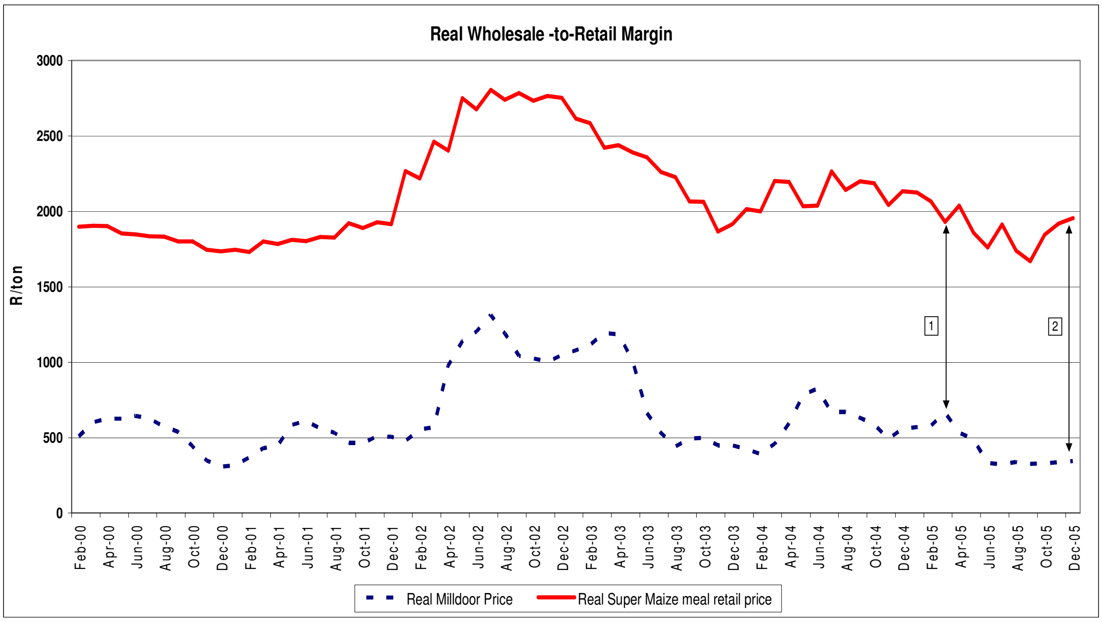

Figure 5.7: The real wholesale to retail margin of super maize meal, Feb 2000 – Dec 2005.

Figure 5.7 depicts the real wholesale-to-retail margin of super maize meal, in other words, the difference between the real mill door price of grain and the real retail price of super maize meal. As can be seen, in the past there were a few points in time where the margin between the two prices actually moved apart. Point 1 shows clearly that the two prices moved a bit closer together, while point 2 clearly indicates that the two price series are moving apart. As inflation does not play a role in this, the question needs to be asked, 'Why this is occurring?' Figure 5.7 may solve this problem as it depicts firstly, how the wholesale-to-retail margin has moved on its own and secondly, how much, in percentage terms, the wholesale margin comprises of the retail price. Figure 5.8 then looks at the increases in conversion costs, followed by an analysis of whether the increases in conversion costs have caused an increase in the margin.

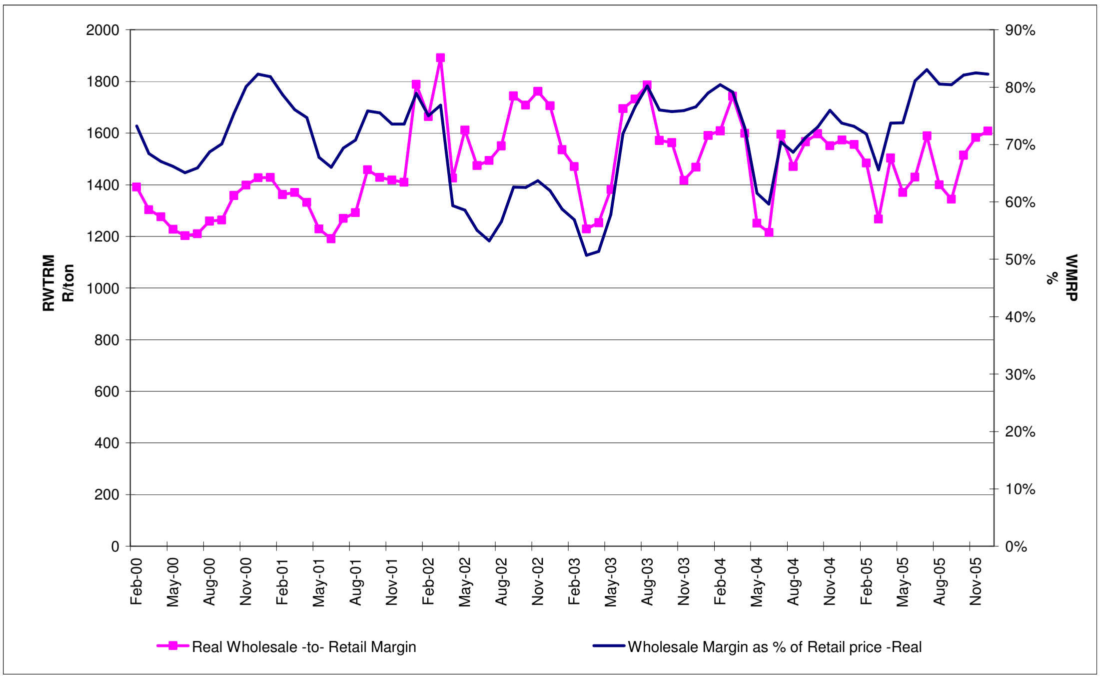

Figure 5.8: Comparison of the real wholesale-to-retail margin of super maize meal and the wholesale margin as a percentage of the retail price

The real margins where calculated by discounting the nominal terms with the inflation rate. The real margin gives a representation of the trend that the margin follows once the inflation rate is taken out of the equation. The wholesale-to-retail margin has, on average, continued to increase since 2000, ending in 2005 on R1607.89 per ton. This is the margin's highest value since March 2004, where it peaked at R1743.02 per ton. The wholesale margin, as a percentage of the retail price, declined over the five year period relative to the retail price, meaning that other factors made up a larger and larger part of the retail price over time.

It must be asked which factors could have an increasing effect on the wholesale-to-retail margin. The product incurs a number of costs along the wholesale-to-retail leg of the supply chain. These costs include storage, distribution, marketing and handling. Profits also account for some part of this margin. If the trend in the costs can be accounted for by representing it as a percentage of the final retail price, then it will be interesting to see how the remaining part of the retail price, in other words, the percentage that is not accounted for by the costs, behaves in this period. A decrease in the costs as a percentage of the retail price and an increase in the retail price, signals an increase in margins and profits.

Costs always play an important role in the retail price of a product. An increase in the milling, processing, administration and/or distribution costs will always influence the profit margin, but it must be asked whether they justify an abnormally high increase in the retail price or not.

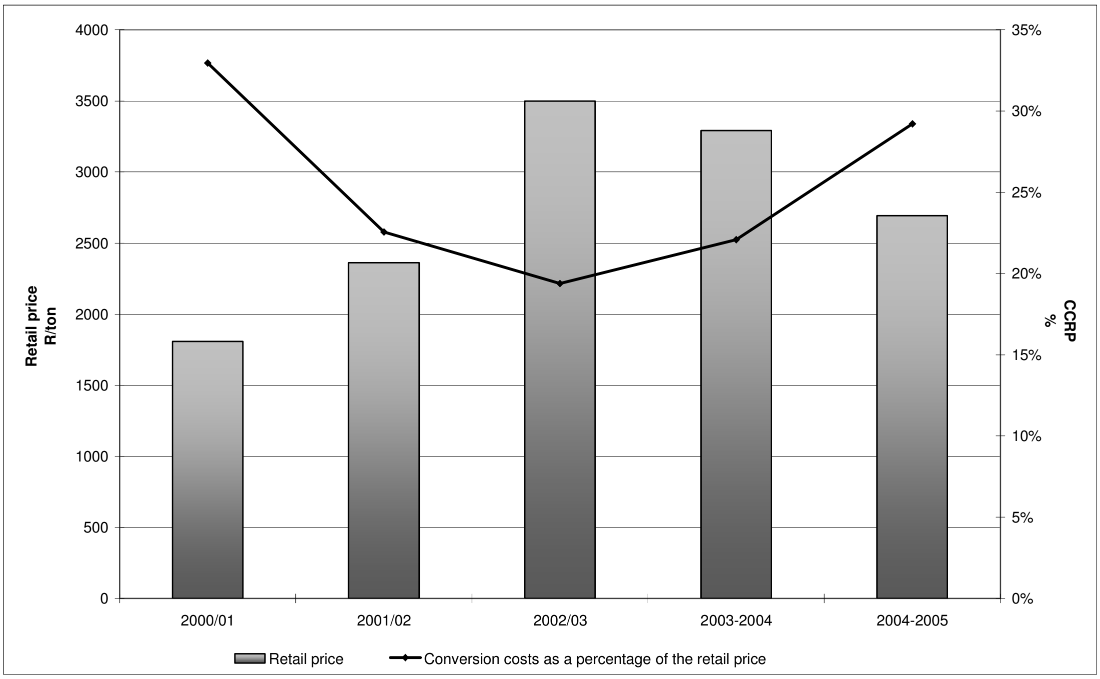

Figure 5.9: The super maize meal retail price and the conversion costs as a percentage of the retail price.

If all of the previous assumptions are indeed correct, then Figure 5.9 provides some answers to the questions that have been previously asked. The line, which is parabolically shaped, explains the increase in the wholesale-to-retail margin. The costs of producing maize meal were transferred directly to the consumer, as shown in Figure 5.8. The wholesale-to-retail margin increased and the wholesale margin, as a percentage of the retail price, increased, but at a decreasing rate. This is further supported by Figure 5.9, which indicates that during the last months of 2005, the period in which the increases in the margin where discovered, the conversion costs made up an increasingly larger amount of the retail price than that of one or two years ago, for example. The percentage increased from 19.38% in 2002/03 to 22.09% in 2003/04 and, finally, to 29.21% in 2004/05.

The procedure discussed in this section represents a framework that can be followed and adapted to analyse the margins, costs and prices incurred within supply chains. The procedure is simple and yet it pinpoints to sections in supply chains that could experience unjustified price increases.

5.4 The beef supply chain

5.4.1 Introduction

In South Africa, stock farming is the only viable agricultural activity in a large part of the country. Of the 122.3 million hectares of land surface of South Africa, 68.61% is suitable for raising livestock, in particular cattle, sheep and goats (FPMC, 2003).

The red meat industry evolved from a highly regulated environment to one that is totally deregulated today and since 1997, the year of deregulation, all prices in the industry are determined by the market forces of demand and supply (FPMC, 2003). It is estimated that there are approximately 20 000 to 25 000 commercial farmers currently farming with livestock. The country's herds, according to the National Department of Agriculture, consist of 2.39% bulls, 63.71% cows of the age two and older, 17.07% heifers aged one to two years, 18.20% calves, 6.71% young oxen and 2.5% oxen (NDA, 2003).

The following section analyses the entire supply chain and discusses the various role players within the chain, as well as the levels of the supply chain at which changes in retail prices can be verified.

5.4.2 Farm-to-retail store

In their investigation, the Food Price Monitoring Committee found that the entire beef supply chain has become increasingly vertically integrated. The committee further established that this integration is mainly fuelled by the feedlot industry, where most of the large feedlot owners also own their own abattoirs, or at least have some business interest in certain abattoirs. Furthermore, some feedlots have integrated themselves further down the chain and sell directly to consumers through their own retail outlets, while others have integrated vertically towards the wholesale level (FPMC, 2003).

Figure 5.10 represents the red meat industry structure. The arrows in the diagram indicate the direction of the flow of products.

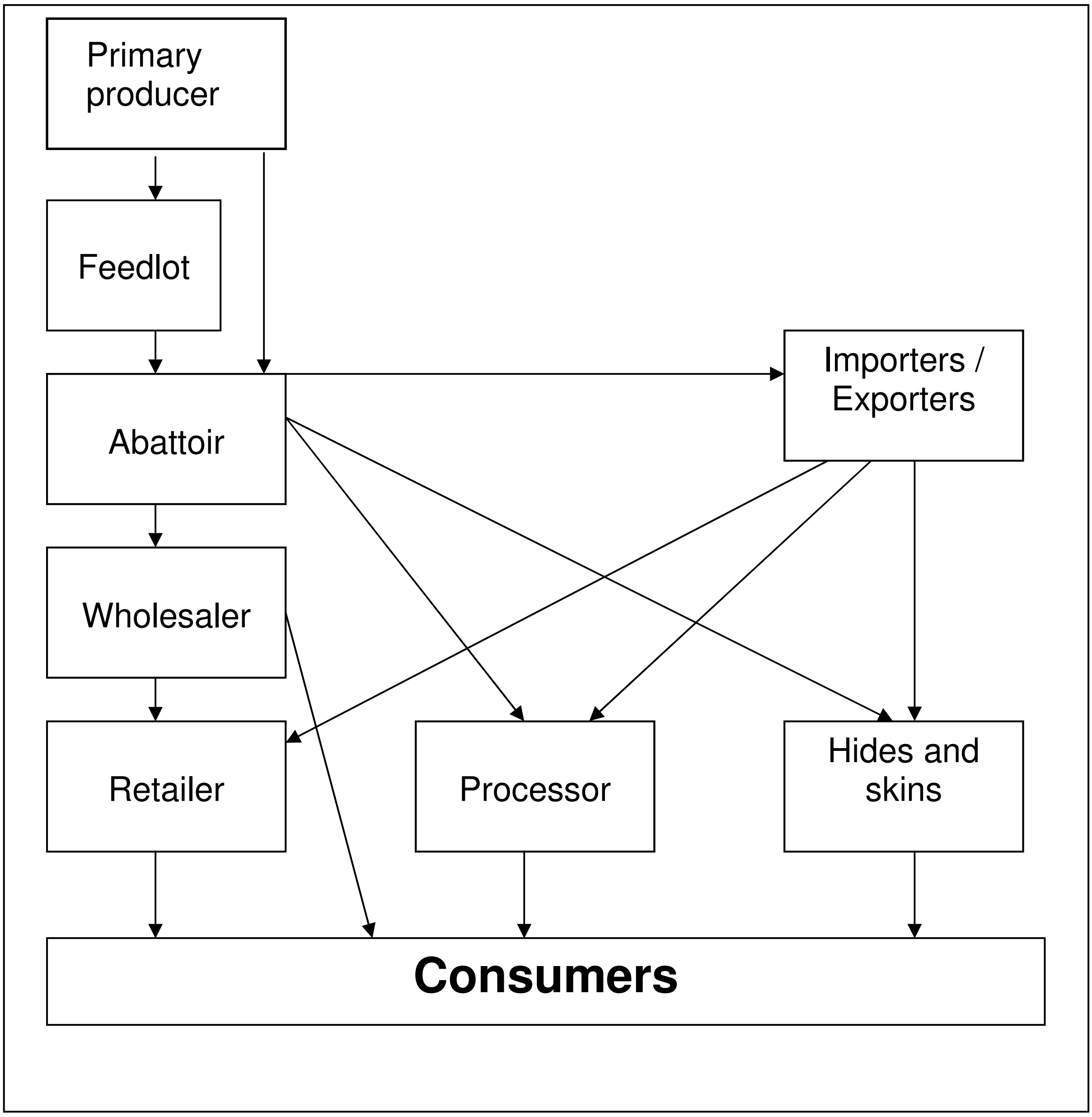

Figure 5.10: The supply chain of the South African red meat industry
Source: Food Price Monitoring Committee, 2003.

Figure 5.10 indicates how prices could flow from the producer right through to the consumer. Producers who have engaged in economies of scale can manage to bypass feedlots and, in so doing, deliver their livestock directly to the abattoir. In South Africa, the feedlot industry produces around 70% to 80% of all the beef in the formal sector. It is estimated that, at any point in time, the feedlot industry has the capacity of 420 000 heads of cattle (FPMC, 2003). On average, animals enter the feedlot system when they have a live body mass of between 200 and 220 kg. The

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animals then remain in the feedlot for 100 days, after which they should realise a carcass weight of approximately 220 kg to 225 kg (FPMC, 2003). Table 5.4 gives an indication of the capacity of the largest nine feedlots in South Africa and where they are located.

Table 5.4: The nine biggest feedlots in South Africa and the average number of animals standing at the feedlot at any specific point in time

Name	Location	Nr of animals at any specific time
Karan beef	Heidelberg	70 000
Kolosus / Vleissentraal	Pochefstroom Magaliesburg	40 000
EAC Group	Sasolburg Harrismith Bethlehem	35 000
Beefcor	Bronkhorstspruit	25 000
Chalmar beef	Bapsfontein	15 000
Sparta beef	Marquard	40 000
Beefmaster	Christiana	20 000
Crafcor	Cato ridge	30 000
SIS	Bethal	22 000
Total		**297 000**

Source: Food Price Monitoring Committee, 2003.

The abattoir within the supply chain seems to be one of the most important links, as all of the products have to flow through them in order to reach their final destination. All the different meat quality grades, including the fifth quarter, are mostly distributed via the abattoir. The abattoir also supplies the wholesalers, exporters and processors directly with carcasses.

Abattoirs in South Africa are categorised according to classes. For example, only 40% of all slaughterings are performed by abattoirs that may slaughter an unlimited number of animals. These abattoirs would fall under the Class A category. Class B abattoirs are defined as abattoirs where 50 to 100 units are slaughtered. When one adds the Class B category abattoirs to the grand total, then it can be concluded that 60% of all slaughterings in South Africa take place in a highly regulated environment. Table 5.5 gives an overview of how these abattoirs function and what categorises them.

Table 5.5: An overview of the South African abattoir industry.

Class	Slaughter unit*	Nr of abattoirs	Estimated slaughtering per Class (%)
A	100+	33	40
B	50-100	38	20
C	15-50	38	15
D	8-15	70	15
E	<8	162	10

* 1 cattle = 1 horse = 3 weaners = 5 pigs = 15 sheep
** It should also be noted that there could be at least 80 Class E abattoirs more than official statistics suggest
Source: RMAA, 2002

The Food Price Monitoring Committee found that most of the Class A and B abattoirs have some links to the feedlots. In general, it is estimated that at least 60% of the 80% of animals that go through the feedlots are slaughtered by vertically integrated abattoirs. Table 5.6 represents the vertical integration up to abattoir level by selected feedlots.

Table 5.6: Vertical integration up to abattoir level by selected feedlots.

Feedlot	Abattoir
Karan Beef	Balfour
Crafcor	Cato Ridge
SIS	Witbank
EAC	Vereeniging, Wolwehoek, Harrismith
Beefmaster	Kimberley
Sparta Beef	Welkom
Beefcor	Krugersdorp
Chalmar Beef	Bapsfontein
Kolosus	Bullbrand

Source: Food Price Monitoring Committee, 2003.

Wholesalers, processors, retailers and exporters then purchase the whole carcasses directly from the abattoirs and, in most cases, add value to them by dissecting them into the different cuts. This chapter only discusses the selected cuts as they appear in the South African food basket. These cuts, as discussed in Chapter 3, comprise of rump steak, sirloin steak, topside, chuck and brisket.

5.4.3 Trends in the farm value, retail value, price spreads and prices of inputs

When one adapts the methodology, which is explained in Chapter 3, an adjusted farm value is generated and this then represents the value of the farm product's equivalent as it is purchased by the consumer. The retail value takes the weight of the selected food basket cuts into account and multiplies this weight with each of the selected product's retail prices. The final retail value for all of the selected cuts is a sum of the individual values. The farm-to-retail price spread is calculated by subtracting the farm value from the retail value.

5.4.3.1 The farm value and retail value of beef

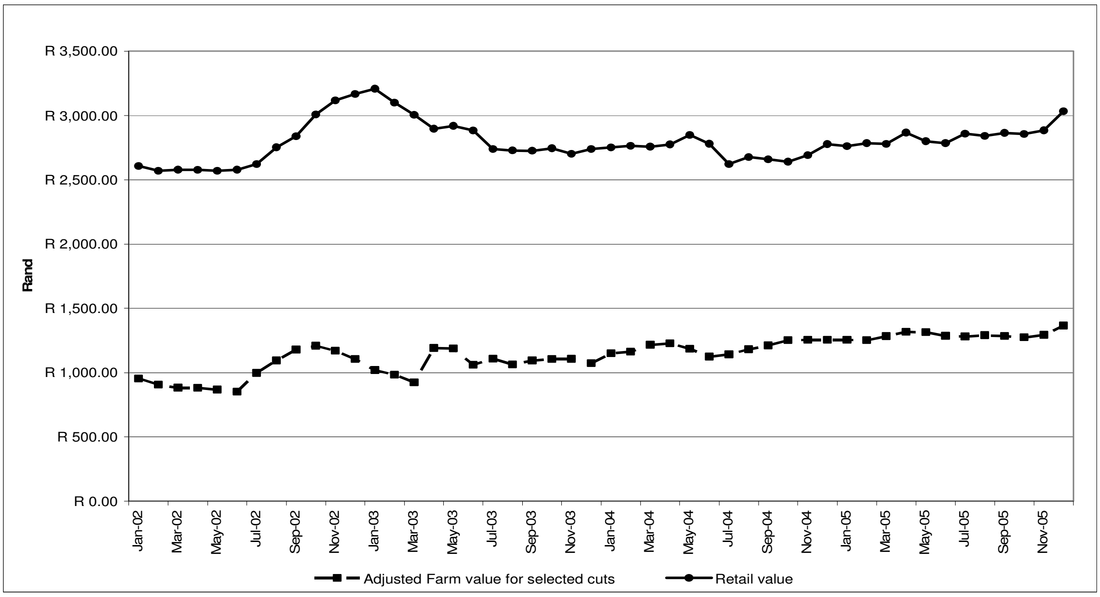


Figure 5.11: The adjusted farm value and retail value spreads for the selected beef cuts, 2002 – 2005.

As indicated by Figure 5.11 above, the adjusted farm value for the selected cuts slowly increased over time, from a value of R1000 per selected cuts per carcass in January 2002 to around R1364 in December 2005. The adjusted farm value for the selected cuts of beef per carcass showed some spikes during the latter half of 2002 and again during the first semester of 2004. As indicated by Figure 5.11, these spikes seemed to occur approximately four months before the equivalent spike in the retail price took place. In other words, the effect of the price increase in the producer price/farm value takes four months to filter through to the retail price.

The retail value for the selected beef products also increased slightly from 2002 up until 2005. In January 2002, the retail value was R2605 for the selected cuts per carcass. The retail value then reached a peak in January 2003 once the spike in the farm value finally filtered through. Unlike in the case of the farm value, this peak in the retail value even exceeded the retail value in December 2005, which stood at R3031. Graphs can sometimes be deceiving, therefore, we need to calculate these increases in percentage terms in order to see by what percentage the values increased.

The farm value increased by 26.60% from January 2002 up until October 2002, whereas the retail value for the selected cuts of beef only increased by 23.08% from January 2002 up until January 2003. As previously mentioned, January 2003 was chosen as the retail value spiked the most during that month. Therefore, even though the retail value increased by a far larger margin between January 2002 and January 2003, when it reached its peak, in percentage terms it still increased by 3.52% less than the farm value when taking the same peak in values into account.

When one looks at the entire period, the farm value of the selected beef cuts increased by 43.09%, while the retail value for the same products only increased by 16.37%. This then indicates that the farm value increased by a far greater amount, in percentage terms, than the retail value over the same period. This basically means that the farmers were better off in 2005 than what they were in 2002.

5.4.3.2 The farm-to-retail price spread and farm value share of beef

Figure 5.12 represents the movement of the farm value share of selected beef products as well as the farm-to-retail price spread of those same products. The farm value share is represented by the bars while the farm-to-retail price spread is depicted by the solid line.

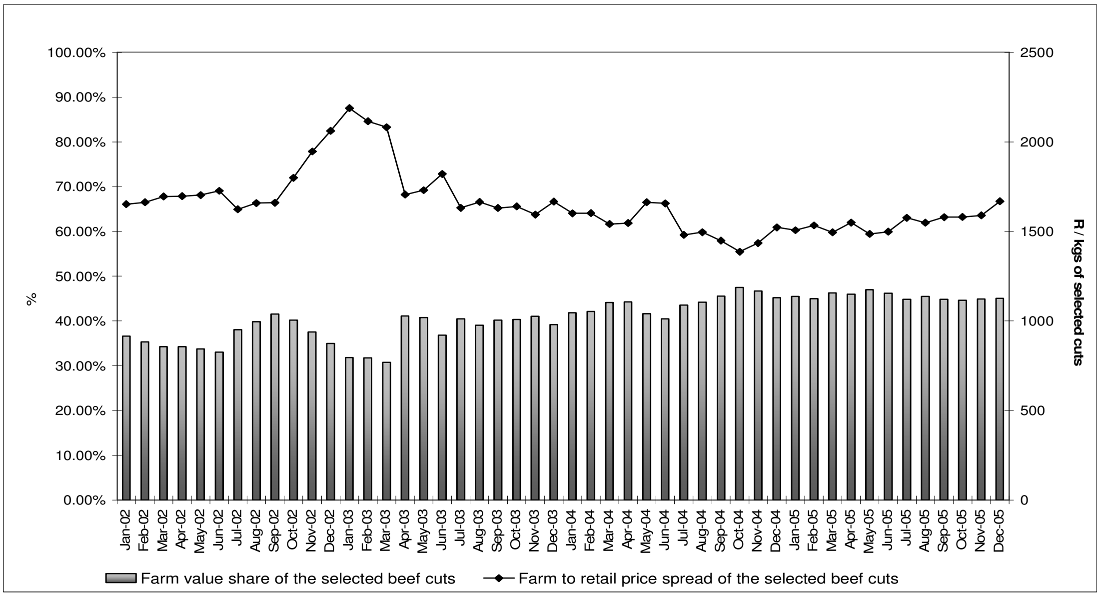


Figure 5.12: Farm value share and farm-to-retail price spread of the selected beef products, 2002 – 2005

It is interesting to see how the farm-to-retail price spread peaked together with the retail value. The farm value share, being an indication of what percentage the farm value makes up of the retail value, followed a very similar pattern to the farm value, decreasing to its lowest point in the two year period of 30.73% in March 2003. The farm value share then increased and since 2004, generally averages above 40%. The farm-to-retail price spread, on average, decreased from its highest peak during January 2003 and levelled off, never dipping below a value of R1300.

There are a few points that can be highlighted when analysing the relationship between the beef producer prices or, in this case, the beef farm value and the retail value of the same products:

- It seems that the producer prices and retail prices move in tandem
- The farm value share of beef products varies between 31% and 47% and, during the period under review, averaged around 41%.

- There seems to be some lag effect between the producer price/farm value and the retail value of these selected beef products.
- The farm value share and the farm-to-retail price spread seem to move in opposite directions. This is to be expected, as the farm value share expresses, in percentage terms, how much the farm value makes up of the retail value. Therefore, if the retail price increases, but the farm value does not, then the share will decline, but the spread will increase.

5.4.3.3 The costing and pricing by feedlots, abattoirs and retailers

5.4.3.3.1 Pricing, profits and costs at feedlots

The South African feedlot industry is characterised by the fact that supply and demand forces generally determine the purchase prices at which weaners are bought. In general, producers will shop around in order to receive the best price, while feedlots will sometimes approach farmers or farmers will offer their animals to particular feedlots with certain prices in mind. It is also well known that feedlots will pay for quality. If farmers, therefore, produce the right type of animals, they will receive a premium from the feedlot. Feedlots are also keen to purchase animals from producers, even if the producers lived further away, but were to produce meat at a higher quality (FPMC, 2003). Feedlots, therefore, seem to be focused on purchasing the right quality animals, even if it means purchasing them at a premium.

Feedlots, who are positioned further along the supply chain, sell the carcasses and the fifth quarter to wholesalers and retailers and again the prices are determined by demand and supply conditions. Wholesalers and retailers will buy where the price is right and the associated quality is best (FPMC, 2003).

The Food Price Monitoring Committee found that a general characteristic or problem, which the feedlot industry was experiencing, was that of negative buying margins and positive feeding margins. An example would be a feedlot which purchases a weaner of 200 kg at R9 per kg. At a dressing percentage, this refers to the weight of the carcass after the animal has been slaughtered of 48% of its weight. It would mean that the feedlot is actually paying R18.75 per kg, while the market price per kg is averaging R14.11 per kg. This would then have been the negative buying margin.

The positive feeding margin is a scenario in which the value per kg carcass weight gained is higher than the cost of feeding the animal to gain a kg of carcass weight. For example, if we assume that an average daily feed ration costs R1.27 per kg and an animal eats 9 kg to gain 1.5 kg in live weight per day, then the feed costs amount to R11.43 per day. In any industry there are overhead costs to take into account. If we assume that these costs are R1.50 per day, this then brings the total daily feeding cost to R12.93. The total daily feeding cost is then divided by the kilograms in live weight gained per day. Therefore, 12.93 is divided by 1.5 and the result is 8.62, which is the feed cost required for the animal to gain 1 kg of live weight. The calculation is then taken further in order to find the feeding cost per day per kilogram of carcass weight gained. The R8.62 is, therefore, divided by 0.65. The result is then a value of R13.26, which, in other words, means that the feed to produce 1 kg of carcass weight costs R13.26 at a market price of R14.11 per kilogram.

Below follows a discussion which uses the methodology discussed above. This methodology was also used by the Food Price Monitoring Committee in 2003.

Table 5.7: Calculation of the buying margin for December 2005

Description	Market price December '05	Feedlot price December '05	Calculation	Result
Buying margin	R 15.95 / kg	R 9.50 / kg	15.95 - (9.50/48%) = -3.84	R -3.84

Source: Formulas from Food Price Monitoring Committee, 2003 values from the industry.

Table 5.7 represents the calculations necessary to calculate the buying margins. This is a decision the feedlot is faced with when purchasing weaners. The smaller the margin is for them the better the final weighed up result will be.

Table 5.8: Calculations of the feeding margin using December 2005 costs

Description	Feedstock cost per kg December '05	Overhead costs per day December '05	Calculation	Result
Feeding cost per day per kg of live weight gained per day	R1.27 x 9kg = R 11.43 / kg	R 1.50 per day	12.93 / 1.5 =8.62	Feeding cost is R 8.62 per kg of **live** weight gained per day
Feeding cost per day per kg carcass weight gained	-	-	R 8.62 / 0.65 = 13.26	The feed cost to produce 1 kg of **carcass** weight is R 13.26
The feeding margin	-	-	R 13.26 – 8.62 =4.64	The positive feed margin is R 4.64 per kg

Source: Formulas from Food Price Monitoring Committee, 2003 values from the industry.

The feeding margin ultimately determines whether the feedlot will lose a lot of money or whether they will make some money on their livestock. In this case, we have a negative buying margin of R3.84 per kg and a positive feeding margin of R4.64 per kg. The result is a net profit of R0.80 per kg. This then translates into a profit of R176 per 220 kg carcass. In 2002, however, the feedlots made losses of between R200 and R600 per carcass. The argument was that if they could regulate the industry, they would definitely not suffer such huge losses. The Food Price Monitoring

Committee concluded that although this industry is characterised by a large degree of concentration, it is still unable to affect the market significantly in any way and market forces still have the greatest influence.

5.4.3.3.2 Pricing, profits and costs at abattoir level

There are a number of definitions at abattoir level which need to be considered and understood. The first definition refers to the abattoir sales price. The abattoir sales price is the average price per carcass as stipulated to the trade directly after slaughter. The slaughter price excludes costs such as VAT, the slaughtering fee, transportation costs and the fifth quarter. The second definition refers to the abattoir's purchase price. This price is the cold carcass weight and the additional value of the fifth quarter, namely the total price as paid to the feedlot or producer, excluding VAT (Olivier, 2004).

There are three different types of payments which producers, feedlots and wholesalers make use of when they trade with an abattoir. In the first case, the abattoir retains the offal and the hide. In the second case, the abattoir only retains the offal and in the third case, the abattoir retains nothing and only a slaughtering fee is negotiated. Interestingly enough, the offal enters the informal market and sells at its peak in the winter months, not in summer, as the buyers normally have limited cold storage facilities.

In the case where the abattoir purchases the animal, slaughters it and finally sells it off, the abattoir cost structure looks something like this:

Table 5.9: Costs and profits within the abattoir cost structure

Description	Cost units	Calculation of costs	Example of costs
Abattoir purchase price	R/kg	Average monthly price	R14.70
Carcass mass initial kg/head	Kg	Weight per carcass	207.20
Abattoir monthly slaughter capacity	Units	Units	240
Abattoir slaughter days per month	Units	Units	21
Total expenditure on carcasses	**R/carcass**	**Average monthly price x carcass weight**	**R3045.84**
Fifth quarter income	R/carcass	Average income per fifth quarter x LSU	R367.34
Total abattoir purchasing expense less fifth quarter income	R/carcass	Total expenditure on carcass – fifth quarter income	R2678.50
Total purchasing expense	**R/carcass**	**Same as above**	**R2678.50**
Operating expenses	R/carcass	Total operating overhead	R213. 37
Fixed capital costs	R/carcass	Financing costs etc.	R1058.33
Total cost to abattoir per carcass	R/carcass	Sum of total purchasing cost, total operating expenses and total fixed capital costs	R3950.20
Abattoir selling price	R/kg	Average monthly price	R14.90
Carcass mass cold kg / head	Kg	Weight per carcass	205.13
Total income from sales	**R**	**Abattoir selling price x carcasses sold**	**R3056.44**
Abattoir profit from sales per carcass	R/carcass	Total income from sales / number of units sold – total cost per animal	- R893. 77
Slaughter fee	R/head	Total fixed cost x 20% + operating cost	424.67

Source: Olivier, 2004.

5.4.3.3.3 Pricing and profits at wholesale and retail level

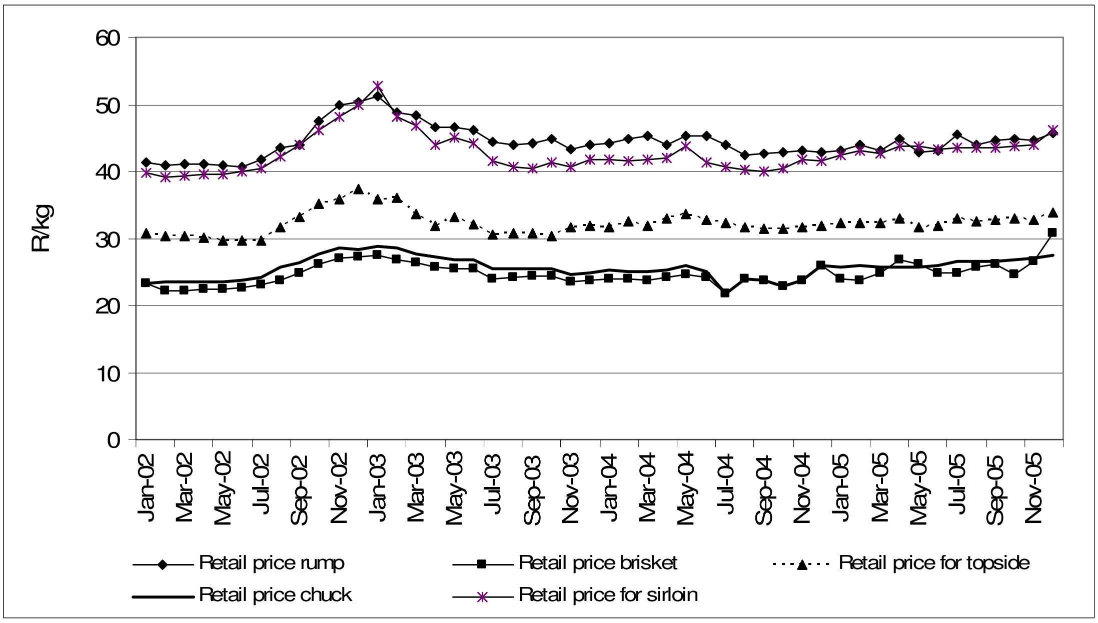


Figure 5.13: Retail prices of the selected cuts from January 2002 – December 2005

Source: Calculated from Statistics South Africa data, 2005.

The retail prices followed a relatively constant trend except for the spike towards the end of 2002. The figure above indicates that the increase in the retail prices was greater among the higher value beef cuts than among the lower value beef cuts, such as brisket and chuck. Table 5.10 below represents the percentage changes in the different retail products from January 2002 up until January 2003.

Table 5.10: Percentage changes in the retail prices of selected beef cuts from January 2002 - January 2003

Product	Units	January 2002	January 2003	% change
Rump	R/kg	41.37	51.26	24%
Sirloin	R/kg	39.75	52.85	33%
Topside	R/kg	30.71	35.87	17%
Brisket	R/kg	23.27	27.55	18%
Chuck	R/kg	23.3	28.77	23%

Source: Calculated from Statistics South Africa data, 2005.

In terms of percentage changes, the higher value products, such as rump and sirloin, experienced price increases of 24% and 33% respectively, while the lower value products, such as topside, brisket and chuck, only saw price increases of 17%, 18% and 23% respectively.

These alternative increases in retail prices over a year period could mean that retailers work towards making better profits from higher value added products, such as rump steak and sirloin, and fewer profits from cuts such as chuck and brisket. The Food Price Monitoring Committee made similar findings in their 2002 report. They found that, 'the profit margins on beef products in the South African retail sector are very thin and that, to a large extent, retailers make an outright loss on a product like stewing beef' (FPMC, 2003).

The model developed in Chapter 4 shows that by using the available data, retail prices of the identified cuts cannot be explained as a function of the beef producer price and, therefore, some form of unjustified price situation may exist along the supply chain. The unpacking of the beef supply chain has certainly identified costs at certain levels of the chain where it would be possible for role players to either manipulate prices or charge abnormally high rates in order to make substantially larger and unfair monetary gains. One needs to ask whether a substantially larger increase in one or two of the higher value beef products is justified when other calculations, for the same period of time, show that lower value products increased, sometimes by only half of that margin.

5.5 Conclusion

The widening of farm-to-retail price spreads and error correction models that indicate that the retail prices are not, as expected, explained by the farm gate prices, have resulted in a need for a more detailed discussion of supply chains and the different cost structures at different levels within the chain.

The methodology used to unpack the above mentioned supply chains gives researchers the necessary framework to detect abnormalities and even pin point where such abnormalities occurred if unexplained price spread discrepancies are identified. The framework is designed to represent a relatively standard form of a chain and should more detail be needed, it can be added without any huge complications.

The findings in Chapter 4 have certainly been reinforced and by applying this methodology to a supply chain, it has become clear that there are many areas where discrepancies can exist. The only question that remains is to what degree are discrepancies unfair and at what level in the chain do they need to occur in order to be justified

Chapter 6

Summary and conclusions

Peltzmann (2000) argues that asymmetric price transmission in agricultural supply chains is the rule rather than the exception and concludes that, since asymmetric price transmission is prevalent in the majority of producer and consumer markets, standard economic theory that does not account for this situation must be incorrect. Meyer and von Cramon-Taubadel (2004) also found that a possible implication of asymmetric price transmission is that consumers are not benefiting from a price reduction at the producers' level or, on the other hand, producers may not benefit from a price increase at the retail level. The general opinion of the two authors was thus, that under asymmetric price transmission, the distribution of welfare effects across levels and among role players will not be the same, as is in the case of symmetric price transmission.

What has been described in the paragraph above does not only occur in the developed world, but reflects what occurred during 2002 when the South African food industry experienced similar phenomena. The problem of the possible effects on the South African food industry, together with the phenomenon of price transmission, be it symmetric or asymmetric in nature, led to the formulation of a statement and a set of objectives which this dissertation aimed to address within its context.

The objectives of this dissertation were to review and analyse producer and retail price trends of five specific products in the food sector, as well as to apply a methodology that provides the food sector with a framework for the continued analysis of food prices, with the aim of contributing to the understanding of the costs involved in transforming and relocating the different food products from the farm all the way to the shelf of a retail store. The dissertation further aimed to test five different food supply chains for asymmetric price transmission and, if this was to be the case, to identify two chains which would then be unpacked in greater detail with the aim of identifying potential problem areas within those chains. The critical costs in these supply chains would then be identified and an idea would be given as to at what level of the supply chain these costs play important roles.

At first, an overview of the South African food and agricultural sector was studied in order to establish which factors led to the creation of a market structure as it stands in South Africa today. Since Peltzman (2000) argues that asymmetric price transmission may be a characteristic of competitive, as well as oligopolistic market structures, it was thought that it is wise to understand the South African market structure, but not to blame possible asymmetries on that alone. It is better rather to investigate possible problem areas among the various role players within each one of the five selected supply chains. These potential problem areas could possibly include the granting of confidential rebates, company policies on returns and losses, the management of the cold chain and soundness of the relationship between the manufacturer and the retailer.

After addressing the problem statement, five product supply chains, which are interesting in nature and each have different industries, were identified. The products were not chosen on the market structure alone, but because it was understood that some form of problem with data transparency could exist. The five product supply chains that were identified are those of five different beef cuts, super maize meal, fresh full cream milk, fresh whole chicken and sugar. Previously developed and documented methodology on quantifying the price spreads and farm values was then used and applied to these food value chains in order to make them more transparent.

An econometric modelling technique, in the form of an error correction model approach, was employed to test the five different supply chains for possible asymmetric price transmission and their adherence to economic theory. The error correction model approach helps the researcher with concrete and supportive evidence as to what has possibly been identified as a concern when the farm value and the farm-to-retail price spread have been calculated. The ECM methodology can be used in great detail to test the relationship between the different prices in each supply chain.

Although the methodology that has been developed addresses critical questions asked about supply chains and applies potential ways of solving them, it still requires the researcher to have a concrete understanding of how and why certain costs and profit margins exist along certain levels of the chain and why they are necessary for the continued production of the specific product. The applied methodology also requires the researcher to fully understand the market structures which govern the markets to which this methodology has to be applied, as well as how the resultant price formation at different levels of the supply chain will affect other role players. From experience, it is sometimes dangerous to point fingers at various role players within the market and to accuse them of abnormal behaviour based solely on calculations of the farm-to-retail price spread and marketing margins. The methodology does, however, provide a basis of knowing that something abnormal is occurring within the supply chain and that it needs to be investigated further.

The results from Chapter 4 point out that, of the five supply chains, only two of them, namely chicken and maize (from farm gate to miller), adhered to some form of economic theory, whereas the other three either suffered from insignificant/unrepresentative data or actual price transmission asymmetry. The results of this exercise indicated that, of the five supply chains, at least three of them showed some signs of either asymmetry within the value chain or other possible data discrepancies. On the basis of this, the supply chains of both super maize meal and the five selected beef cuts were unpacked with regards to the profit margin and the role player's cost formation at the different levels within the value chains. It may be concluded that part of the maize supply chain (mill door to retailer), the beef supply chain, the sugar supply chain and the dairy supply chain all suffer from asymmetric price transmissions or, alternatively, a data discrepancy. This conclusion is drawn from the fact that the ECMs for these specific industries failed most of the diagnostic tests and contained some insignificant variables. The diagnostic tests did not only test for misspecification, but included a standard procedure, using the Jarque Bera test for normality, the ARCH LM test for heteroscedasticity, the White test for heteroscedasticity, as well as the Breusch Godfrey test for serial correlation. The fact that the ECMs of these supply chains had these problems gives rise to a concern as to the transmission of prices within some of the supply chains within the South African food industry. Policy makers should be well aware of the fact that, in times of high food price inflation, role players within these supply chains could benefit to a greater extent than what is fair.

Chapter 5 discusses the maize-to-maize meal and beef supply chains in detail. The chapter applies a methodology to unpack the chains, with the aim of developing a framework that can be adapted and used for similar analyses in the future. The aim of the chapter was solely to develop and apply a methodology to two completely different supply chains and to illustrate, by the use of real data, how this framework can benefit future research.

Future studies could make use of the proposed methodology to unpack supply chains in every detail and at relevant costs and prices, should evidence exist that abnormalities, be they in the form of price asymmetry or other data related issues, have occurred within a given product's supply chain or better still, at a certain level of that supply chain. An opportunity exists for future studies to focus on the dynamic interaction between the various role players in the value chain, instead of focussing on advance modelling techniques, as presented within this context. Elements such as confidential rebates and the policy on returns and losses are key drivers that determine the level of price transmission through various levels of the chain and these could definitely add value if they were researched further. There are many other food items of which their supply chains need to be researched, unpacked and for which some form of continuous analysis framework needs to be established. The dynamics within supply chains change on a continuous basis and, therefore, the proposed analyses should not be conducted once off, but rather on a regular basis. Based on the results of such a proposed study, conclusions can be drawn and the necessary steps taken to ensure that the representative producer's organisation is notified and that measures are taken to rectify this situation.

References

ACNielsen, 2005. Retail prices of selected commodities.

Afrinem, 2005. Annual report 2005. African institute for economic modelling, University of Pretoria, Pretoria, South Africa.

Bailey, D.V. and B.W. Brorsen (1989). "Price Asymmetry in Spatial Fed Cattle Markets", *Western Journal of Agricultural Economics*. Vol 14: 246 – 252.

Balke, N.S., Brown S.P.A. and M.K. Yücel (1998). "Crude oil and Gasoline prices: An asymmetric Relationship?", Federal Reserve Bank of Dallas, Economic Review, 2-11.

Ball, L. and N.G. Mankiw (1994). "Asymmetric Price Adjustment and Economic Fluctuations", *Economic Journal*, Vol. 104: 247 – 261.

Blinder, A.S. (1982). "Inventories and Sticky Prices: More on the Microfoundation of Macroeconomics", *American Economic Review*, Vol. 72 (3): 334 – 348.

Blinder, A.S. (1994). "On Sticky Prices: Academic Theories Meet the Real World." In *Monetary Policy*, ed. N.G. Mankiw, Chicago: University of Chicago Press.

Blinder, A.S., Canetti, E.R., Lebow, D.E. and J.B. Rudd (1998). *Asking About Prices: A New Approach to Understanding Price Stickiness.* New York: Sage Foundation.

Board on Tariffs and Trade (1992), *An investigation into the Price Mechanisms in the Food Chain*, Report No.3273, BTT, Pretoria.

Competition Commission of South Africa (2002), *Inquiry into Food Price Rises,* Pretoria, South Africa.

Diamant N. (2003). South African Food Review, October 2003.

Dickey, D. and W.A. Fuller (1979). "Distribution of the Estimate for Autoregressive Time Series with a Unit Root", *Journal of the American Statistical Association*, Vol. 74: 427 – 431.

Elitzak, H. (1997). "Food Cost Review 1950 – 97", Economic Research Service, United States Department of Agriculture, Report number 780.

Ender, W. (2004). *Applied Econometric time series*. Second Edition. Wiley and Sons, 2004.

Engle, R.F. and C.W.J. Granger (1987). "Co-integration and Error Correction: Representation, Estimation, and Testing", *Econometrica*. Vol. 55: 251 - 276.

Esterhuizen, D., J. van Rooyen and L. D'Haese (2006). "Analysing the competitiveness of the South African Agribusiness Sector in a Dynamic World". Unpublished PhD Thesis, Department of Agricultural Economics, Extension and Rural Development, University of Pretoria.

Food Price Monitoring Committee, 2003. *Final report of the Food Price Monitoring Committee*. Pretoria, South Africa.

Gardener, B. (1975). "The Farm-to-Retail price spread in a Competitive Food Industry", *American Journal of Agricultural Economics*, Vol 57 (3) : 399 – 410, August 1975.

Garderner, B. (2003). " US food quality standards: Fix for market failure or costly anachrosim?", *American Journal of Agricultural Economics*, Vol 85 (3): 725 – 730, August 2003.

Grain Silo Industry (2002). www.sansor.org/members/g/grainsilo

Granger, C.W.J. and P. Newbold (1974). "Spurious Regression in Econometrics", *Journal of Econometrics*, Vol (2): 111 – 120.

Gujarati, D.N. (2003). *Basic Econometrics*. 4th edition. Mcgraw Hill, 2003. Chapter 21 and 22.

Hahn, W. (2004). "Beef and Pork values and price spreads explained", *LDP-M-118-01*, Economic Research Service, USDA, 2004.

Jayne T.S. and L. Ndibongo Traub (2004). "The Effects of Market Reform on Maize Marketing Margins in South Africa", *MSU International Development*

Working Paper, Number 82. Department of Agricultural Economics, Michigan State University.

Kohls, R.L. and J.N. Uhl (1998). Marketing of agricultural products. 8th edition. Prentice hall. Upper Saddle River. USA

Louw A, Kirsten J F and H Madevu (2004). "Securing Small Producer Participation in Restructured Agri-food Systems in South Africa". ABSA Chair in Agribusiness, University of Pretoria, Pretoria, South Africa.

Mackinnon (1991). Values and formulas from the Mackinnon's tables in Gujarati, D.N. (2003). Basic Econometrics. 4th Edition. Mcgraw Hill, 2003.

Meyer J. and S. von Cramon-Taubadel (2004). "Asymmetric Price Transmission: A Survey", *Journal of Agricultural Economics.* Vol. 55: 581 – 611.

Milk Producers Organisation (2006) www.mpo.co.za and *personal communication*

Moor, G. (2005). *Personal communication*

National Chamber of Milling, (2003). *Personal communication.*

National Chamber of Milling, (2006). www.grainmilling.org.za

NDA (2003). "Economic review of South African Agriculture 2002/2003." *Directorate Agricultural Statistics*. ISBN 1-86871-147-1.

NDA (2005). "Abstracts of Agricultural Statistics 2005". *Directorate of Agricultural Statistics.*

Olivier, G.O. (2004). "An analysis of the South African beef supply chain: From farm to fork ", published Masters Thesis, Rand Afrikaans University.

Peltzman S. (2000). "Price rise faster than they fall ", *Journal of Political Economy*, Vol 108 (3): 477 – 502, 2000.

Planet Retail (2006). www.planetretail.net

Reagan, P. and M. Weitzman (1982). "Asymmetries in price and quantity adjustment by the competitive firm", *Journal of Economic Theory*, Vol. 27, 410 – 420.

Red Meat Abattoir Association (2002). Red Meat Abattoir Association Annual Report 2002.

South African Meat Industry (2005). www.samic.co.za

South Africa Online (2004). http://www.saonline.co.za

South African Canegrowers (2005). http://www.sacanegrowers.co.za

Spencer, S. (2004). "Price determination in the Australian Food Industry, A Report", Australian Government, Department of Agriculture, Fisheries and Forestry, Canberra.

Statistics South Africa (2005). *Agricultural Census 2002.* http://www.statsa.gov.za

United States Department of Agriculture, (2006). *Personal communication.*

Von Cramon-Taubadel, S. and S. Fahlbusch (1994). "Identifying asymmetric price transmission with Error Correction Models", Poster Session EAAE European Seminar in Reading.

Vavra, P and B. Goodwin (2005). "Analysis of price transmissions along the food chain.", *OECD Food, Agriculture and Fisheries Working Papers*, No. 3, OECD Publishing.

Ward, R.W. (1982). "Asymmetry in Retail, Wholesale, and Shipping Point Prices for Fresh Fruits and Vegetables", *American Journal of Agricultural Economics*. Vol. 62: 205 – 212.

Wohlgenant, M.K. (1985). "Competitive Storage, Rational Expectations, and Short Run Food Price Determines", *American Journal of Agricultural Economics*. Vol. 67, No.4, pp. 739 – 748.

Wohlgenant, M.K. (2001). "Marketing Margins: Empirical Analysis", in Bruce Gardener and Gordon Rausser, ed., *Handbook of Agricultural Economics, Volume 1*, Amsterdam: Elsevier Science B.V., Chapter 16, pp.934 – 970.

World Bank, Southern Africa Department (1994). "South African Agriculture: Structure, performance and options for the future", *Discussion paper 6.* Washington D.C., USA.

Zachariasse, V. and F. Bunte (2003). *How are farmers faring in the changing balance of power along the food supply chain?*, OECD Conference: Changing Dimensions of the Food Economy: Exploring the Policy Issues, The Hague, 6-7 February 2003.

Annex A: Results and empirical application

1. Test for unit roots and stationarity

Variable	Specification	Lags	ADF (τ τ_μ τ_τ)	ADF (ϕ_3 ϕ_1)	Lags	PP
	Beef (Rump, Sirloin, Topside, Brisket, Chuck per kg)					
Ln Retail	τ_τ	3	−4.59***	4.74	3	−3.45*
	τ_μ	4	−1.778	2.15	3	−1.46
	τ	4	1.52		3	0.84
Δ Retail	τ	3	−5.10***	9.10***	3	−6.02***
	τ_τ	3	−5.11***	11.48***	3	− 6.10***
	τ_μ	3	−4.71***		3	− 6.01***
Ln Farm	τ_τ	3	− 3.02	2.58	3	− 2.02
	τ_μ	3	- 2.87	3.01	3	-2.00
	τ	3	0.48		3	0.36
Δ Farm	τ	0	−4.90***	12.06***	3	−4.95***
	τ_τ	0	−4.96***	24.64***	3	−5.02***
	τ_μ	0	−4.97***		3	−5.03***

Variable	Specification	Lags	ADF (τ τ_μ τ_τ)	ADF (ϕ_3 ϕ_1)	Lags	PP
	Sugar (2.5 kg packet, white)					
Ln Retail	τ_τ	0	−3.37*	6.65	3	−3.38*
	τ_μ	1	−3.38**	6.84	3	−3.43**
	τ	0	1.64		3	1.89

Δ Retail	τ	0	−8.33***	34.82***	3	−8.43***
	τ_τ	0	−8.12***	65.97***	3	−8.13***
	τ_μ	0	− 7.68***		3	−7.66***
Ln Wholesale	τ_τ	0	− 1.48	1.63	3	−1.49
	τ_μ	0	− 1.81	3.25	3	−1.80
	τ	0	0.83		3	0.8
Δ Wholesale	τ	0	− 6.84***	23.39***	3	−6.84***
	τ_τ	0	− 6.73***	45.41***	3	−6.74***
	τ_μ	0	− 6.71***		3	−6.71***
Ln Farm	τ_τ	0	− 1.37	1.67	3	−1.36
	τ_μ	0	−1.71	2.93	3	−1.75
	τ	0	−0.39		3	− 0.35
Δ Farm	τ	0	−6.81***	23.20***	3	−6.83***
	τ_τ	0	−6.65***	44.24***	3	−6..65***
	τ_μ	0	−6.67***		3	−7.63***

Variable	Specification	Lags	ADF (τ τ_μ τ_τ)	ADF (ϕ_3 ϕ_1)	Lags	PP
	Maize (Super and Special, 5kg packets)					
Ln Retail	τ_τ	0	-3.22*	7.11***	3	-3.25*
	τ_μ	0	−0.96	0.93	3	−1.18
	τ	0	−0.10		3	−0.1
Δ Retail	τ	0	−5.66***	16.08***	3	−5.66***
	τ_τ	0	−5.44***	29.57***	3	−5.45***

	τ_μ	0	−5.49***		3	−5.51***
Ln Wholesale	τ_τ	1	−3.87**	12.18**	3	−3.25**
	τ_μ	1	−2.05	10.75**	3	−1.66
	τ	1	−0.36		3	−0.19
Δ Wholesale	τ	0	− 3.85**	7.48*	3	−3.79**
	τ_τ	0	−3.84***	14.78***	3	−3.77***
	τ_μ	0	−3.88***		3	−3.88***
Ln Farm	τ_τ	2	−3.51***	8.32**	3	−2.90
	τ_μ	1	−1.35	5.92*	3	−1.00
	τ	1	0.50		3	−0.56
Δ Farm	τ	0	−4.17***	8.78**	3	−4.15**
	τ_τ	0	−4.18***	17.55***	3	−4.13***
	τ_μ	0	−4.02***		3	−4.17***

Variable	Specification	Lags	ADF (τ τ_μ τ_τ)	ADF (ϕ_3 ϕ_1)	Lags	PP
	Chicken (whole frozen per kg)					
Ln Retail	τ_τ	3	−3.24*	3.37	3	−3.88**
	τ_μ	0	−3.04**	9.25**	3	−3.03**
	τ	1	0.75		3	0.87
Δ Retail	τ	0	−9.16***	42.09***	3	−9.28***
	τ_τ	0	−9.28***	86.09***	3	−9.40***
	τ_μ	0	−9.29***		3	−9.37***
Ln Farm	τ_τ	2	−3.89**	4.63*	3	−2.83

	τ_μ	1	−2.50	4.38*	3	−2.42
	τ	4	1.06		3	−0.67
Δ Farm	τ	3	−4.57***	6.66**	3	−5.33***
	τ_τ	3	−4.62***	8.53***	3	−5.37***
	τ_μ	3	−4.50***		3	−5.39***

Variable	Specification	Lags	ADF (τ τ_μ τ_τ)	ADF (ϕ_3 ϕ_1)	Lags	PP
	Dairy (1 lt fresh milk sachets full)					
Ln Retail	τ_τ	0	−2.64	4.88*	3	−2.63
	τ_μ	0	−3.00**	9.04**	3	−3.00
	τ	0	0.78		3	0.76
Δ Retail	τ	0	−6.41***	19.31***	3	−6.19***
	τ_τ	0	−5.98***	35.76***	3	−5.95***
	τ_μ	0	−5.96***		3	−5.93***
Ln Farm	τ_τ	0	−2.37	4.05*	3	−2.37
	τ_μ	0	−1.14	1.30	3	−1.27
	τ	0	−0.13		3	−0.133
Δ Farm	τ	0	−6.67***	22.27***	3	−6.67***
	τ_τ	0	−6.49***	42.16***	3	−6.51***
	τ_μ	0	−6.56***		3	−6.57***

* statistically significant at 10% level

** statistically significant at a 5% level

*** statistically significant at a 1% level

Annex B: Proposed co-integration relationships of the variables

Proposed co-integration relationship for beef products (Dependent Variable:LN_RBEEF)

Variable	Coefficient	Std. Error	t-Statistic
SHIFT04	-0.081441	0.020300	-4.011863
LN_A2BEEF	0.294327	0.081861	3.595461
C	7.203037	0.204376	35.24406

Proposed co-integration relationship for sugar (Dependent Variable: LN_RETWSG)

Variable	Coefficient	Std. Error	t-Statistic
LN_SGCPRSA	2.916576	0.671457	4.343651
LN_AMDPSG	1.850634	0.247800	7.468270
C	-27.35697	5.308662	-5.153271

Proposed co-integration relationship for maize (Dependent Variable: LN_RETSUPMM)

Variable	Coefficient	Std. Error	t-Statistic
LN_MDPWM	0.294659	0.042644	6.909785
C	0.768083	0.286053	2.685105

Proposed co-integration relationship for maize (Dependent Variable: LN_MDPWM)

Variable	Coefficient	Std. Error	t-Statistic
LN_FGPRWM	0.975827	0.002572	379.4597

Proposed co-integration relationship for chicken (Dependent Variable: LN_RETPCHK)

Variable	Coefficient	Std. Error	t-Statistic
LN_CHKPP	0.719042	0.091751	7.836846
C	1.055892	0.223501	4.724329

Proposed co-integration relationship for dairy: (DependentVariable:LN_RETFFCM)

Variable	Coefficient	Std. Error	t-Statistic
LN_FMPP	0.617356	0.182742	3.378295
C	1.136346	0.113784	9.986836

Annex C: The Engle – Granger test for co-integration

1. Beef

N	Model	% significance	Lags	ADF: C(p)	Conclusion
1	Constant, no trend	1	3	-2.69 < -3.571	No cointegration
		5	3	-2.69 < -2.923	No cointegration
		10	3	-2.69 > -2.599	Cointegration

2. Sugar

n	Model	% significance	Lags	ADF: C(p)	Conclusion
1	Constant, no trend	1	0	-3.83 > -3.571	Cointegration
		5	0	-3.83 > -2.923	Cointegration
		10	0	-3.83 > -2.599	Cointegration

3. Maize – Retail price and Milldoor price

n	Model	% significance	Lags	ADF: C(p)	Conclusion
1	Constant, no trend	1	0	-1.69 < -3.571	No cointegration
		5	0	-1.69 < -2.923	No cointegration
		10	0	-1.69 < -2.599	No cointegration

4. Maize Milldoor price and farm gate price

n	Model	% significance	Lags	ADF: C(p)	Conclusion
1	Constant, no trend	1	1	-3.77 > -3.571	Cointegration
		5	1	-3.77 > -2.923	Cointegration
		10	1	-3.77 > -2.599	Cointegration

5. Chicken

n	Model	% significance	Lags	ADF: C(p)	Conclusion
1	Constant, no trend	1	0	-4.56 > -3.571	Cointegration
		5	0	-4.56 > -2.923	Cointegration
		10	0	-4.56 > -2.599	Cointegration

6. Dairy

n	Model	% significance	Lags	ADF: C(p)	Conclusion
1	Constant, no trend	1	0	-2.93 < -3.571	No cointegration
		5	0	-2.93 > -2.923	Cointegration
		10	0	-2.93 < -2.599	Cointegration

Annex D: Diagnostic tests performed on the various ECMs

1. Beef

Test	H_0	Test statistic	p-value	Conclusion
Jarque - Bera	Not normally distributed	0.058463	0.971192	Normally distributed
ARCH LM	No heteroscedasticity	0.039505	0.842452	Homoscedastic
White	No heteroscedasticity	7.529704	0.274621	Homoscedastic
Breusch – Godfrey	No serial correlation	1.050199	0.591497	No autocorrelation
Ramsey Reset	No misspecification	3.087191	0.378376	No misspecification

2. Sugar

Test	H_0	Test statistic	p-value	Conclusion
Jarque - Bera	Not normally distributed	0.283053	0.868032	Normally distributed
ARCH LM	No heteroscedasticity	0.618014	0.431786	Homoscedastic
White	No heteroscedasticity	1.476320	0.687746	Homoscedastic
Breusch – Godfrey	No serial correlation	1.912416	0.384348	No serial correlation
Ramsey Reset	No misspecification	0.384348	0.254536	No misspecification

3. Maize (Farmgate to Milldoor)

Test	H_0	Test statistic	p-value	Conclusion
Jarque - Bera	Not normally distributed	4.725606	0.094156	**Not normally distributed**
ARCH LM	No heteroscedasticity	16.56965	0.000047	**Heteroscedastic**
White	No heteroscedasticity	6.174065	0.186521	Homoscedastic
Breusch - Godfrey	No serial correlation	20.71469	0.000032	**Serial correlation**
Ramsey Reset	No misspecification	9.178181	0.027013	**Misspecification**

4. Maize (Milldoor to Retail)

Test	H_0	Test statistic	p-value	Conclusion
Jarque - Bera	Not normally distributed	0.805142	0.668599	Normally distributed
ARCH LM	No heteroscedasticity	1.356658	0.244118	Homoscedastic
White	No heteroscedasticity	0.356747	0.985862	Homoscedastic
Breusch - Godfrey	No serial correlation	1.143573	0.564516	No serial correlation
Ramsey Reset	No misspecification	4.022398	0.259056	No misspecification

5. Chicken

Test	H_0	Test statistic	p-value	Conclusion
Jarque – Bera	Not normally distributed	0.187720	0.910410	Normally distributed
ARCH LM	No heteroscedasticity	0.989731	0.319808	Homoscedastic
White	No heteroscedasticity	2.402124	0.662244	Homoscedastic
Breusch – Godfrey	No serial correlation	1.816412	0.403247	No serial correlation
Ramsey Reset	No misspecification	2.728172	0.435461	No misspecification

6. Fresh full cream milk

Test	H_0	Test statistic	p-value	Conclusion
Jarque – Bera	Not normally distributed	185.3311	0.000000	**Not normally distributed**
ARCH LM	No heteroscedasticity	0.185485	0.666701	Homoscedastic
White	No heteroscedasticity	24.73876	0.000057	**Heteroscedastic**
Breusch - Godfrey	No serial correlation	1.402804	0.495889	No serial correlation
Ramsey Reset	No misspecification	23.24922	0.000036	**Misspecification**

Annex E: The Engle Yoo third step procedure

The Engle Yoo third step regression requires that coefficient of the lagged residual in the ECM is multiplied by the by every explanatory variable in the co-integration relationship except for any dummy, shift or constant variables. The Engle Yoo third step regression will however only be performed with residual values from the ECMs that passed all of the diagnostic tests in the previous section.

1. Beef

Results from the Engle Yoo third step regression

Variable	Coefficients	Standard error
0.306875*LN_A2BEEF	-0.001023	0.008633

Variables	Original coefficients	3rd step coefficients	New coefficients (elasticity)	3rd step standard error	New t stat
LN_A2BEEF	0.294327	-0.001023	0.293304	0.008633	33.97475

2. Sugar

Results from the Engle Yoo third step regression

Variables	Coefficients	Standard error
0.479985*LN_SGCPRSA	-0.124555	0.236575
0.479985*LN_AMDPSG	0.079053	0.150329

Variables	Original coefficients	3rd step coefficients	New coefficients (elasticity)	3rd step standard error	New t stat
LN_SGCPRSA	2.916576	-0.124555	2.792021	0.236575	11.801843
LN_AMDPSA	1.850634	0.079053	1.929687	0.150329	12.836425

3. Maize (Milldoor to Retail)

Results from the Engle Yoo third step regression

Variables		**Coefficients**		**Standard error**	
0.168261*LN_MDPWM		0.00000573		0.013618	
Variables	**Original coefficients**	**3rd step coefficients**	**New coefficients (elasticity)**	**3rd step standard error**	**New t stat**
LN_MDPWM	0.294659	0.00000573	0.2946647	0.013618	21.637884

4. Chicken

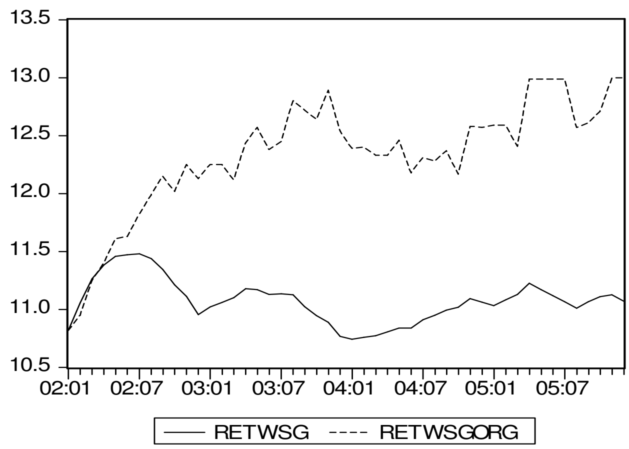
Results from the Engle Yoo third step regression

Variables		**Coefficient**		**Standard error**	
0.0615570*LN_CHKPP		-0.000273		0.003388	
Variable	**Original coefficient**	**3rd step coefficients**	**New coefficients (elasticity)**	**3rd step standard error**	**New t stat**
LN_CHKPP	0.719042	-0.000273	0.718769	0.003388	212.151416

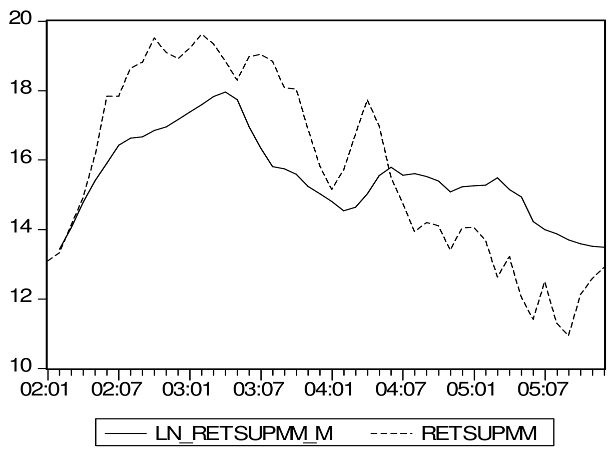
Annex F: Rewriting the equation back to its levels and simulating the model dynamically

The ECMs are then simulated in order to see how close the model represents the actual data. Below are some of the ECMs and their output with respect to the other variables. The solid line is always the model's output whilst the dotted line is the original retail price.

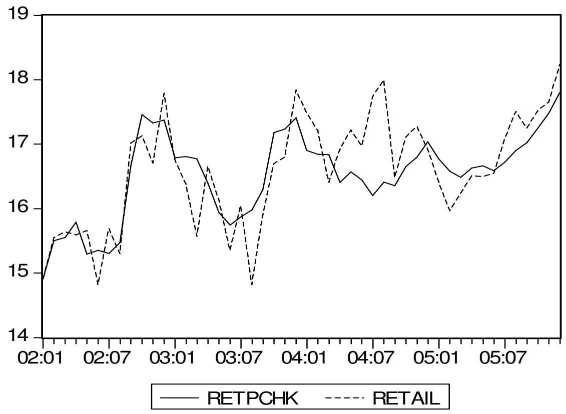
1. Sugar



2. Maize



3. Chicken



4. Dairy