

Playing chicken: The players, rules and future of South African broiler production

by

P Davids

A dissertation submitted in partial fulfilment of the requirements for the degree

MSc (Agric) in Agricultural Economics

in the

Department of Agricultural Economics, Extension and Rural Development

Faculty of Natural and Agricultural Sciences

University of Pretoria

South Africa

October 2013

DECLARATION

I, P Davids, declare that the dissertation, which I hereby submit for the degree MSc (Agric) Agricultural Economics at the University of Pretoria, is my own work and has not been submitted for a degree at this or any other tertiary institution.

Signature

October 2013

Date

Acknowledgements

This dissertation would not have been possible without the help and support of a number of individuals. A huge thank you goes to my supervisor, Prof Ferdi Meyer, whose guidance, support and input was invaluable in the completion of the study. Thank you also for providing me with every opportunity to complete the study at the Bureau for Food and Agricultural Policy. In addition, Prof Johann Kirsten and Ms Marlene Louw provided valuable inputs and answered many questions. Further to all my friends and colleagues at the Bureau for Food and Agricultural Policy as well as the department of Agricultural Economics at the University of Pretoria, thank you for the support and encouragement in completing this study.

Numerous industry specialists and broiler producers contributed to the industry insight required for this study. Particular thanks go to Magda Prinsloo from the South African Poultry Association for providing endless data in order to complete the model.

To my mom, who gave me every opportunity and taught me the value of dedication and hard work, thank you for your love and encouragement – you are an inspiration and I dedicate this MSc degree to you. Finally thank you to my heavenly Father, thank you for blessing me with the talent to be successful – to him be all the glory and praise!

Tracy Davids

Pretoria

October 2013

Playing chicken: The players, rules and future of South African broiler production

by

P Davids

Degree: MSc (Agric)

Department: Agricultural Economics, Extension and Rural Development

Supervisor: Prof F.H. Meyer

ABSTRACT

The South African broiler industry is the greatest contributor to the South African agricultural sector, while at the same time providing the cheapest form of protein to the South African consumer. In light of a recent application for increased tariffs due to the industry's inability to compete with the price of imported products, the need for a tool that is able to quantify the benefit of increased tariff protection to producers, while at the same time considering the cost of increased tariffs on South African consumers became apparent. The integrated nature of the industry however raised the concern that the assumptions associated with traditional quantitative modelling techniques, particularly that of a perfectly competitive market, would not allow the current broiler model within the BFAP sector modelling framework to represent the industry accurately.

The primary objective of the study was to determine the true method of price discovery within the South African broiler market, in order to specify a price equation that is able to capture the dynamics surrounding price formation with improved accuracy. This price formation mechanism was then integrated into a simulation model that represents the industry accurately. Due to its ability to represent reality within the market with greater accuracy, the New Institutional Economic (NIE) framework was used to analyse the structure of the South African broiler industry as action domain. The actors and activities in the value chain were evaluated, followed by an analysis of the institutions that govern exchange within the market,

highlighting the implications of these institutions for price formation within this coordinated market structure.

Upon evaluation of compensation structures used within broiler production contracts, it became evident that the market for live broilers produced by contract growers could be considered as a market for grower services, as opposed to a market for live broilers. Compensation based on a broiler production tournament offers significant incentives for greater efficiency, effectively ensuring that production efficiency increases on a continuous basis. Despite the contractual obligation of integrated producers to pay their contracted growers based on a formula including the cost of production, the broiler producer price is negotiated between integrators and retailer, within a concentrated market structure. The cost of production is used as bargaining tool in price negotiations, yet the availability of imported products at extremely competitive prices limits the extent to which increased production costs can be passed up through the value chain. This was confirmed by the fact that the response of the domestic broiler producer price was much more elastic to changes in the international price than to changes in feed costs.

The theoretical factors that drive broiler producer prices in South Africa were confirmed econometrically through the use of an error correction model, estimated empirically using secondary monthly data from 2007 to 2012. The estimated equations were integrated into a partial equilibrium framework using an import identity to establish equilibrium in the market, rather than a price equilibrator. The inelastic response from the domestic broiler producer price to changes in broiler feed prices raised questions regarding South African producers' ability to compete with imported products and produce sustainably in the long run. Given the higher costs of production domestically, as well as the relative size and importance of the broiler industry within the South African agricultural sector, the need to evaluate the tariff application objectively was clear.

Policy decisions should weigh the benefit of increased producer prices on broiler producers against the cost of protective policy to consumers, while also considering the specific consumers that would be required to bear the cost of increased tariffs. Integration of the partial equilibrium model of the broiler industry into the BFAP sector modelling framework enabled the simulation of various tariff scenarios, quantifying the effect on the agricultural sector, as well as chicken consumption. At the same time, the successful simulation of different

scenarios and policy shocks validated the model. Simulation of the tariffs applied for by SAPA resulted in a producer price increase of 6%, which would be a significant margin on the bottom line for domestic producers. The cost to consumers of a 3.3% increase in retail prices also seems digestible; however the underlying factors that drive competitiveness should also be addressed in order to ensure long run sustainability for the industry.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	I
ABSTRACT	II
TABLE OF CONTENTS	V
LIST OF TABLES	VIII
LIST OF FIGURES	IX
CHAPTER 1: INTRODUCTION	
1.1 BACKGROUND	1
1.2 PROBLEM STATEMENT	5
1.3 PURPOSE STATEMENT	7
1.4 RESEARCH OBJECTIVES	8
1.5 RESEARCH DESIGN AND METHODOLOGY	9
1.6 STUDY OUTLINE	12
1.7 DELIMITATIONS	12
1.8 ASSUMPTIONS	13
1.9 DEFINITION OF KEY TERMS	13
CHAPTER 2: THE SOUTH AFRICAN BROILER INDUSTRY AS ACTION DOMAIN	
2.1 INTRODUCTION	16
2.2 THE INTERNATIONAL BROILER MARKET	17
2.2.1 International broiler production and consumption	17
2.2.2 International broiler trade and prices	20
2.3 THE SOUTH AFRICAN BROILER MARKET	20

2.4	STRUCTURE OF THE SOUTH AFRICAN BROILER SUPPLY CHAIN	25
2.4.1	Primary breeder flock	27
2.4.2	Parent stock	28
2.4.3	Broiler farm	30
2.4.4	Feed supply	32
2.4.5	Processing	34
2.5	CONCENTRATION WITHIN THE INDUSTRY	35
2.6	KEY ACTORS IN THE SOUTH AFRICAN BROILER SUPPLY CHAIN	36
2.6.1	Rainbow Chicken Ltd	36
2.6.2	Astral Foods	39
2.6.3	Country Bird Holdings	42
2.6.4	Afgri Poultry	44
2.6.5	Pioneer Foods Poultry Division	46
2.6.6	South African Poultry Association	49
2.7	CONCLUSION	50

CHAPTER 3: INSTITUTIONAL DIMENSIONS AND CONTRACTUAL ARRANGEMENTS IN BROILER MARKETS

3.1	INTRODUCTION	52
3.2	ECONOMIC COORDINATION AND ORGANISATIONAL FORM IN BROILER MARKETS	52
3.3	CONTRACTUAL ARRANGEMENTS IN WORLD BROILER MARKETS	56
3.3.1	Characteristics of broiler contracts in world markets	56
3.3.2	Comparing different pricing methods in world broiler markets	58
3.4	CONTRACTUAL ARRANGEMENTS IN THE SOUTH AFRICAN BROILER MARKET	61
3.4.1	Characteristics of broiler contracts in South Africa	61
3.4.2	Compensation within broiler contracts in South Africa	63
3.4.3	Pricing at integrator level	67
3.4.4	Implications of the price formation process in the South African broiler market	68
3.5	CONCLUSIONS	70

CHAPTER 4: MODELLING THE SOUTH AFRICAN BROILER MARKET

4.1	INTRODUCTION	72
4.2	TRADITIONAL APPROACHES TO MODELLING COMMODITY MARKETS	73

4.2.1	Merits and limitations of the traditional modelling approach	74
4.2.2	Adjusting models in order to capture the reality of coordinated markets	75
4.3	MODELLING THE SOUTH AFRICAN BROILER INDUSTRY	76
4.3.1	Causality between prices at different levels of the value chain	76
4.3.2	Empirical estimation of the South African broiler producer price	78
4.3.3	Transmission from producer to retail prices	86
4.3.4	Domestic supply and demand equations	90
4.3.4.1	Domestic consumption estimate	90
4.3.4.2	Domestic production estimate	91
4.3.4.3	Exports and stock levels	93
4.3.5	Model closure and baseline simulation	94
4.4	CONCLUSION	97
 CHAPTER 5: EVALUATION AND QUANTIFICATION OF THE EFFECT OF PROPOSED TARIFF PROTECTION ON THE SOUTH AFRICAN BROILER INDUSTRY		
5.1	INTRODUCTION	99
5.2	THEORETICAL EFFECTS OF TRADE PROTECTION	101
5.3	AN HISTORIC PERSPECTIVE ON SOUTH AFRICAN CHICKEN IMPORTS	104
5.4	SIMULATING THE EFFECT OF INCREASED TARIFFS	106
5.5	CONSIDERING THE IMPACT OF INCREASED TARIFFS ON CONSUMERS	111
5.6	CONCLUSION	114
 CHAPTER 6: SUMMARY AND RECOMMENDATIONS		116
 LIST OF REFERENCES		121

LIST OF TABLES

Table 1:	Abbreviations used in the document.....	15
Table 2:	Provincial distribution of broiler production in South Africa.....	21
Table 3:	Import tariffs for chicken meat products applied by South Africa.....	24
Table 4:	Broiler efficiency benchmark: 2011.....	31
Table 5:	Market share of large commercial chicken producers in South Africa.....	35
Table 6:	Import tariffs applied by South Africa.....	50
Table 7:	Variable production cost breakdown of South African broiler producers.....	62
Table 8:	Results of Granger causality test.....	78
Table 9:	Results of ADF test for stationarity.....	80
Table 10:	Estimation results of the Engle-Granger co-integration equation.....	81
Table 11:	Results of Engle-Granger co-integration test.....	82
Table 12:	Estimation results of the ECM.....	83
Table 13:	Diagnostic tests results.....	85
Table 14:	Engle-Yoo third step adjustment.....	85
Table 15:	Long run elasticities and t-statistics following the Engle-Yoo adjustment.....	86
Table 16:	Results of ADF test for stationarity.....	86
Table 17:	Estimation results of the Engle-Granger co-integration equation.....	87
Table 18:	Results of Engle-Granger co-integration test.....	88
Table 19:	Estimation results of the ECM.....	88
Table 20:	Engle-Yoo third step adjustment.....	89
Table 21:	Long run elasticities and t-statistics following the Engle-Yoo adjustment.....	89
Table 22:	Estimation results of the per capita consumption equation.....	90
Table 23:	Broiler feed inclusion rates.....	92
Table 24:	Estimation results of the broiler production equation.....	93
Table 25:	Key macro-economic assumptions associated with the baseline simulation.....	96
Table 26:	Key policy assumptions associated with the baseline simulation.....	97
Table 27:	Classification of chicken meat imports into South Africa.....	105
Table 28:	Tariffs used for baseline and simulated scenarios.....	107
Table 29:	Summarizing the effect of different tariff scenarios on the fundamentals of the South African broiler industry.....	110

LIST OF FIGURES

Figure 1: Conceptual framework for institutional analysis.....	10
Figure 2: Annual percentage change in broiler production for the top three producing countries.....	18
Figure 3: World chicken consumption: 2005-2011	19
Figure 4: Annual consumption share of the top four chicken consumption countries.....	19
Figure 5: Production, consumption and imports of broiler meat by South Africa: 2000-2011 .	21
Figure 6: Broiler production, consumption and chicken to maize price ratio: 2002-2022	22
Figure 7: Broiler domestic price and import parity price comparison in South Africa	23
Figure 8: Origin of South African chicken imports: 2010-2012.....	25
Figure 9: Broiler meat production process.....	26
Figure 10: Diagrammatic representation of a generic broiler supply chain in South Africa	27
Figure 11: Average broiler breeders placed per annum	29
Figure 12: Soybean cake price comparison in South Africa and Brazil	33
Figure 13: Soybean cake production, consumption, trade and prices in South Africa	33
Figure 14: Diagrammatic representation of Rainbow Chicken Ltd’s poultry operations.....	37
Figure 15: Diagrammatic representation of Astral Foods’ poultry operations	40
Figure 16: Diagrammatic representation of Country Bird Holdings’ poultry operations.....	43
Figure 17: Diagrammatic representation of Afgri’s Poultry operations	45
Figure 18: Diagrammatic representation of Pioneer Foods’ poultry operations.....	47
Figure 19: Features included in USA broiler contracts.....	57
Figure 20: Price determination process in South African broiler production contracts.....	64
Figure 21: Input price index, chicken price index and integrator performance	69
Figure 22: Real broiler producer price in South Africa compared to FOB price + tariff	79
Figure 23: Comparing actual and fitted values from the ECM.....	84
Figure 24: Model of the South African broiler market	95
Figure 25: Baseline outlook for the South African broiler industry	96
Figure 26: Effect of a tariff increase on South African chicken imports.....	102
Figure 27: Composition of South Africa’s chicken imports per tariff classification.....	105
Figure 28: Nominal chicken producer price comparison: Baseline vs. Scenarios.....	108
Figure 29: Percentage change in the nominal chicken retail prices for three scenarios.....	109
Figure 30: Meat consumption patterns in South Africa	112
Figure 31: Chicken and Beef consumption per income quintile: 2000-2010	113
Figure 32: Poultry as a percentage of the food consumption basket in 2010.....	114

CHAPTER 1

INTRODUCTION

“New institutional economists are the blue-collar guys with a hearty appetite for reality.”
Oliver Williamson, 2000

1.1 BACKGROUND

In 2011, the South African poultry industry was the largest segment of the South African agricultural sector, contributing 24% of total agricultural production (SAPA, 2012c:8). Apart from dominating production, chicken meat was also the cheapest and most consumed source of animal protein, contributing 65.5% of domestically produced animal protein consumed in 2011 (SAPA, 2012c:7). The dominance of the broiler industry within the South African agricultural sector is apparent, yet the past three years has seen the industry under pressure as a result of significant increases in relatively cheaper imports, with domestic producers struggling to compete in the midst of increasing feed prices. As a result of the pressure on the domestic industry, consumption growth of 4.6% from 2010 to 2011 was accompanied by growth of only 0.8% in production and growth of 35.6% in imports. As such, the industry has approached government for increased tariff protection in order to remain sustainable.

The welfare effects of such increased protection on both producers and consumers must be carefully considered before policy decisions are taken. Due to its significant contribution to agricultural gross domestic product (GDP), as well as its role in food security in supplying the cheapest source of animal protein, the sustainability of the South African broiler industry is of great importance, yet the effect of higher prices due to proposed tariff increases on the poorest of South African consumers makes the issue particularly sensitive. The need for tools to inform strategic decisions with regards to the sustainability of the industry is apparent, yet the ability of these decision making tools to simulate reality accurately is crucial if they are to be used successfully.

Tools that quantify the effect of proposed policy changes have a significant role to play in informing strategic decisions; however qualitative consideration of the reasons underpinning

the domestic industry's lack of competitiveness is equally important. The institutional structure of the South African broiler market has significant implications for price formation as well as efficiency through the supply chain and therefore decision making tools that do not include an analysis of the institutional arrangements within the market would represent an incomplete picture. Matching the institutional structure of the market to a quantitative simulation model will provide a decision making tool that considers a more complete picture and provides improved, useful predictions and simulations for given scenarios.

Quantitative modelling is a popular tool used to inform decision making and has many advantages, the greatest of which is arguably the ability to quantify the effects of certain policies or other possible scenarios, thereby providing an objective view of the results of certain decisions. Poonyth, Van Zyl and Meyer (2000:607) indicated that quantitative models are useful for three levels of analysis, namely market analysis, forecasting of future prices and quantities, and policy analysis. Strauss (2009:38) further argued that regression models have a major strength in that they are accurate in representing actual interrelationships and trends based on historic data. These models are therefore applicable in order to guide understanding of causality resulting in variation in the market. Strauss (2009:38) also argued that as a result, these models add significant value when analysing the impact of risk on a market system, making them particularly useful as tools to inform decision making.

Though modelling has been proven useful in order to inform decision making, the approach is by no means perfect. According to Soregaroli and Sckokai (2011:1), the high volatility in world cereal markets between 2008 and 2011 brought the models used for predictive purposes in agricultural commodity markets under scrutiny, as these models had difficulty predicting the volatility that was experienced. They are, however, not the only authors to question the predictive power of these models. Binfield, Adams, Westhoff and Young (2002:6) indicated that models are simplifications of reality and as some factors are not incorporated into these models, even the best models can fail.

Soregaroli and Sckokai (2011:1) argued that a good starting point when discussing the simplified structure of agricultural models could be the assumptions that underly these models. Market equilibrium models are based on certain structural assumptions, like constant returns to scale technology, homothetic consumer preferences and perfectly competitive markets (Soregaroli, Sckokai & Moro, 2011:196; Calcaterra, 2002:22; Van Tongeren, Van

Meijl & Surry, 2001:152). It is assumed that the number of buyers is great enough for the market to be considered nearly perfectly competitive (Calcaterra 2002:24). In addition, commodity models make further assumptions regarding the commodity traded; assuming homogeneous products that are perfect substitutes both domestically and internationally. Soregaroli and Sckokai (2011:1) however argued that the structure and characteristics of these models are often too simplified to represent the complexities of agricultural markets. The essential assumption of these models is that equilibrium prices are formed at the point where supply and demand intersect, achieving market clearance.

Kherallah and Kirsten (2002:121) however argued that structural changes and the increasingly industrialized nature of agriculture have led to a fresh approach to markets. Economic agents engaging in transactions now constitute a market, as opposed to a large number of firms interacting anonymously. Products are often traded within a coordinated supply chain by means of contractual commitment or alternatively, large parts of the supply chain are integrated as a hierarchy within a firm. Within this system, prices are not formed at equilibrium, but rather negotiated between economic agents along the supply chain, resulting in transaction costs, roughly defined as the costs of doing business. Included in these transaction costs are the costs of obtaining information, negotiation, monitoring, coordination and the enforcement of contracts (Kherallah & Kirsten, 2002:121). Different institutional arrangements and organisational structures have emerged in order to minimise these transaction costs.

Jaffee and Morton (1995) further argued that techno-economic characteristics of commodities greatly influence the nature of the institutions that govern their exchange. Within the broiler industry, chickens lose value when they are transported, both directly due to transport and additional feed costs and indirectly due to weight loss and death related to the stress of travelling (MacDonald & Korb, 2011:3). This limits the available options to a farmer for marketing his birds, which could potentially decrease the price received. Dorward and Omamo (2009:99) further indicated that, where actors are exposed to high risk of loss from transaction failure due to significant investment in specific assets and uncertainty in trading partners, they often wish to engage in bilateral contracts in order to reduce risk. Worldwide, poultry industries are characterised by high levels of specific investment in order to obtain technological and economies of scale benefits. These economies of scale benefits lead to high volumes of exchange and increased risk of transaction failure. As a result, contractual

arrangements are a popular form of transacting in poultry markets around the world. In 2008, 90% of the broilers produced in the USA were produced under contract for large, integrated companies (MacDonald & Korb, 2011:13).

The South African broiler industry is no exception, as it is characterised by a complex supply chain that exhibits high levels of vertical integration and coordination. In the commercial broiler supply chain in South Africa, processors consist mainly of subsidiaries or divisions within holding companies. Mature broilers are either supplied within the company structure, or by independent growers contracted to the holding companies. Slaughtering and further processing is then handled by these companies. Large capital requirements and economies of scale benefits act as barriers to entry for new, small scale producers, resulting in high levels of concentration within the industry (Louw, Schoeman & Geyser, 2011:262). Investigations by the competition commission, such as those initiated in 2009 against Rainbow Chicken Ltd., Astral Foods, Pioneer Foods, Country Bird Holdings and Afgri Poultry have raised concern regarding the levels of market concentration in the South African broiler industry and whether this concentration leads to uncompetitive behaviour. In 2011, the two largest producers, Rainbow Chicken Ltd. and Astral Foods produced just under 50% of total production.

Considering the concentrated nature and institutional structure of the South African broiler market, as well as the assumptions associated with traditional commodity models, the available tools to inform strategic decisions regarding the South African broiler industry present certain limitations. The Bureau for Food and Agricultural Policy (BFAP) based at the University of Pretoria, uses a model described by Meyer (2006:9) as a relatively large scale, multi sector commodity level econometric simulation model. A partial equilibrium model of the South African Broiler industry, developed by De Beer (2009:60-80), is integrated into the BFAP sector model. Though it has been used successfully to simulate different scenarios in the past, its aggregated nature prevents the simulation of detailed tariff scenarios as proposed in the tariff application. The extent to which price formation within the model accounts for the integrated structure and institutional arrangements within the market is also questionable.

Considering the fact that the South African broiler industry is in distress, this study proposes an approach that evaluates the South African broiler market within the new institutional economic framework, followed by the estimation of a quantitative model based on the insight gained from the institutional analysis. The institutional analysis will evaluate the structure of

the market and more importantly, the resultant implications regarding efficiency and price discovery, while the quantitative simulation model will provide empirical evidence of true price discovery, whilst also enabling the simulation of a more accurate outlook for the industry under various scenarios. While methods related to quantitative modelling, or the new institutional economic framework have distinct advantages as well as specific limitations, the proposed use of both approaches to complement each other will utilize the advantages, while reducing the limitations of using either method in isolation.

1.2 PROBLEM STATEMENT

As the largest contributor to the South African agricultural sector, the long term sustainability of the South African broiler industry must be prioritised. The industry contributes greatly to food security by providing the cheapest source of animal protein to the South African consumer, while at the same time employing 48 118 people directly, before considering the effect on secondary industries that supply inputs to broiler producers (Lovell, 2012:10). South African broiler producers have struggled to compete on the international front and the industry has recently been classified by the South African Department of Trade and Industry (Dti) as an industry in distress. As such, the reasons behind South African producers' lack of competitiveness must be identified.

In light of the application for increased tariff protection, tools that could evaluate various policy options and future scenarios for the industry accurately are important in order to ensure that the correct policies are implemented, prioritising the long term sustainability of the industry. Simultaneous quantification and consideration of the effect of such policies on the South African consumer is no less important. The model used by BFAP provides a quantitative tool to guide decision making within the South African broiler industry and as part of the larger BFAP sector model, the broiler model developed by De Beer in 2009 has performed satisfactorily in the past, yet from an institutional economic perspective, the model does have certain problems and limitations.

When considering the structural characteristics of the South African broiler industry discussed in the previous section, seen in conjunction with the assumptions presented regarding market clearing models, it becomes clear that there is a possible mismatch between the two.

According to Calcaterra (2002:22), the structural assumptions that have been associated with traditional modelling techniques are constant returns to scale technology, homothetic consumer preferences and perfectly competitive markets. It is further assumed that the number of buyers is great enough for the market to be considered nearly perfectly competitive (Calcaterra, 2002:24).

The structure of the broiler industry in South Africa suggests that it has many characteristics that do not typically reflect the conditions of a perfect market economy, which therefore makes the use of a model built on the assumptions of market clearance rather suspect. Analysis of the institutions that govern exchange within the market has not traditionally been a part of model estimation and as such, the ability of the current model to represent the industry accurately must be questioned. The model estimated by De Beer (2009:76) allows for a market that operates at an import parity regime by closing the model on imports and estimating a price equation. This technique was suggested by Meyer (2006:13-27) and is a better representation of reality in the sense that the price can be estimated based on the world price and is not only determined by a clearing mechanism of domestic supply and demand. The equation used to estimate the broiler price within the BFAP sector model is synthetic in nature however, as the equation estimated by De Beer had to be adjusted in order to make reliable simulations. Understanding producer and consumer behaviour as well as pricing mechanisms is key to the correct specification of a partial equilibrium model (Meyer, 2002:125) and in order to estimate a price equation that simulates reality with greater accuracy, price formation within the South African broiler industry must be better understood.

Apart from the assumptions regarding market structure, commodity models make further assumptions regarding the commodity traded, assuming homogeneous products that are perfect substitutes both domestically and internationally. In this sense, the aggregate import tariff used to calculate the import parity within the current broiler model must be questioned. In reality, imports are classified using the eight digit harmonised system classification codes and nine different classifications are used for broiler products entering South Africa. As tariffs differ across classifications, these different classifications must be considered within the import parity calculation, in order to make the assumption of homogenous products more realistic, while allowing the model to simulate the effect of changes to individual tariff lines. The current broiler model within the BFAP sector model does not allow for the simulation of changes to individual tariff lines due to the aggregate tariff currently used in the model and

must therefore be adapted in order to simulate the tariff increases that the South African Poultry Association (SAPA) applied for in 2013. Further there is no consumer price estimate within the current BFAP sector model, leading to the assumption that consumption decisions are made based on the producer price of chicken, in essence assuming unitary transmission elasticity from producer to consumer price. As various factors could influence price transmission from producer to consumer price, this assumption is also questioned.

1.3 PURPOSE STATEMENT

The purpose of this study is to determine the true method of price discovery within the South African broiler market, considering the nature of the institutional arrangements within the market and to capture this method of price discovery into a quantitative model that is able to provide an accurate outlook for the industry under various scenarios. The structure of the South African broiler market as well as the level of concentration in the market must be considered and accounted for in order to estimate a model that represents reality accurately.

The model will contain some equations that form a part of the current broiler model used by BFAP, as well as some new equations that will aid in disaggregating and refining the current model structure. The new model must however have the capacity to capture changes in individual tariff classifications, so that the effect of policy changes can be captured with greater detail.

A complete analysis of the South African broiler industry will be necessary in order to determine the true method of price discovery within the industry. An analysis of the South African broiler supply chain, as well as a review of institutional arrangements that govern exchange within the industry will make a crucial contribution towards understanding price discovery within the industry and capturing the reality of the market into the modelling framework. Though the model will be tested econometrically, a greater emphasis will be placed on capturing the realities of the South African broiler market into the model, by means of a complete analysis of the industry as action domain, including the actors, their activities and the institutions that govern these activities, as is suggested by the New Institutional Economic (NIE) framework (Dorward & Omamo, 2009:79).

1.4 RESEARCH OBJECTIVES

The objective of this research is to analyse the structure of the South African broiler industry, taking into account both conventional neo classical theory and the new institutional economic framework, thus improving the understanding of how prices are discovered within the integrated South African broiler supply chain. Upon gaining a clear understanding of the industry, a partial equilibrium model will be re-estimated, that can be used to simulate various scenarios and estimate the effect of tariff changes on the chicken producer price in South Africa. Specifically, the following objectives have been identified:

- Evaluate the reasons for South African producers' lack of competitiveness internationally
- Identify the key actors and activities in the South African broiler supply chain
- Identify the institutional arrangements that govern exchange within the broiler industry
- Establish the true price formation mechanism within the institutional arrangements that govern exchange within the South African broiler market
- Establish the extent of market integration between the domestic broiler market in South Africa and the world broiler market
- Construct a partial equilibrium model that captures the reality of the South African broiler market, specified in order to capture the true pricing mechanism established in the study, with the ability to simulate changes to individual tariff lines
- Integrate the broiler model into the BFAP sector model in order to simulate the supply response of increased tariffs for chicken on the entire agricultural sector
- Establish the effect of increased import tariffs on South African consumers
- Present various outlook scenarios for the South African broiler industry under different assumptions regarding government support levels

An analysis of the South African poultry industry based on the NIE framework will improve the understanding of how the market functions in reality. Understanding price formation at various stages of the supply chain as well as the role of market power and concentration on the price formation process will lead to improved accuracy in specification of the model, as well as improved predictive or forecasting accuracy. This improved forecasting accuracy will

lead to improved decision making within the industry and will aid in the anticipation of future market trends, guiding investment and ensuring the long term sustainability of this vital industry. Strauss (2009:12) states that modelling works best when change and rate of change is well understood. A complete analysis of the institutions within the South African poultry industry will improve the understanding of change and therefore improve the ability of the modelling approach to capture the true reality of the South African broiler market.

1.5 RESEARCH DESIGN AND METHODOLOGY

The broad research design of the study will be a combination of a descriptive literature review concerning the South African broiler industry, and an empirical study, making use of secondary, quantitative time series data and statistical modelling.

The first part of the study will be purely descriptive and non-empirical, as it concerns the identification of actors and activities in the South African broiler supply chain as well as institutional arrangements that govern exchange within the supply chain. A thorough review of existing literature will be conducted, in order to establish the functioning of the South African poultry supply chain and the institutional arrangements that govern exchange within this supply chain. As it is considered to be a better representation of reality than the neo classical approach (Kherallah & Kirsten, 2002:111) the literature review will be based on the conceptual framework for institutional analysis as developed by Dorward and Omamo (2009:77). This framework consists of the action domain, which is embedded in the institutional environment. Essentially, this means that the action domain is affected by the environment, while changes in the action domain do not have a direct effect on the environment in the short term. According to Dorward and Omamo (2009:77), the key to successfully using this framework is in the correct identification of the action domain, which defines the boundaries of the activity and the interest of the analysis. For the purpose of this dissertation, the action domain will concern the exchange of goods and services in the commercial broiler supply chain in South Africa. Dorward and Omamo (2009:81) indicate that the action domain concerned with the exchange of goods and services will include actors involved in the exchange of goods and services, their activities surrounding the exchange as well as the institutions that govern the exchange of these goods and services. Figure 1

illustrates the conceptual framework for institutional analysis as developed by Dorward and Omamo (2009:79).

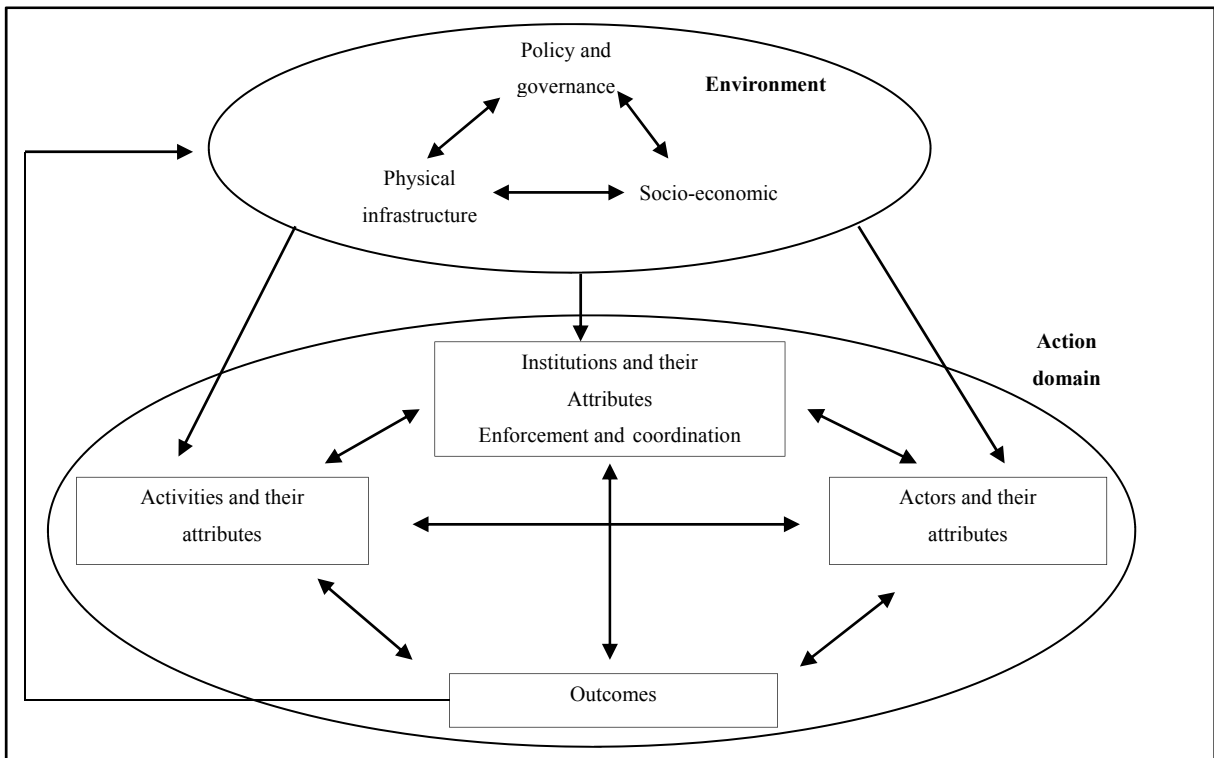


Figure 1: Conceptual framework for institutional analysis

Source: Dorward and Omamo (2009:79).

After the identification of key actors and activities within the South African broiler supply chain, the effect of market power and concentration, coordination, integration and various hybrid organisational forms will be investigated. Identification of the organisational forms that exist in the South African broiler industry will be followed by a detailed analysis of these organisational forms by making use of literature from previous studies. The institutional arrangements used in the industry will be explored, in order to determine how prices are discovered. Confidential interviews with key industry specialists will aid this understanding of price formation.

A comprehensive literature review is essential to any study, but as the correct specification of a statistical model is essential to the correct functioning of the model (Meyer, 2002:125), a thorough review of existing literature in order to guide the understanding of how the South African broiler industry operates in reality becomes even more important. A pure literature review study is limited in the sense that, even though it can provide new insights by

summarising and organising existing literature, it cannot test these insights empirically (Mouton, 2001:180).

Due to the limitations of a pure literature review study, an empirical quantitative analysis is used in combination with the literature review approach. The second part of the study will therefore be empirical in nature, using secondary numeric data in order to construct a statistical simulation model that will be able to simulate various scenarios regarding possible policies to be implemented regarding imported chicken. For the purpose of the statistical model, a comprehensive commodity balance sheet will be constructed. This includes data on broiler production in South Africa, broiler consumption in South Africa, the domestic broiler price in South Africa, broiler imports into South Africa and broiler exports from South Africa. In addition to this, an accurate import parity price must be calculated, for chicken being imported from Brazil. This secondary data will then be analysed within a partial equilibrium framework.

A partial equilibrium model is the preferred method of statistical analysis when a sector is considered in isolation from the rest of the economy and has the benefit that it is able to represent that sector in much greater detail than an economy wide model (De Beer, 2009:3; Meyer, 2006:21). Statistical modelling techniques like partial equilibrium models have been used successfully in the past in order to simulate scenarios and answer policy questions (Van Zyl, 2010; De Beer, 2009; Meyer, 2006; Meyer, 2002). It is due to the success of these models that statistical modelling and particularly partial equilibrium modelling has been chosen for this particular study. Mouton (2001:163) has indicated that statistical models are limited by the quality and availability of data, as well as the plausibility of the assumptions. Recent literature by Soregaroli *et al.* (2011) and Liang, Fabiosa, Jensen and Miller (2010) have however been successful in using models that have relaxed some of the traditional assumptions associated with quantitative modelling, ensuring a better representation of reality. The partial equilibrium model constructed for this study will relax the assumption of a perfectly competitive market.

Though the partial equilibrium modelling approach has been successfully used for quantitative analysis by various authors including De Beer (2009), Meyer (2002), Meyer (2006) and Van Zyl (2010), the new institutional economic framework has not been sufficiently recognised as theoretical background for the specification of these models.

Kherallah and Kirsten (2002:119) indicated that developing countries face unique circumstances in their agricultural sectors and that an institutional analysis is required in order to explain why the costs of transacting are so high in developing countries. The comprehensive literature review conducted in the first part of the study, which is based on the institutional economic framework, will therefore ensure that the assumptions are more plausible and that the model is correctly specified.

No methodology is perfect, with all possible methods exhibiting some limitations. In using the combination approach described above, the limitations of using either approach in isolation will be reduced.

1.6 STUDY OUTLINE

Following the brief introduction provided in Chapter 1 will be a section discussing the delimitations and assumptions of the study as well as definitions for key terms used in the study. This will be followed the literature review section of the study. Chapter 2 concerns the South African broiler industry. The actors and activities at various stages of the value chain are evaluated, after which Chapter 3 considers the institutional arrangements that govern exchange within the supply chain in order to establish the price formation mechanism within the South African broiler market. The empirical section of the study starts at Chapter 4, when various ways of capturing the price formation mechanism into a partial equilibrium simulation model will be considered, while also validating the theoretical price formation process illustrated in Chapter 3. Chapter 5 will evaluate the effect of proposed tariff protection on the South African broiler industry. Chapter 6 will complete the study with a summary and recommendations.

1.7 DELIMITATIONS

The study has several delimitations concerning the institutional analysis. The South African broiler industry will be considered as action domain and while the action domain is embedded in the greater institutional environment, this environment will not be analysed. As a net importer of broilers, imports will form part of the action domain, but institutions in markets that South Africa imports from will not be analysed.

The study will concern institutional arrangements within the South African broiler industry, such as bilateral contracts and vertical integration, but will not include laws and rules from the institutional environment. Institutions like the constitution, property rights, production regulations and health regulations are assumed to be part of the environment, based on the fact that they will have an influence on the action domain, but will not be directly influenced by it in the short term (Dorward & Omamo, 2009:80). The only exception is customs laws, which will be part of the study, due to the inclusion of imports in the action domain.

Further, the study will not consider the entire poultry sector, but rather the broiler sector alone, as broilers form the greatest part of poultry production in South Africa. Within this sector, only the commercial supply chain will be considered as it accounts for the bulk of supply in the market. Small producers that sell broilers in the informal market do exist, but will not be considered for the purpose of this study due to their limited influence on the commercial broiler price.

1.8 ASSUMPTIONS

Studies of this nature do rely on certain assumptions. The main assumption for this particular study will be that the secondary data used for the statistical model is of sufficient quality that the accuracy of the model will not be compromised. The process of statistical modelling also makes certain structural assumptions, but as the validity and relaxation of some of these assumptions form a significant part of the study, they will be discussed in Chapter 4.

1.9 DEFINITION OF KEY TERMS

Some of the key terms used in the document are defined below:

Action domain: In the context of the new institutional economic framework, an action domain is defined as the area or social space in which economic actors interact in social and economic exchange. The action domain is defined by the purpose of the study and in it is included the actors and activities that are of direct relevance to the study.

Asset Specificity: The degree of specificity of a certain asset depends on the ability to use the asset for another purpose. A highly specific asset is an asset that cannot readily be used for a different purpose than what it was originally intended for.

Environment: In the context of the new institutional economics, the institutional environment is defined as the rules and regulations, governance and infrastructure in which the action domain is embedded. The environment will affect the action domain, but in the short term, changes in the action domain will not affect the environment.

Institutions: Institutions are the ‘rules of the game’. Institutions can be formal or informal rules and regulations that govern the behaviour of actors and shape economic, political and social organisation.

Partial Equilibrium Model: A partial equilibrium model is a statistical model that considers a particular sector of the economy in equilibrium, but in isolation from the rest of the economy. The rest of the economy is seen as exogenous to the model, so that it affects the sector considered, but is not directly affected by the sector under consideration.

Transaction costs: Transaction costs are all the costs involved in making a transaction. This includes the costs of obtaining information, the cost of contracting and the costs of enforcing contracts. Transaction costs are not always measurable and also include the cost of time invested into making a transaction.

Various acronyms are used in the document; a list of abbreviations and meanings is provided in Table 1.

Table 1: Abbreviations used in the document

Abbreviation	Meaning
ADF	Augmented Dickey-Fuller
ARCH	Autoregressive Conditional Heteroscedasticity
BFAP	Bureau for Food and Agricultural Policy
CBH	Country Bird Holdings
CPIF	Consumer Price Index for Food
DAFF	Department of Agriculture, Forestry and Fisheries
Dti	South African department of trade and industry
ECM	Error Correction Model
EU	European Union
FAO	Food and Agricultural Organisation of the United Nations
FAPRI	Food and Agricultural Policy Research Institute
FOB	Freight on Board
GDP	Gross Domestic Product
GST	General Sales Tax
ITAC	International Trade Administration Commission of South Africa
NAMC	National Agricultural Marketing Council
NIE	New Institutional Economic
OECD	Organisation for Economic Coordination and Development
OLS	Ordinary Least Squares
SADC	Southern African Development Community
SAPA	Southern African Poultry Association
TDCA	Trade Development and Cooperation Agreement
USA	United States of America
USDA	United States Department of Agriculture
USITC	United States International Trade Commission
VAT	Value Added Tax

CHAPTER 2

THE SOUTH AFRICAN BROILER INDUSTRY AS ACTION DOMAIN

2.1 INTRODUCTION

According to SAPA, the poultry industry was the largest segment of the South African agricultural sector in 2011, contributing 24% (R29,598 billion) to total value of agricultural production. The sector does not only contribute directly however, as it consumes approximately 30% of total maize consumption in South Africa through feed (SAPA, 2012a:8).

Broiler producers in South Africa have been under financial pressure for some time, as feed costs have increased significantly. As a net importer of chicken, the industry is integrated into international markets and prices are therefore expected to follow similar trends as the international market. While feed costs have increased by 157% in nominal terms from 2001 to 2012, the chicken price has been capped by the increased flow of cheaper imports. During the same period, chicken prices have increased by only 61% in nominal terms, which implies that the only mechanism for remaining economically sustainable was through efficiency gains, mainly in the form of improved feed conversion rates. As a result of the cost pressures, many smaller producers that do not have integrated feed producers and economies of scale benefits have been unable to stay in production, leading to even greater levels of concentration. High concentration levels in turn raises concerns of uncompetitive behaviour, as indicated by numerous enquiries from the Competition Commission.

The purpose of this chapter is to provide an understanding of the South African broiler industry that is necessary for the correct specification of a partial equilibrium model (De Beer, 2009:9) that is able to quantify the effect of low cost imports on the South African market and aid decision making regarding these imports. The structure of the industry, as well as the levels of concentration in the market are expected to have a substantial effect on price discovery in the market. In order to understand the true method of price discovery, the various actors within the industry must be identified and their actions and activities must be understood. The South African broiler industry is therefore be analysed as an action domain,

in order to identify the actors and activities across the entire broiler value chain. The attributes of these actors and activities will also be considered.

2.2 THE INTERNATIONAL BROILER MARKET

As South Africa is a net importer of broiler products, changes in the international broiler market will influence the South African broiler industry, making it essential to understand the functioning of the South African broiler market within the context of the international market (De Beer, 2009:10). A short review of the international broiler market is therefore provided in order to guide the understanding of the South African broiler market.

2.2.1 International broiler production and consumption

World production of broilers is dominated by three countries namely the United States of America (USA), Brazil and China. These three countries combined produced a total of 53% of total broiler production worldwide in 2011 (USDA, 2012:13). As indicated in Figure 2, production growth in the USA has been consistently slower than in China and generally slower than in Brazil, indicating a possible decline in global market share for the USA. Apart from 2009, Brazil showed rapid growth in production from 2005 to 2011. World production has increased by an average of 4.17% per annum from 2005 to 2011. Though the USA is still the leading broiler producer worldwide, there are signs that Brazil and China could challenge this position in the future, as production for both these countries is forecast to increase by 5% in 2012, while USA production is forecast to decline by 1% in 2012 (SAPA, 2012a:8).

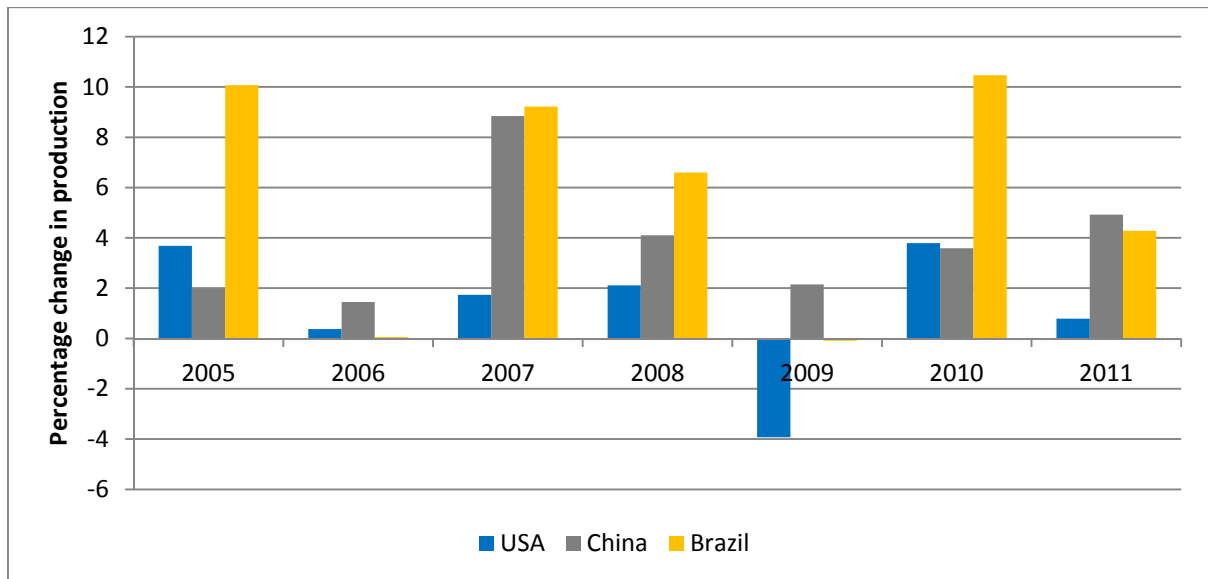


Figure 2: Annual percentage change in broiler production for the top three producing countries

Source: USDA (2012:13).

The upward trend in broiler production has been driven by increased chicken consumption worldwide. World consumption has grown at an average of 4.19% annually since 2005, as indicated in Figure 3. The greatest consumers in the world market are China, USA, Brazil and the European Union (EU). Figure 4 gives an indication that, while the consumption share of China and the EU has stayed relatively constant, the USA's share of world consumption has shown a gradual decline since 2005, while Brazil has shown a steady increase in consumption share, overtaking the EU as the third largest consumer in 2010. Broiler consumption in India has grown at an average of 5.72% per annum from 2005, indicating that it could become a major player in the future.

According to Louw *et al.* (2011:140), chicken consumption in China and the EU is dominant mainly due to population numbers, rather than high per capita consumption. Per capita consumption in China was only 9.1kg per year in 2009, compared to a per capita consumption of 42.6 kg per year in the USA in 2009 and 30.34 kg per year in South Africa in 2009.

According to the OECD-FAO outlook (2013), consumption growth in developing countries remains strong and is expected to drive the demand for meat products up further in the next decade, despite the fact that demand from developed countries seems to have reached saturated levels. World poultry consumption is expected to grow the quickest of all meat types, with demand increasing by 1.9% per annum over the next decade. This projected

growth rate is however slower than the past decade, leading to a slight decrease in prices for poultry products in 2014 and 2015, before increasing again marginally from 2016 onwards. South Africa is a relatively small player in the world market, contributing approximately 1.75% to world production and 2.1% to world consumption in 2011 (USDA, 2012:13).

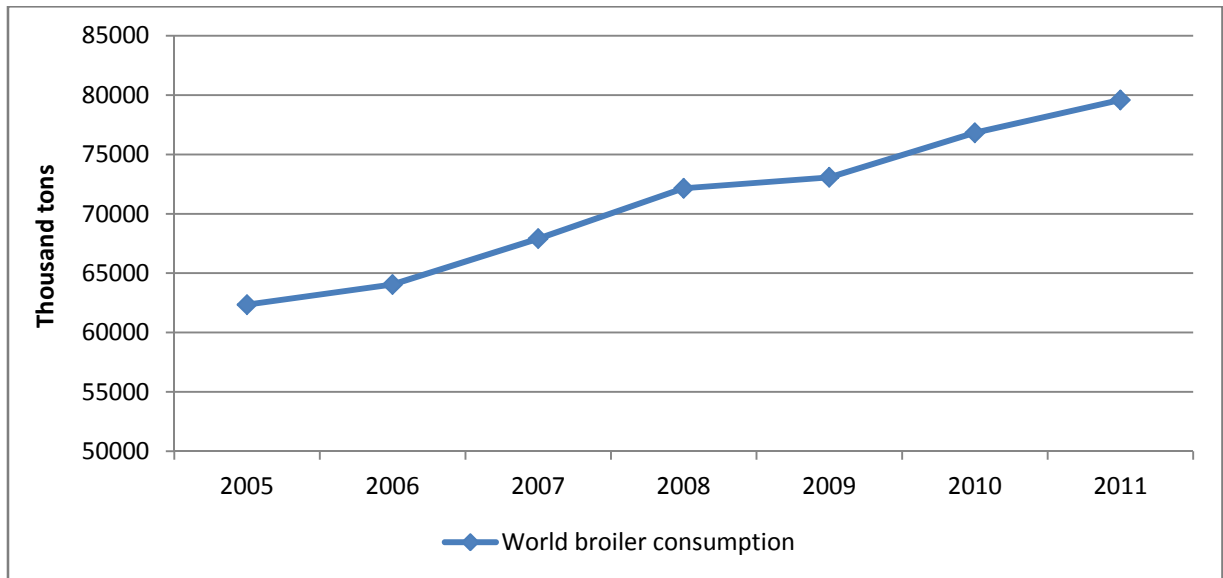


Figure 3: World chicken consumption: 2005 – 2011

Source: USDA (2012:13).

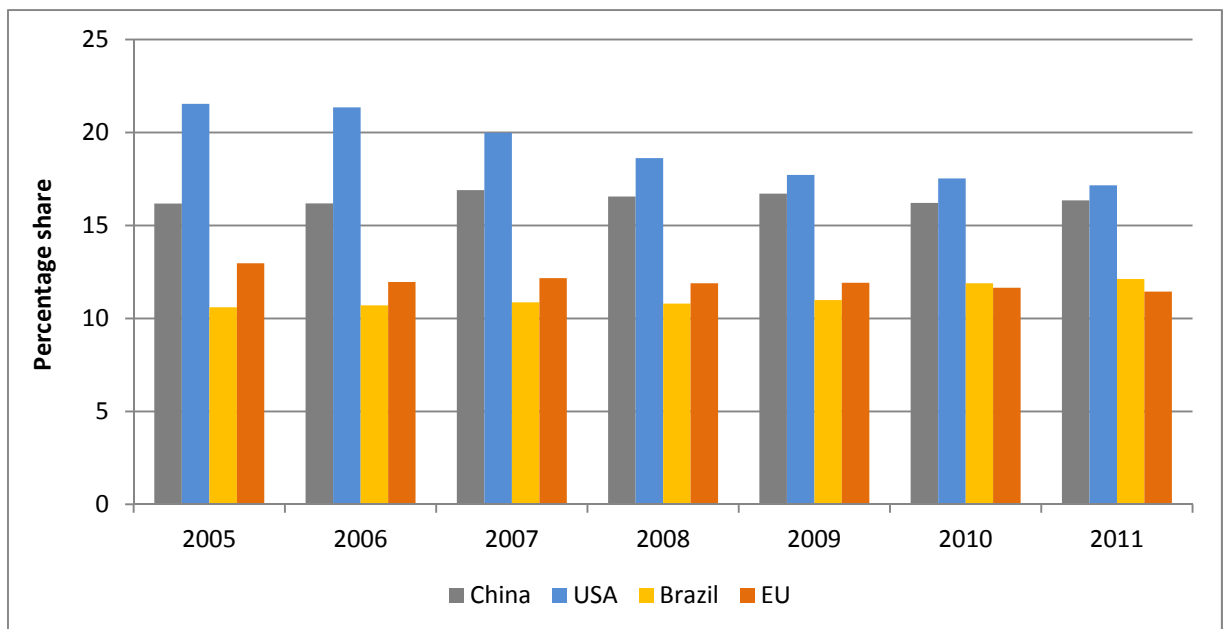


Figure 4: Annual consumption share of the top four chicken consumption countries

Source: USDA (2012:13).

2.2.2 International broiler trade and prices

Broiler trade worldwide has grown with the industry, with world exports reaching a total of 9.37 million tons in 2011, from 6.49 million tons in 2004 (USDA, 2012:14). Broiler exports are expected to reach 9.6 million tons in 2012 (SAPA, 2012a:8). Having overtaken the USA in 2010, Brazil remains the leading exporter worldwide, exporting a total of 3.22 million tons in 2011. Brazil and the USA exported 68.2% of the world total in 2011, clearly making these two countries the leading players in the world export market.

Imports are much more evenly spread amongst the top importing countries, with the leading importers being Japan, Saudi Arabia and the EU. SAPA (2012a:8) indicates that the middle-east will be the primary driver for export expansion in the future, due to anticipated economic growth as well as a rising population. Saudi Arabia and the United Arab Emirates feature in the top 10 importing nations as stated by the USDA already, supporting the plausibility of this statement. SAPA (2012a:8) also identified increased demand from emerging markets in Sub Saharan Africa as a driver of expanding exports. With a 32% increase in poultry meat imports from 2010 to 2011 (SAPA, 2012a:10), South Africa could well fall into this category.

As the USA remains the largest producer of broilers as well as the second largest exporter in the world, it can be assumed that the broiler price in the USA will have a significant effect on the world broiler price (Louw *et al.*, 2011:141). Though the broiler price in the USA is expected to increase by an average of 1.7% annually from 2010 to 2020 (FAPRI, 2011:123), farmers are still struggling to offset the high feed prices, leading to decreased profit margins.

2.3 THE SOUTH AFRICAN BROILER MARKET

As it is a relatively small player in the world market, the South African broiler industry has followed trends similar to that found in the world market. Due to its status as the most affordable source of animal protein, chicken meat consumption has grown rapidly over the past 10 years, driven mainly by increased per capita income, with an average growth rate of 7% per year for chicken consumption over the period from 2000 to 2010 (BFAP, 2011:31). Domestic production has not matched this growth, resulting in an increasing deficit in the

local market, as illustrated by Figure 5. The result has been a trend of increasing imports into South Africa.

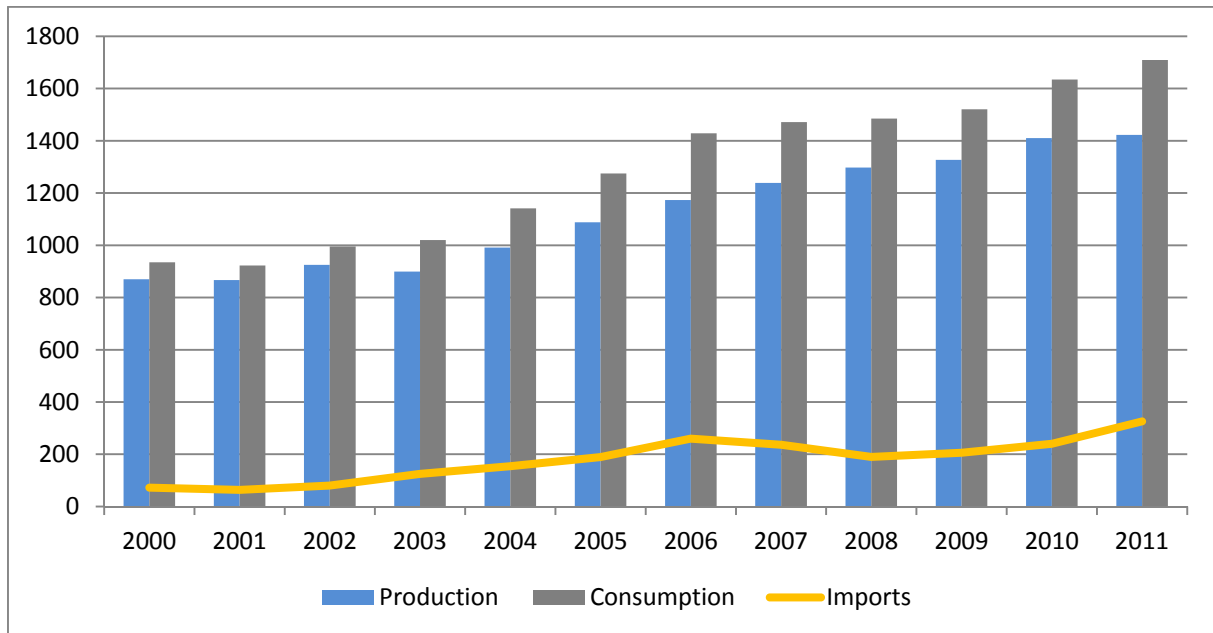


Figure 5: Production, consumption and imports of broiler meat by South Africa: 2000 – 2011
 Source: SAPA (2012c) & BFAP (2011)

In 2011 the South African industry produced 1.42 million tons of broiler meat, an increase of 0.8% from 2010 (SAPA, 2012c:1). This was despite an increase of 3.3% in per capita consumption from 2010 to 2011, indicating that increased consumption was met by imports, as opposed to increased domestic production. Production takes place across the country, but the main broiler producing provinces are North West, Mpumalanga, Western Cape and KwaZulu-Natal. The provincial distribution of broiler farms in South Africa is illustrated in Table 2.

Table 2: Provincial distribution of broiler production in South Africa

Region	Total broiler birds (million)	Percentage of national broiler production
Eastern Cape	6.980	6.36%
Free State	5.658	5.15%
Gauteng	6.863	6.25%
Kwa-Zulu Natal	16.125	14.69%
Limpopo	2.557	2.33%
Mpumalanga	21.603	19.68%
North West	27.169	24.74%
Western and Northern Cape	22.826	20.80%
TOTAL	109.781	100

Source: SAPA (2013:1-2).

Since 2008, domestic broiler prices in South Africa have been under pressure from cheaper imports as well as increasing and volatile feed prices. According to Louw *et al.* (2011:233) feed prices represent between 60% and 80% of input costs for broiler growers, a figure that was verified in interviews with key broiler producers in South Africa. BFAP (2013:47) has indicated that the chicken to maize price ratio remains a key indicator of potential profit within the industry. The chicken to maize price ratio from 2002 to 2022 (as estimated by BFAP) is illustrated in Figure 6.

The chicken to maize price ratio in Figure 6 clearly indicates that after a period of large profits from 2003 to 2005, profitability within the broiler industry has declined significantly. From 2009 to 2012 the ratio deteriorates to the lowest level in 10 years. In real terms, the broiler price has shown a steady decline from 2007 to 2010, before increasing only marginally in 2011. This is a trend that closely resembles that of the real import parity price for broiler meat imported from Brazil.

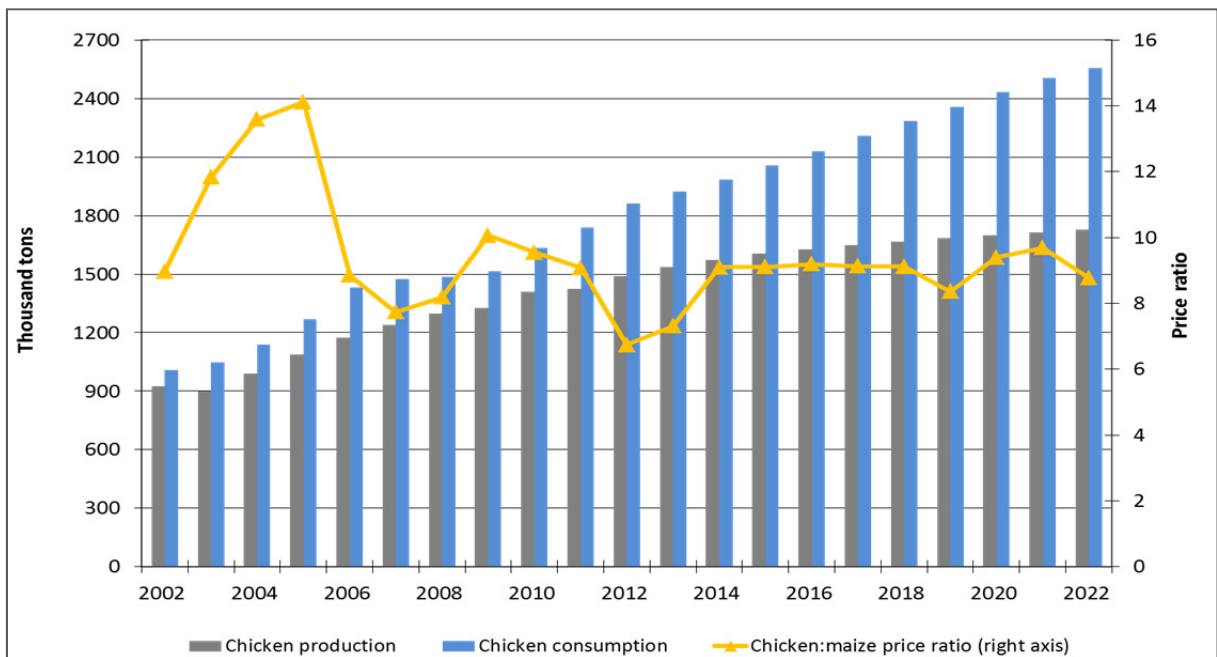


Figure 6: Broiler production, consumption and chicken to maize price ratio: 2002 – 2022
Source: BFAP (2013:47).

The trend of increasing imports indicated by the growing deficit between domestic production and consumption in Figure 6 has been a major concern for domestic broiler producers. South African producers have struggled to remain competitive against their Brazilian counterparts due to economies of scale benefits and more stable production costs as a result of ample feed

supply in Brazil (SAPA, 2011:13). The result has been that in 2010, South Africa imported 73% of its total poultry imports from Brazil (SAPA, 2011:35). This has been despite the fact that South African customs laws offer protection to domestic producers. The import parity price for whole birds imported from Brazil and Argentina has been below the domestic whole bird price for most of the past three years, as illustrated in Figure 7.

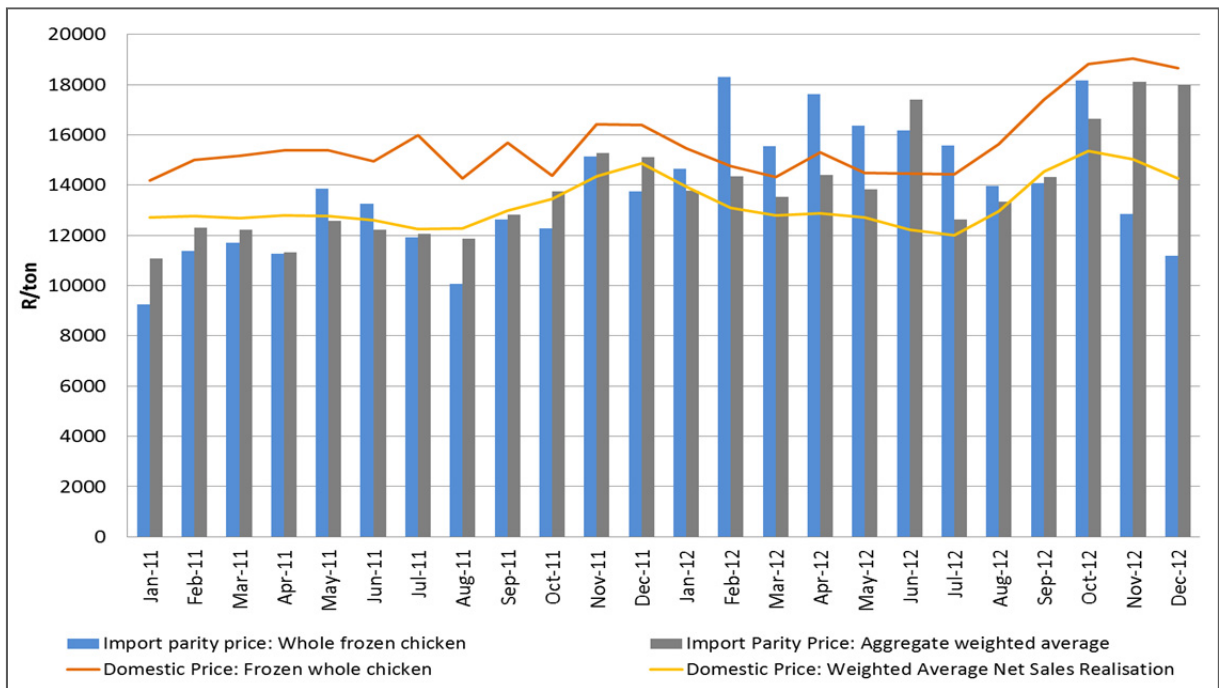


Figure 7: Broiler domestic price and import parity price comparison in South Africa

Source: BFAP (2013:52)

South Africa applies import tariffs based on the Harmonised System eight digit classification codes. These import tariffs are indicated in Table 3. In addition to the tariffs indicated in Table 3, South Africa applies anti-dumping tariffs for frozen bone in portions (including leg quarters) originating from the USA. Anti-dumping tariffs for boneless cuts and frozen whole birds originating from Brazil were instituted provisionally for six months from February to August in 2012, while the investigation by the International Trade Administration Commission of South Africa (ITAC) was completed (ITAC, 2012a:41). Upon completion of the investigation by ITAC, the Dti in South Africa did not institute anti-dumping tariffs further. In the period from February 2012 to July 2012, the import parity price for whole birds moved above the domestic price however, as indicated in Figure 7. Due to free-trade agreements, the applied tariffs for the EU and Southern African Development Community (SADC) are different.

Table 3: Import tariffs for chicken meat products applied by South Africa

HS Classification Code	Description	General Tariff	EU Tariff	SADC Tariff
02071100	Fowls, not cut in pieces, fresh or chilled	0%	0%	0%
02071210	Fowls, not cut in pieces, frozen, mechanically deboned	0%	0%	0%
02071220	Fowls, not cut in pieces, frozen, carcass with cuts removed	27%	0%	0%
02071290	Fowls, not cut in pieces, frozen, other	27%	0%	0%
02071290	Fowls, not cut in pieces, frozen, other	Provisional anti-dumping payments: Products produced in and imported from Brazil: 62.93% (Only applied from February to August 2012)		
02071300	Fowls, cuts and offal, fresh or chilled	0%	0%	0%
02071410	Fowls, cuts and offal, frozen, boneless cuts	5%	0%	0%
02071410	Fowls, cuts and offal, frozen, boneless cuts produced and exported by Aurora Alimentos Brazil	Provisional anti-dumping tariff on products produced by and exported by Aurora Alimentos in Brazil: 6.26% (Only applied from February to August 2012)		
02071420	Fowls, cuts and offal, frozen, offal	27%	0%	0%
02071490	Fowls, cuts and offal, frozen, other	220c/kg	0%	0%
02071490	Fowls, cuts and offal, frozen, other originating and imported from USA	Anti-dumping tariffs on products originating from the USA: 940c/kg		

Source: SARS (2013:8).

Historically, imports have originated from Brazil and Argentina, who have a strong comparative advantage in producing chicken due to relatively cheaper feed production costs and their status as net exporters of maize and soya cake. In the past two years however, the EU has come to the fore as a major player when the origin of imported chicken is concerned. The change in market share of partnering countries in the origin of South African imports is indicated in Figure 8. Due to a change in import tariff classification codes in 2009, the composition of imports is shown only for 2010 to 2012.

While Brazil was the origin of 75% of South African imports in 2010, only 40% of imports originated in Brazil in 2012. The share of imports originating from the EU has increased from 5% in 2010 to 46.95% in 2012. This represents an increase from 12.29 thousand tons in 2010 to 137.51 thousand tons in 2012. The change in patterns concerning the country of origin is of great importance, as imports from the EU are currently duty free under the Trade Development and Cooperation Agreement (TDCA).

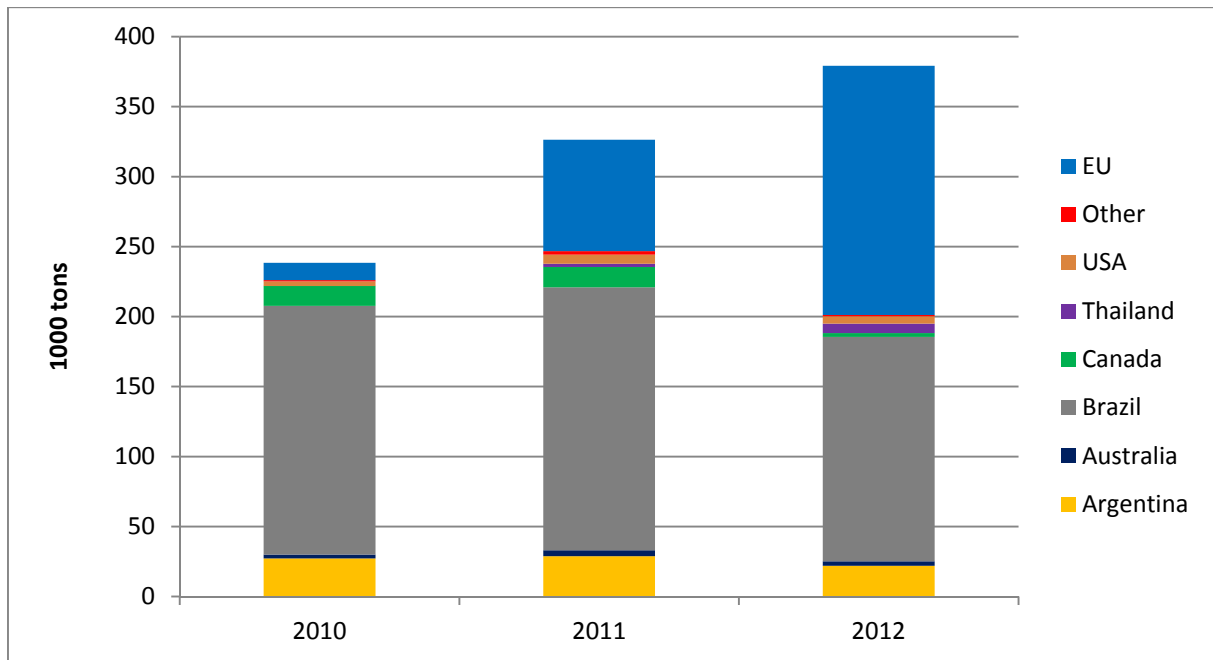


Figure 8: Origin of South African chicken imports: 2010-2012

Source: Trademap (2013c)

SAPA (2011:13) has identified potential exports as a window of opportunity; however these exports still have to compete with countries like Brazil, with substantially lower production costs. An increase of 143% in South African broiler exports from 2010 to 2011 does however indicate that this could be a potential market for South African producers to exploit, however the increase is from a very small base, making it still an insignificant part of the South African broiler market.

2.4 STRUCTURE OF THE SOUTH AFRICAN BROILER SUPPLY CHAIN

Technology within the broiler industry has improved to the extent that commercial growers produce mature birds from day old chicks in a cycle of 35 days. Though this cycle may be extremely short, the complete biological cycle in order to increase production from grandparent level takes approximately 18 months, as indicated by Figure 9.

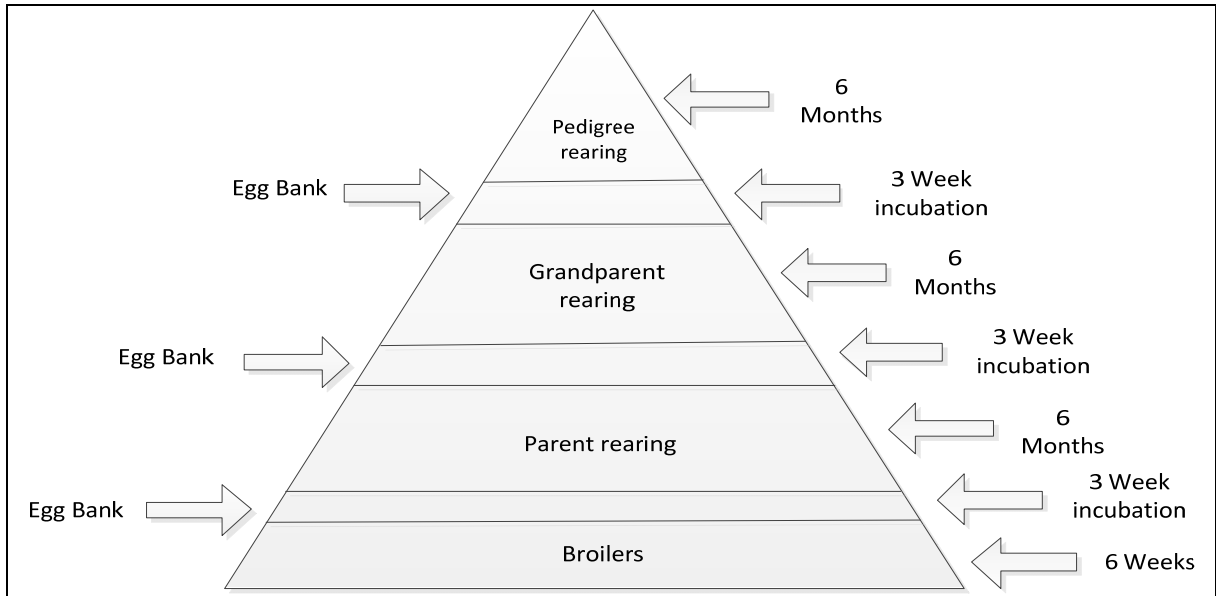


Figure 9: Broiler meat production process

Source: SAPA (2011:20)

Due to the integrated nature of the industry, the South African broiler supply chain is best understood when represented as individual supply chains for major holding companies. Figure 10 however represents an overview of the structure of the industry, before individual holding companies are discussed separately as part of the main actors within the industry in section 2.6.

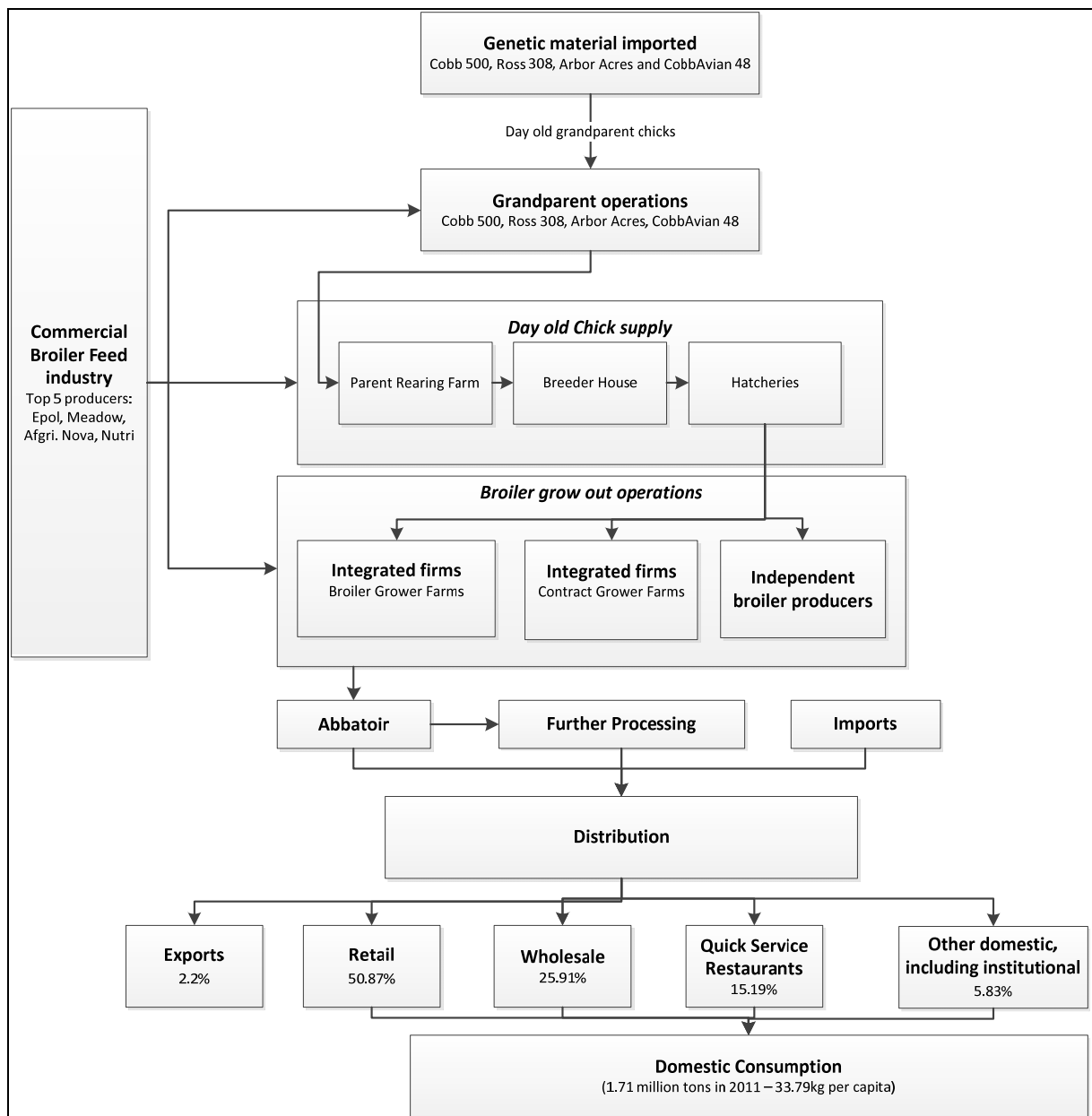


Figure 10: Diagrammatic representation of a generic broiler supply chain in South Africa
Source: DAFF (2010:33) & SAPA (2011)

2.4.1 Primary breeder flock

The first stage of broiler supply is represented by the primary breeder flock. According to SAPA (2011:19) broiler breeders are imported into South Africa at great grandparent or grandparent level, as no commercial level day old chicks or fertile eggs may be imported. These birds are imported as day-old chicks before being raised on breeder farms around South Africa. Bio-security is of vital importance and as a result, many integrated producers raise grandparent stock in different areas than parent stock. Broilers are bred for fast growth and

performance and so breeders must be raised carefully according to set standards for each breed in order to ensure optimum performance upon entering production.

Independent producers in the South African industry choose genetics from various lines or breeds, including Cobb500, Ross308, Ross788, Arbor Acres and CobbAvian48. Importing the primary breeder flock ensures that the South African industry remains competitive with the rest of the world in terms of genetic potential, but as most of the primary breeders have sole supply rights for their respective breeds in South Africa, the barriers to entry are substantial, leading to a concentrated market. As all suppliers of genetic stock are integrated into a holding company to some extent, numbers and quality sold to independent producers or competitors could easily be controlled. As a result, most major producers use only a single breed, leaving the market for parent stock highly concentrated. Barriers to entry at this stage of the supply chain are significant. Apart from exclusive rights pertaining to the distribution of specific breeds in South Africa, costs of establishment and needed facilities are important considerations. Importing pure lines requires quarantine facilities, as all imports must be quarantined for 8 weeks from day old chicks.

The breeds used in South Africa are also successful worldwide, with the Cobb500 being the breed of choice for Tyson Foods, the largest producer in the USA. Though many successful breeds internationally have also been successful in South Africa, international success does not necessarily mean that the breed could be adopted successfully in South Africa. Many of South Africa's broiler growers produce at altitude, which has led to the successful introduction of the Ross788 breed, specifically selected for its performance at altitude. The South African poultry association estimated the primary breeder flock to consist of around 400 000 birds in 2010.

2.4.2 Parent stock

A constant supply of high quality pullets is crucial to the success of the broiler industry. Primary breeders supply day old birds to be raised on the pullet farm before these pullets are moved to the breeder house shortly before they start producing. Most birds will remain in production for approximately 40 weeks. As modern broilers are bred for improved feed conversion and rapid growth, controlling the mass of pullets and eventual parent females is critical in order to prevent dramatic losses in fertile egg numbers.

The parent flock of the South African broiler industry consisted of approximately 6.52 billion female parents in 2011, producing an estimated commercial progeny of 1.036 billion chicks for the broiler industry. Breeder placement numbers since 2000 are indicated in Figure 11, clearly illustrating the growth in the industry from 2003 – 2008, a period during which the rapid growth in per capita GDP in South Africa drove strong consumption growth and the chicken to maize price ratio was high, resulting in rapid expansion of production. In 2009, a decreased chicken to maize price ratio and weak economy lead to a very small increase in broiler breeder placements.

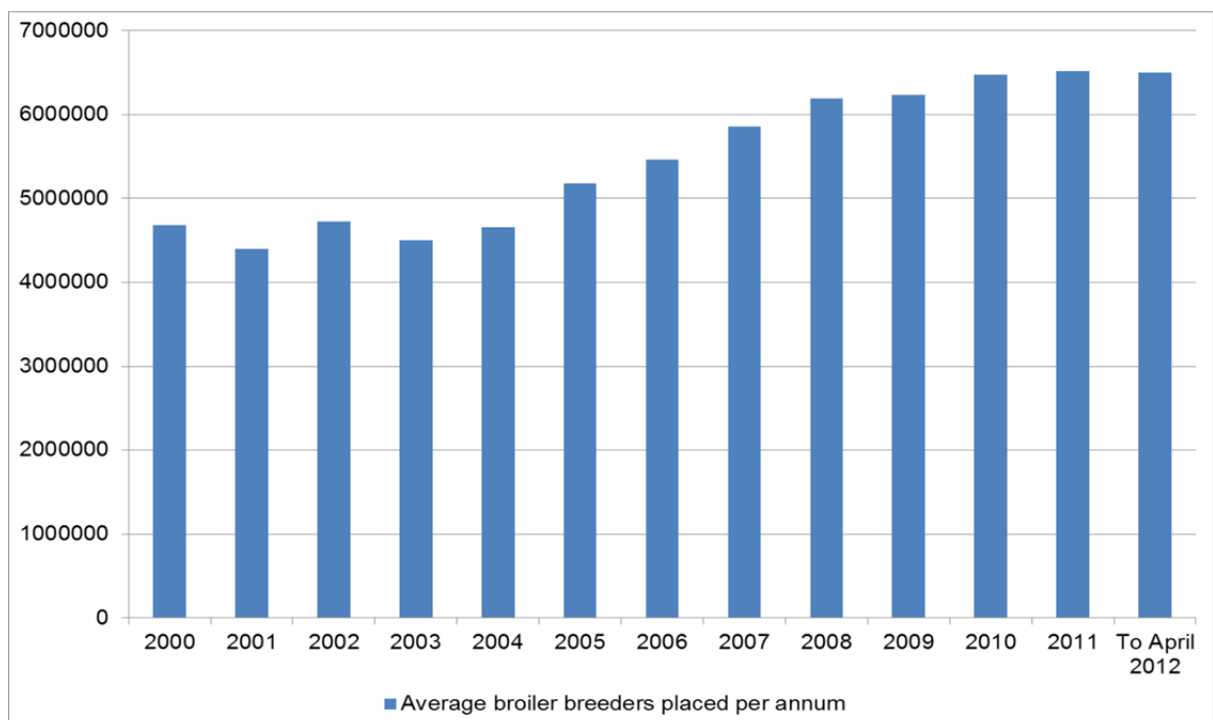


Figure 11: Average broiler breeders placed per annum

Source: SAPA (2012c:14)

According to SAPA (2012c:14), statistics show a steady increase in the potential availability of broiler chicks in South Africa. Figures based on parent stock placed indicate that a substantial oversupply of commercial day old chicks is possible; indicating that in excess of 20.1 million day old chicks could potentially be placed per week. During 2011, an average of 19.86 million commercial broiler chicks was placed per week. This would indicate that domestic expansion is possible in order to meet increased consumption, should cheaper imports be contained.

2.4.3 Broiler farm

In terms of the broiler farm, three types of growers can be identified namely contract growers, independent growers and direct growers (Louw *et al.*, 2011:226). Contract growers grow birds on their own farms and deliver to a specific company, while direct growers grow for a holding company on the company farms. Independent growers have no obligation to deliver to anybody and can source their own feed from various suppliers, but at the same time have no guarantees in terms of selling the product. This is the only stage of the broiler supply chain that is not fully integrated into the holding companies in the market. The reasons for this are discussed in Chapter 3.

Technically, South African growers are very efficient compared to international producers, yet when costs are introduced, they are generally found wanting in terms of world standards. Production standards for the Arbor Acres breed suggest that the feed conversion ratio at 35 days, the average production period in South Africa, should be 1.594 (Aviagen, 2012). SAPA indicates that the feed conversion ratio in South Africa was 1.66, while Louw *et al.* (2011:237) suggested that the feed conversion ratio for farmers in their sample averaged 1.65, while the National Chicken Council in the USA report that feed conversion ratios in the USA in 2011 were approximately 1.91, compared to the Arbor Acres standard of 1.837 at 45 days. This is a deviation from the breed standard of 3.9% in the USA and 3.5% in South Africa. A comparison to the Ross308 performance objectives yields similar results. Cobb suggests that the performance data from the Cobb500 worldwide provides a feed conversion ratio of 1.78 at an average slaughter age of 37.8 days in South Africa, compared to a feed conversion ratio of 1.87 in 43.9 days in Brazil and a feed conversion ratio of 1.9 in 45.8 days in the USA (Cobb Vantress, 2012). This is another indication that the feed conversion ratios in South Africa are comparable to those achieved in the most efficient broiler producing countries worldwide.

Mortality rates should also be considered when comparing broiler growers' efficiency. Louw *et al.* (2011:239) suggested a mortality rate of 5.3% in 2010 for the growers in their sample, while the National Chicken Commission suggested a mortality rate of 4% in the USA in 2010. SAPA indicates that mortality rates of South African producers are between 4 and 6 %. A universal measure of broiler efficiency is the production efficiency factor, which is calculated using the feed conversion ratio achieved, days fed and mortality rate of each producer (Louw *et al.*, 2011:239). SAPA indicates that the production efficiency factor in South Africa was

292 in 2010, compared to worldwide production efficiency factors of between 270 and 300, with the difference being attributed to disease pressure and high altitude production systems. Louw *et al.* (2011:238) estimated the production efficiency factor of the producers in their sample to be 283, which is well within the range of world producers. In 2012, SAPA presented results of a benchmark in production efficiency between South Africa, Brazil and the USA, the results of which clearly indicate that South African producers are technically efficient. The results are presented in Table 4 below.

Table 4: Broiler efficiency benchmark: 2011

Efficiency Measure	Unit	Brazil	USA	RSA
Age	days	35	35	35
Live Weight	kg	1.88	1.81	1.84
Average daily gain	g/day	53.81	51.59	52.56
Mortality	%	3.14	2.37	4.52
Feed Conversion Ratio		1.66	1.80	1.67
Performance Efficiency Factor		314	280	301

Source: Lovell (2012).

Considering the fact that technical efficiency of South African growers is comparable to some of the top broiler producing countries, South African producers should be able to hold their own against competition from South America, yet the import parity price calculated by BFAP (2013:47) is significantly below the domestic price, suggesting that upon introduction of the costs of production, South African producers no longer compete that well. The US International Trade Commission (2012:8.11) in fact state that ‘Despite rising feed costs, Brazil and the United States are the most efficient and lowest-cost broiler producers in the world, giving both countries a competitive advantage against producers in third-country markets.’ Based on July 2011 data, the cost per kg of producing a live bird in Brazil was between 1.05 and 1.19 US dollars, depending on the production region, while in the USA, production costs per kg live bird was approximately 1.01 US dollars (US International Trade Commission, 2012:8.11). In South Africa, SAPA estimate the production cost per kg live bird to be between 1.28 and 1.38 US dollars. Cost of production in South Africa is therefore clearly higher than in the USA and Brazil. Louw *et al.* (2011:233) identified the quality, consistency and cost of feed as the major contributing input and one of the major challenges facing South African producers. In addition, contract producers are provided with feed and day old chicks and therefore have no control or choice regarding the quality or price of these

essential inputs. In addition to high feed costs, costs and availability of other key inputs like electricity and labour were further identified as challenges.

2.4.4 Feed supply

Feed is arguably the most important input to the broiler producer. Louw *et al.* (2011:233) estimate that at least 70% of a broiler grower's input costs consists of feed costs and as a result, good quality feed at stable prices is crucial to successful broiler production. Feed costs over the past 5 years have however been highly volatile, mainly due to the volatile nature of raw material prices. Higher feed costs can be regarded as one of the main reasons for South African producers' lack of competitiveness with their South American counterparts (SAPA, 2011:35). Higher feed costs can be attributed to higher raw material costs. Maize and soya contribute the bulk of raw materials for broiler feed and as a result, prices of maize and soya have the greatest influence on the cost of broiler feed. Brazil, Argentina and USA are net exporters of both these products (Trademap, 2013b), ensuring ample supply at competitive prices. South Africa on the other hand deals with extreme volatility in yields, with the maize price fluctuating between import and export parity levels. Despite increased production over the past decade, South Africa remains a net importer of Soya cake and as a result, prices are affected by a volatile exchange rate, as well as South American trade policies, such as the export taxes of 32% imposed on Argentinian oilcake. Over the past 5 years, 99% of South African oilcake imports originated from Argentina (Trademap, 2013d) and as a result the Freight on Board (FOB) price for South African buyers of Argentinean Soymeal will be higher than the domestic price in Argentina. The difference in soya oilcake prices in Brazil and South Africa are illustrated in US dollar terms in Figure 12. It is evident that South African prices are significantly higher, especially in the last few years.

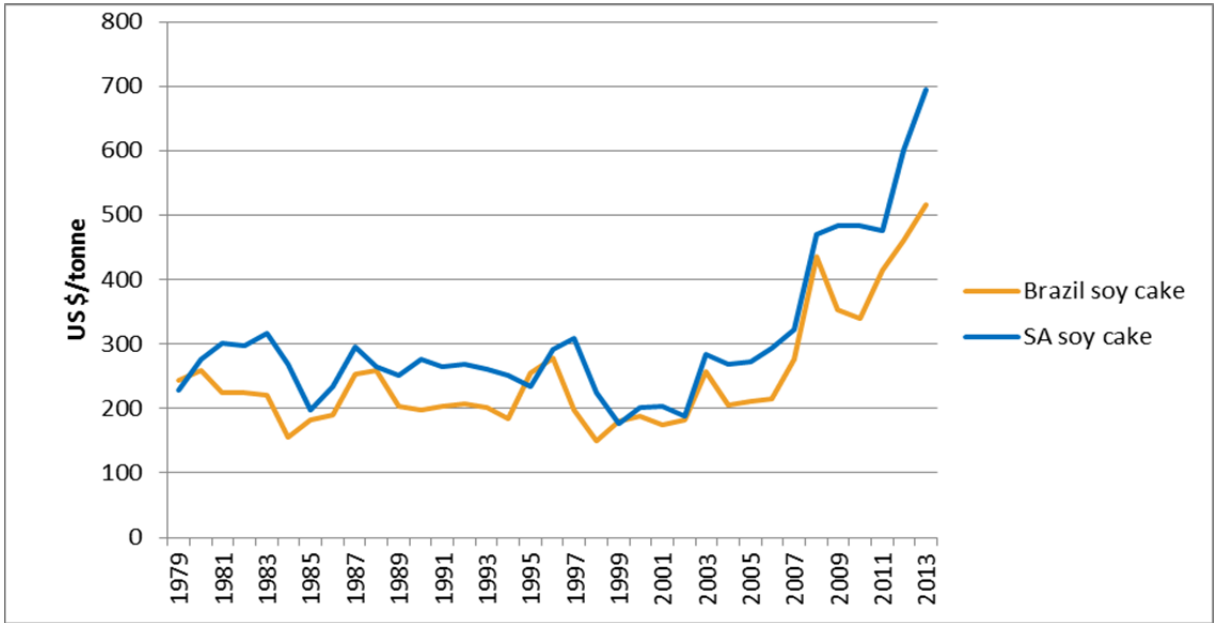


Figure 12: Soybean cake price comparison in South Africa and Brazil
 Source: BFAP (2013:131).

Figure 13 indicates South African production, consumption and imports of Soya Cake for the past 12 years. Imports are clearly declining, but BFAP projects that SA will remain a net importer of Soya Cake for the next decade and as long as this remains the case, domestic prices will be led by import parity prices (Meyer, 2006:51), leading to expensive ingredients for South African poultry feed.

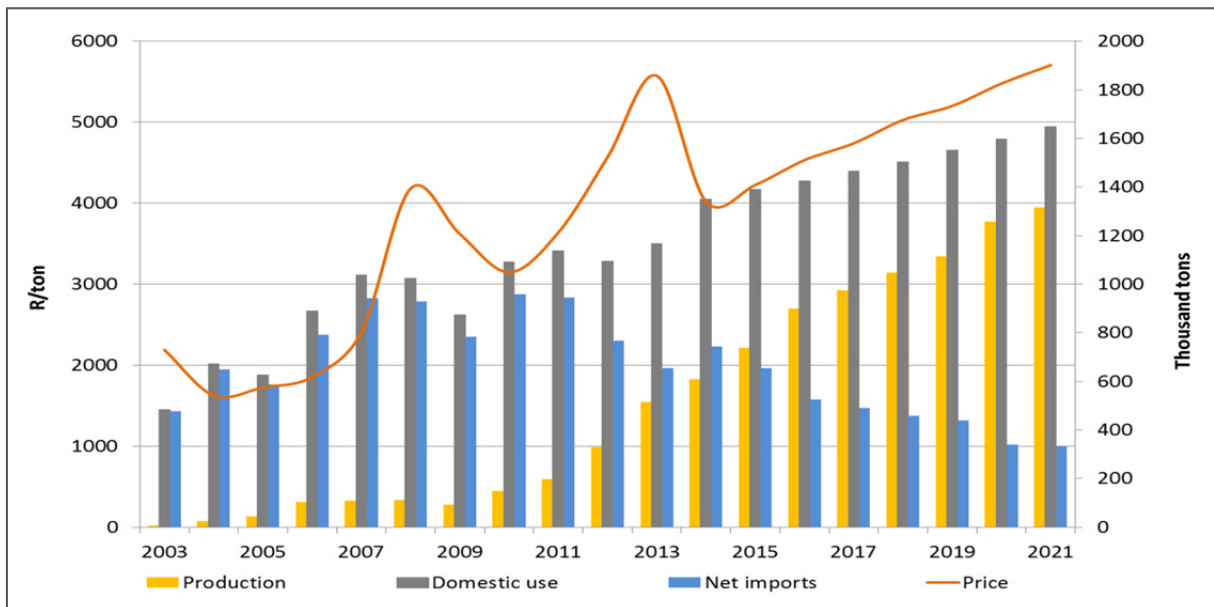


Figure 13: Soybean cake production, consumption, trade and prices in South Africa
 Source: BFAP (2013:41).

Feed suppliers are linked into various parts of the poultry supply chain, supplying breeder rations to breeders and various rations for different growth stages of broiler production. The National Agricultural Marketing Council (NAMC) (2007:2) indicated that many of these large producers are vertically integrated with poultry feed businesses, a fact that is also stated by Louw *et al.* (2011:160-164). Epol Feeds is a division of Rainbow Chicken Ltd., Meadow Feeds is a division of Astral Foods and Nutri Feeds is a division of Country Bird Holdings. As it comprises the biggest share of input costs, feed quality and price is essential to the broiler grower. The fact that growers are supplied feed by the holding company that they produce for places a significant limitation on the bargaining power and quality choice of the producer.

With feed cost increases greatly outpacing broiler price increases in the past decade, improved efficiency has been the only way for broiler producers to remain competitive in the market, with feed conversion ratios in South Africa improving by an average of 1.14% per annum over the past decade.

2.4.5 Processing

In the commercial broiler supply chain in South Africa, processors consist mainly of subsidiaries or divisions within holding companies. Mature broilers are either supplied within the company structure, or by independent growers contracted to the holding companies. Slaughtering and further processing are then handled by these companies. Chicken is sold fresh, frozen or in further processed form. Individually quick frozen pieces make up the bulk of the market, comprising 65.13% of the domestic market in 2010 (SAPA, 2011:8).

The different varieties of chicken are marketed into various channels, mostly at wholesale or retail level or alternatively to foodservices or institutions like mines or hospitals. In 2011, 52% of sales were at retail level, followed by 25% at wholesale level and 15% to foodservice providers (Figure 10). Though a price is quoted at wholesale and retail level, the price received by the farmer is not stated. This is mainly due to the fact that the farmer receives a price from which the price of key inputs supplied to him has been subtracted, in effect being paid for his services in raising the broilers. The determination of the price paid to the grower as stated in the growing contract, will be discussed in Chapter 3.

2.5 CONCENTRATION WITHIN THE INDUSTRY

The South African broiler industry is not only a complex supply chain; it also exhibits high levels of coordination and integration (Louw *et al.*, 2011:262). Investigations by the Competition Commission, such as those initiated in 2009 against Rainbow Chicken Ltd., Astral Foods, Pioneer Foods, Country Bird Holdings and Afgri Poultry have raised concern regarding market concentration in the South African broiler industry. In 2010, DAFF estimated the number of broiler producers in South Africa as 404, of which 199 are producers that are integrated into large holding companies and 205 are contract growers contracted to these integrated companies. The 2 largest producers (Rainbow Chicken Ltd. and Astral Foods) account for just under 50% of total production, while 5 medium sized producers account for a further 30.74%. Market shares of the larger commercial broiler producers are indicated in Table 5. Not added into this table is the market share of imports, which was 19% of consumption in 2011, placing it third on the list of market shares, behind Rainbow Chicken and Astral Foods.

Table 5: Market Share of large commercial chicken producers in South Africa

Producer	% Market Share
Rainbow Chicken Ltd.	25.04
Astral Foods	22.45
Country Bird Holdings	7.99
Tydstroom Poultry (Pioneer Foods)	6.39
Afgri Poultry	5.97
Chubby Chick	5.86
Sovereign Foods	4.53
Others	21.77

Source: SAPA (2012c), Rainbow Chicken Ltd. (2012), Astral Foods (2012), Pioneer Foods (2012) & Afgri (2012).

From the information in Table 5, it is clear that the South African broiler market is highly concentrated, which leads to questions regarding competitive conduct within the industry, as 7 companies produce close to 80% of total production. Several investigations by the Competition Commission have also questioned the competitive conduct within the industry.

In an industry where barriers to entry are significant and economies of scale combined with vertically integrated supply chains ensure a significant comparative advantage to larger producers, a high level of concentration does not necessarily point to uncompetitive

behaviour; however, integration could also be due to the significant decrease in cost of production in an industry where margins are small. Concentration would then simply be a symptom of increased vertical integration.

2.6 KEY ACTORS IN THE SOUTH AFRICAN BROILER SUPPLY CHAIN

The South African broiler supply chain discussed in section 2.5 is clearly complex, with different actors and activities at various stages of this supply chain. Various institutional arrangements are found at different stages of the supply chain, which will be detailed in Chapter 3. Identification of the actors in this action domain is important, as these actors can be seen as the main ‘players’ in the industry. Understanding the attributes and activities of these actors is important in order to gain an understanding of how the industry functions in reality and how prices are actually formed. This section will serve to identify these actors and provide an overview of the attributes and activities of the different actors in the South African broiler market.

Arguably the most prominent actors in the South African broiler industry are the integrated holding companies that control most of the supply chain. In an industry that exhibits high levels of concentration, such as the South African broiler industry, the attributes and activities of the major players have a significant impact on the industry as a whole. The two biggest players in the South African broiler industry have been identified as Rainbow Chicken and Astral Foods. Together, these two integrated companies produce almost 50% of commercial broilers in South Africa. This value has declined however from the 2005 values, where the combined market share of the two largest integrated companies was estimated as 63% (DAFF, 2010:9; NAMC, 2007:2).

2.6.1 Rainbow Chicken Ltd

Rainbow Chicken Ltd. is a fully integrated broiler producer, breeding and rearing its own chickens and feeding these chickens from its own feed mills (Epol Feeds). Rainbow Chicken Ltd. also processes, distributes and markets its own fresh, frozen and value added chicken as the largest processor and marketer of chicken in South Africa (Rainbow Chicken Ltd., 2012:2). Figure 14 presents a diagrammatic representation of Rainbow Chicken’s operations.

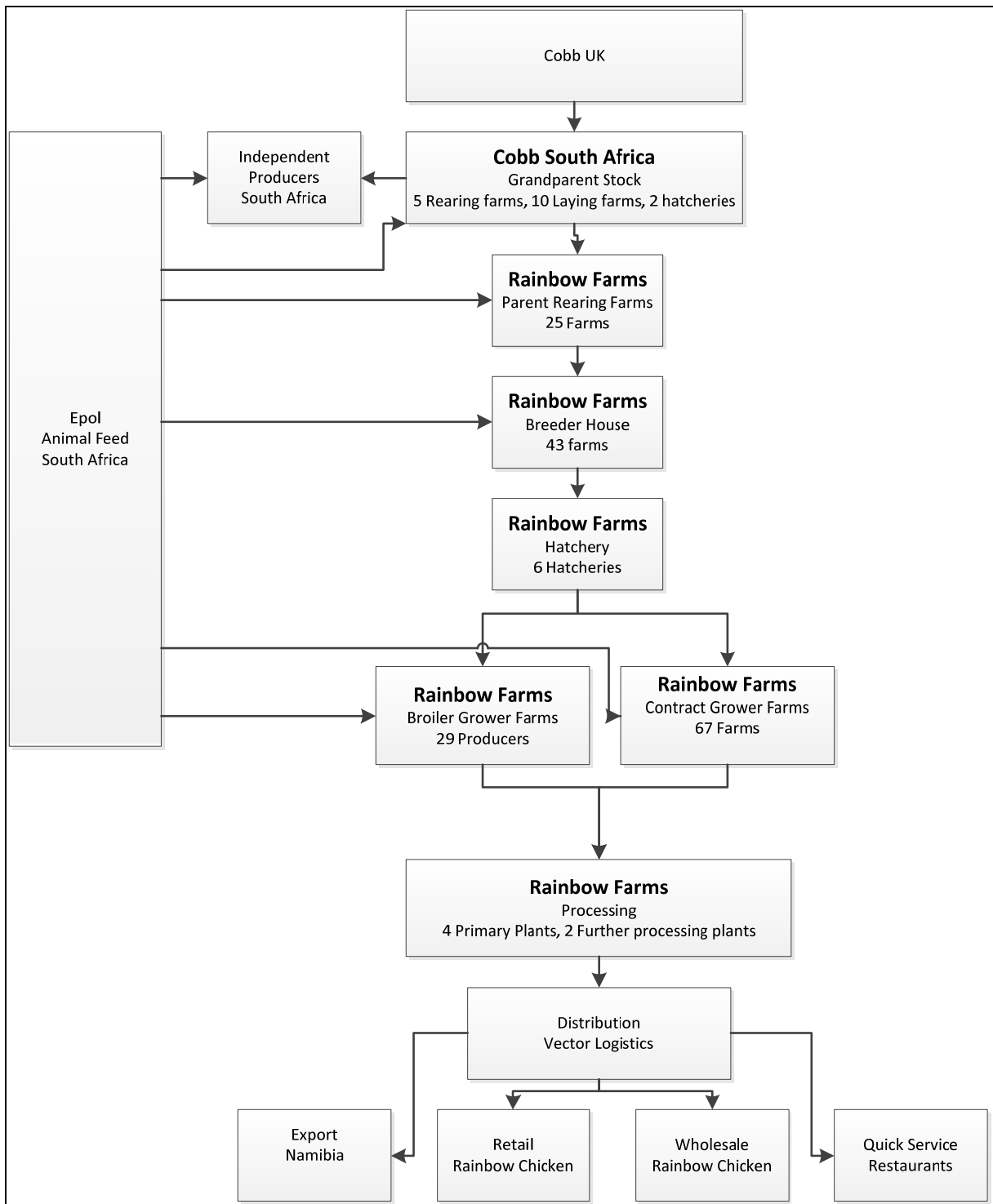


Figure 14: Diagrammatic representation of Rainbow Chicken Ltd’s poultry operations
 Source: Rainbow Chicken Ltd. (2012).

Rainbow Chicken’s grandparent operations are handled by Cobb South Africa. Cobb South Africa has exclusive rights to the distribution of Cobb 500 genetic stock in South Africa. Pure line day old chicks are imported from Cobb Europe and raised on five different farms located in Carolina and East London. The Cobb breed is the oldest pedigree broiler bird in the world

and is wholly owned and used by Tyson Foods in the USA. Cobb SA further has ten laying farms and two hatcheries that are used to produce parent stock for both Rainbow Farms and other independent hatcheries, who will ultimately supply day old chicks to independent broiler growers.

Rainbow Farms comprises both parent farms and broiler farms located around South Africa. Production areas are centralised in the North West province around Rustenburg, in KwaZulu-Natal between Pietermaritzburg and Durban and in Cape Town in the Western Cape. Day old parent chicks supplied by Cobb SA are raised for 21 weeks on 25 different rearing farms, before being transferred to 43 different laying farms for a laying cycle of approximately 40 weeks. Eggs are hatched in one of six different hatcheries over a three week period. Day old chicks produced are delivered to various grower farms, some owned by Rainbow and others owned by contract farmers who grow the chicks out to maturity over a period of 34 days.

Grandparent, parent and grower operations are provided with feed rations specialised to the specific period of production by Epol Feeds, a subsidiary of Rainbow Chicken. Epol Feeds utilises five feed mills located in the North West province, KwaZulu-Natal, East London and Cape Town. These five mills have the capacity to produce 20 600 tons of feed per week. Of the feed produced, approximately 80% is used by Rainbow Chicken, with the balance being sold to independent producers.

Processing of chicken is also handled as part of Rainbow Chicken's integrated operations. Four primary processing plants slaughter 4.7 million birds per week and are situated in Limpopo, North West, KwaZulu-Natal and the Western Cape. Further processing and value adding is handled by two plants in the Northern production region and in KwaZulu-Natal. These further processing plants have the capacity to produce 27 thousand tons per week.

Distribution is handled by Vector Logistics, a division of Rainbow Chicken Ltd. Distribution facilities include four plant based cold storage facilities, along with 15 distribution sites located across South Africa as well as in Windhoek in Namibia. 163 thousand cases are delivered daily by a fleet of 410 vehicles.

The Rainbow Chicken value chain produces two main sets of products, traditional, mainstream chicken, as well as value added chicken. Value added products have increased

from a contribution of 30% to total revenue in 2004, to a contribution of 53% to total revenue in 2012. This is one way in which the entire integrated value chain of Rainbow Chicken has been able to deal with the continued threat of low-cost imports from South America.

2.6.2 Astral Foods

Astral Foods was listed on the Johannesburg Stock Exchange (JSE) in 2001, after being established from Tiger Brands' unbundled agricultural operations. According to its annual report of 2011, Astral Poultry (the poultry division within Astral Foods) has the capacity to slaughter 4.215 million broilers per week, making it the second largest broiler producing company in South Africa. As broiler producers, Astral Foods have several subsidiary companies that form an integrated supply chain for broiler production. In addition to its poultry concerns, Astral also produces feed and feed premixes for the Southern African market. Astral's operations are strategically located throughout Southern Africa, with poultry operations in South Africa, Swaziland and Zambia and feed mills in South Africa, Mozambique and Zambia. A diagrammatic representation of the structure of Astral Food's poultry supply chain is presented in Figure 15.

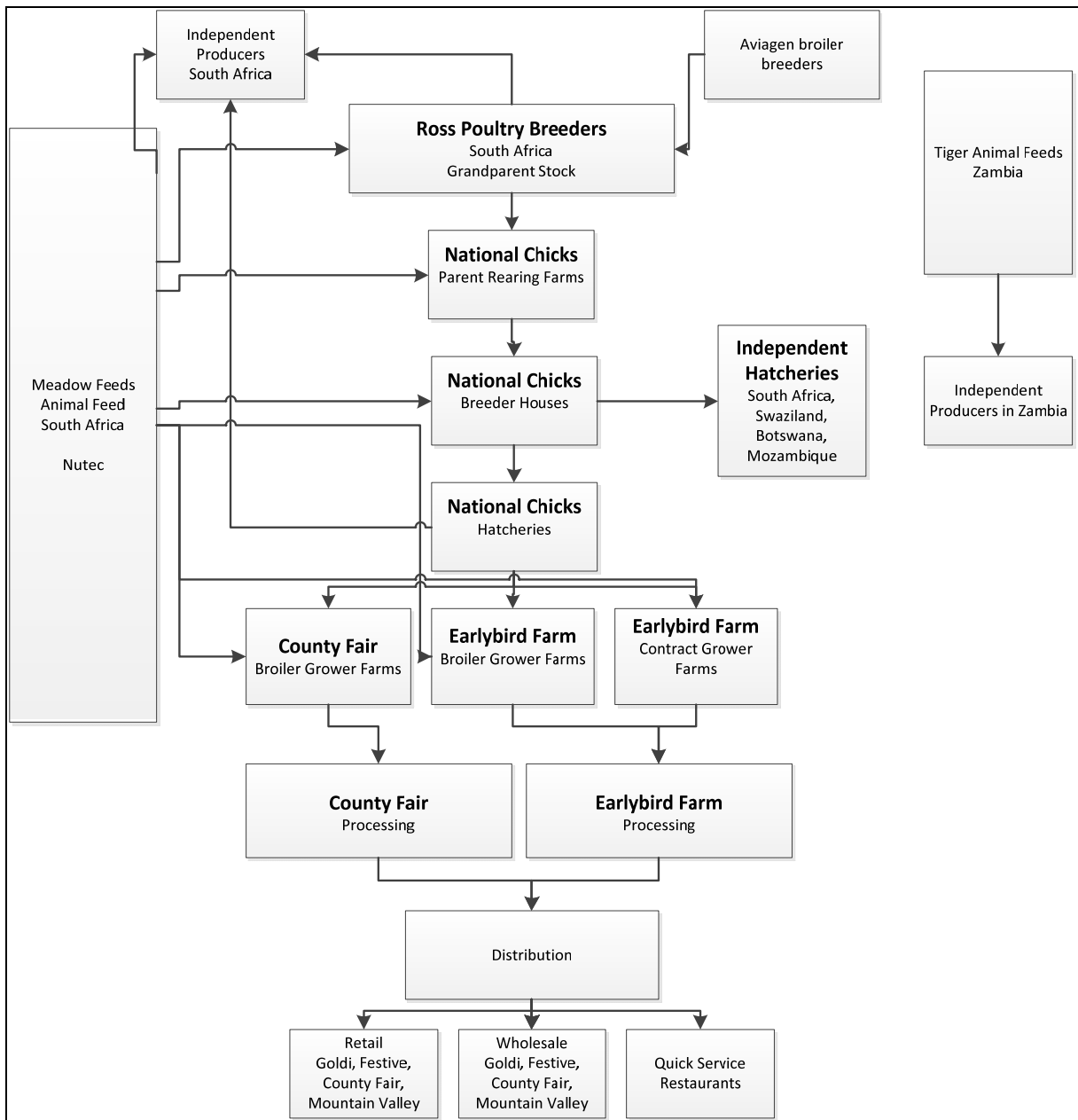


Figure 15: Diagrammatic representation of Astral Foods’ poultry operations

Source: Astral Foods (2012).

Ross Poultry Breeders, a subsidiary owned by Astral Foods, is the sole distributor and supplier of Ross308 parent stock to the South African poultry industry. Ross Poultry Breeders supply day old parent stock to Astral subsidiary National Chicks, as well as independent producers, the largest of which is Eagles Pride Hatchery. Ross Poultry Breeders rear approximately 1.1 million pullets per breeding cycle. After 22 weeks of rearing, the birds will enter the layer house, where they lay roughly 2 million fertile eggs in a breeding cycle of 40 weeks (Astral Foods, 2012:5-7).

National chicks, a subsidiary owned by Astral Foods, is a supplier of both day old chicks and fertilised eggs to Astral Poultry's integrated broiler operations, as well as independent broiler operations and hatcheries in South Africa, Swaziland, Botswana and Mozambique. National chicks operates in three major areas namely Camperdown in KwaZulu-Natal, Boschkop, east of Pretoria and Manzini in Swaziland. The Camperdown facility produces 65% of fertile eggs produced, while the Boschkop facility produces 30% of fertile eggs produced and includes the largest hatching facility.

Astral Poultry's broiler production and processing is handled through subsidiaries County Fair, in the Western Cape and Early Bird farms in Gauteng, Mpumalanga and KwaZulu-Natal. Earlybird has broiler production, processing and distribution operations in Standerton (slaughtering capacity of 1.45 million birds per week), Olifantsfontein (slaughtering capacity of 1.3 million birds per week) and Camperdown (slaughtering capacity of 135 000 birds per week) (Astral Foods, 2012:5-7). Earlybird makes use of 74 contract grower farms (approximately 70% of production), as well as farms operated by its own staff (approximately 30% of production). Growers produce day old chicks to mature broilers in a cycle of 34 days, with an average live slaughter weight of 1.8kg. After processing, the chicken is marketed under three different brands namely Festive, Goldi and Supa Star to consumers through the wholesale and retail sector. Earlybird also supply restaurants like Spur, Steers and Wimpy. County Fair is located in the Western Cape and supplies mature broilers to the abattoir in Agter-Paarl. Chicken is processed further in Epping Industria, Cape Town.

Throughout the broiler production chain, feed is supplied to growers by Meadow Feeds. Meadow Feeds have seven strategically placed feed mills in Randfontein, Delmas, Welkom, Paarl, Port Elizabeth, Pietermaritzburg and Ladysmith. Meadow Feeds in Randfontein, Delmas and Pietermaritzburg supply feed to Earlybird farms, whilst Meadow Feeds in Paarl supply County Fair. Meadow Feeds supply different feed rations, specifically produced for broiler breeders and for various stages of broiler production. In addition to supplying Astral Foods' integrated operations, Meadow also supplies feed to independent producers of poultry as well as other livestock operations. In addition, Astral Foods has a 50% share in Nutec, providers of vitamin and mineral premixes to the animal feed industry. This strategic partnership with Provimi holdings in Holland provides access to expert knowledge and international cooperation.

Despite being the second largest poultry producer in South Africa, Astral Foods have also expanded into the rest of Southern Africa through Tiger Chicks and Tiger Animal Feeds. This is in addition to the National Chick breeding facility and hatchery situated in Manzini in Swaziland. Tiger Chicks is a hatchery that produces day old broiler chicks for the Zambian market. Tiger Chicks has introduced a new breed in the form of Lohman Meat not only into the Zambian market, but also the rest of Africa. The Lohman meat is the first slow feathering broiler bird to be bred in Africa. Through Tiger animal feeds, Astral is also able to distribute feed and provide on-site nutritional services to the Zambian poultry market. As Zambia has now become a consistent producer of surplus maize, the Zambian market offers lucrative opportunities for investment into poultry production. Through Meadow Mozambique, Astral operates a feed mill in Mozambique, with possible plans for expansion in the future.

2.6.3 Country Bird Holdings

Country Bird Holdings (CBH) Ltd. is an integrated agricultural group that consists of subsidiaries involved in chicken production in South Africa (Supreme Poultry), feed production in South Africa (Nutri feeds), poultry breeding in Southern Africa (Ross Africa) and feed operations in Southern Africa (Master Farmer) (CBH, 2012:2). In addition to its poultry operations, CBH also has other livestock operations in Southern Africa. The structure of CBHs' poultry operations is represented diagrammatically in Figure 16.

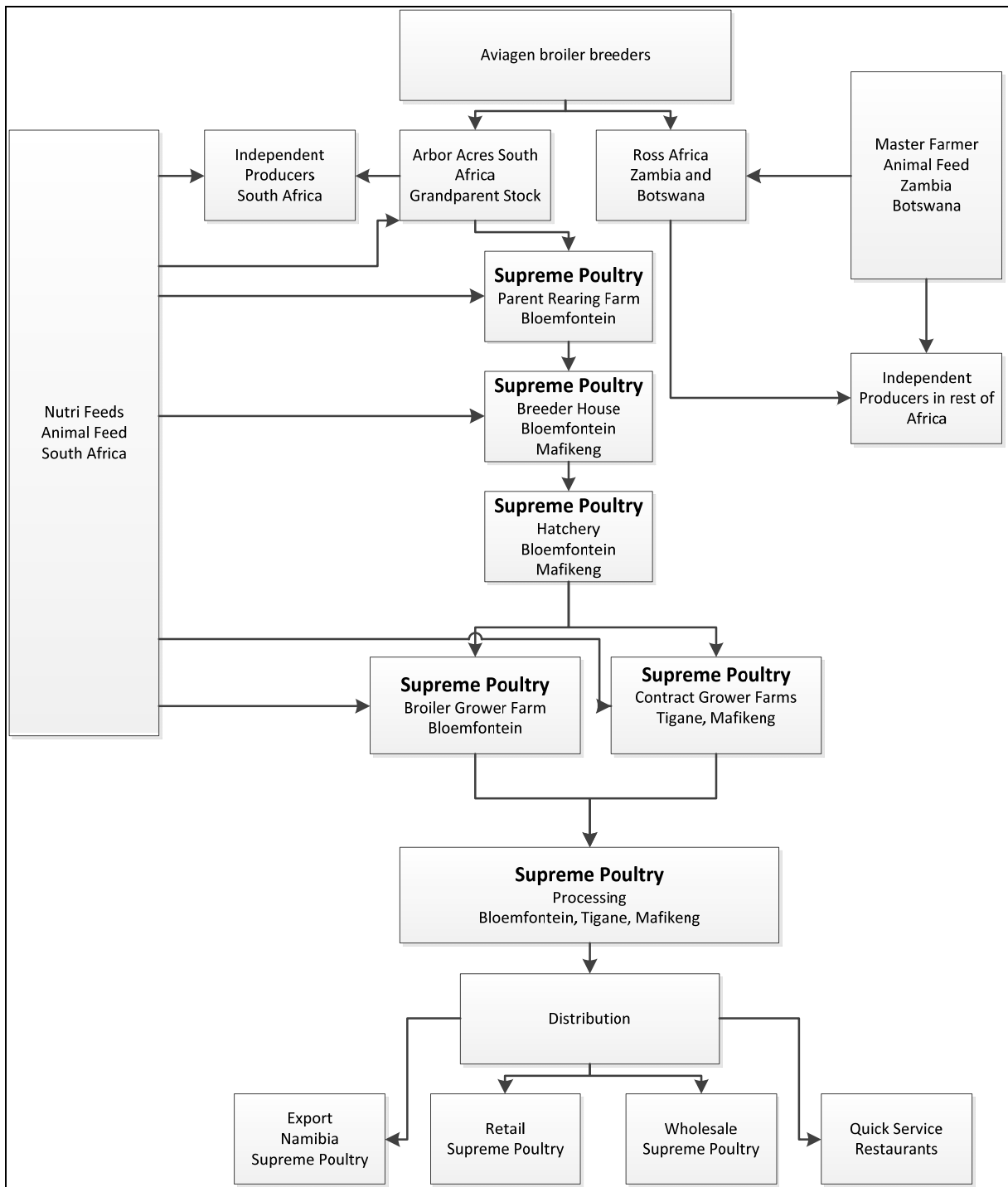


Figure 16: Diagrammatic representation of Country Bird Holdings' poultry operations

Source: Country Bird Holdings (2012)

Country Bird Holdings have acquired the sole distribution rights of the Arbor Acres breed, which it has been selling in the South African market as parent stock since 2007 through Arbour Acres South Africa. Arbour Acres South Africa supplies parent stock to independent producers in the South African market, as well as to Supreme Poultry, an integrated broiler production and processing company that operates as a subsidiary of CBH.

Supreme Poultry is located in the Free State and North West provinces. Breeding facilities in Belgie, Ramatlabama and Custom Hatch currently produce 1.9 million eggs per week, which are hatched in Bloemfontein and Mafikeng hatching facilities. Supreme Poultry's broiler operations consist mainly of a broad base of contract growers (76 growers), as well as its own broiler farm in Botshabelo. These operations together supply approximately 1.5 million broilers per week to the abattoirs situated in Bloemfontein, Mafikeng and Klerksdorp. After processing, fresh and frozen products are distributed throughout South Africa through wholesale and retail chains. Supreme is also the second largest supplier to the quick service restaurant industry in South Africa, as well as being the largest exporter of chicken in South Africa, supplying mainly the Namibian market (CBH, 2012).

Through Nutri Feeds, CBH supplies different broiler feed varieties to breeders and growers at various stages of its integrated broiler supply chain. Nutri Feeds has feed mills in Viljoenskroon (monthly capacity of 25 000 tons), in Bloemfontein (monthly capacity of 6 000 tons) and in Mafikeng (monthly capacity of 9 800 tons). Apart from supplying the South African market, Nutri Feeds also exports to Botswana, Lesotho and Namibia.

Through Ross Africa, CBH hold the agency to supply the Ross308 bird to the rest of Africa, despite using Arbour Acres genetics in South Africa. Ross Africa consists of a poultry breeding operation at grandparent level in Zambia, as well as a parent farm, broiler farm and abattoir in Botswana.

2.6.4 Afagri Poultry

Afagri Poultry has a long history of poultry operations, starting as shareholders in Earlybird farms, which was later sold to the Astral group. In 2006, Afagri re-entered the poultry market with the acquisition of Daybreak farms near Delmas. Afagri Poultry has since become a fully integrated broiler producer, from grandparent level right through to final processing. After acquiring the Rossgro processing facility in 2010, Afagri Poultry has increased its capacity by 350 thousand birds per week and is now the fourth largest producer of broilers in South Africa. The integrated Afagri Poultry supply chain is detailed in Figure 17.

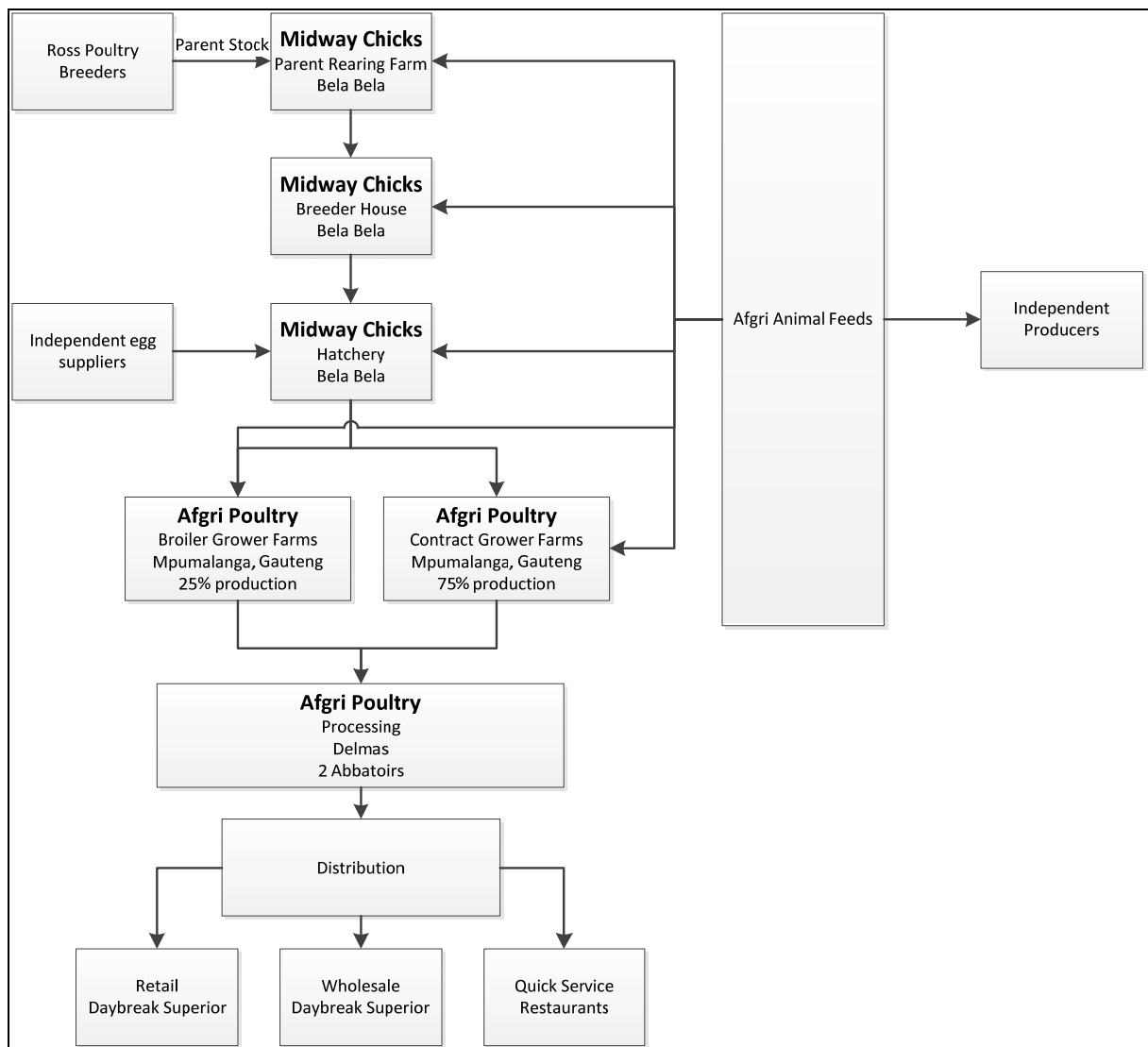


Figure 17: Diagrammatic representation of Afagri Poultry’s operations

Source: Afagri (2012)

Previously, Afagri’s grandparent operations consisted of Hubbard South Africa, but recently Afagri has switched to Ross 308. A subsidiary of Afagri, Midway Chicks, situated in Bela Bela, acquires day old parent stock from Ross Poultry breeders. Midway Chicks raises the parent stock on two separate farms and possesses a state of the art hatchery where day old chicks are hatched. Additional eggs are sourced from independent suppliers if needed to fill the hatchery’s capacity. Midway Chicks supply these day old chicks to Afagri’s own broiler farms, as well as designated contract growers. Due to insufficient capacity, limited amounts of day old chicks are purchased from outside the integrated chain from time to time. After a grow out period of approximately 36 days, mature birds are delivered to one of Afagri Poultry’s two processing plants, situated only 8km apart in the Delmas area. The second plant was purchased from Rossagro in 2010 and has increased Afagri’s processing capacity by 350

thousand broilers per week. Following processing, chicken is marketed under the Daybreak superior brand, through wholesale and retail channels. Afgri also supplies the quick service restaurant industry and has recently signed an agreement to become the third supplier to KFC.

Throughout the value chain, broilers and broiler breeders are fed specialised rations prepared for the particular growth stage by Afgri Feeds. Through its involvement in grain storage and other areas of the grain value chain, Afgri is able to provide its contract growers as well as its own farms with specialised rations needed for the production process at the lowest possible cost.

2.6.5 Pioneer Foods Poultry Division

Tydstroom Poultry is part of the Agribusiness segment of Pioneer Foods, together with Nova Feeds and Nulaid Eggs. Tydstroom Poultry's head office is located near Durbanville in the Western Cape, but products are distributed throughout South Africa, as well as Namibia and Angola. Tydstroom Poultry slaughters over 1 million chickens per week. Figure 18 provides a diagrammatic representation of the poultry division within Pioneer Foods' Agribusiness segment.

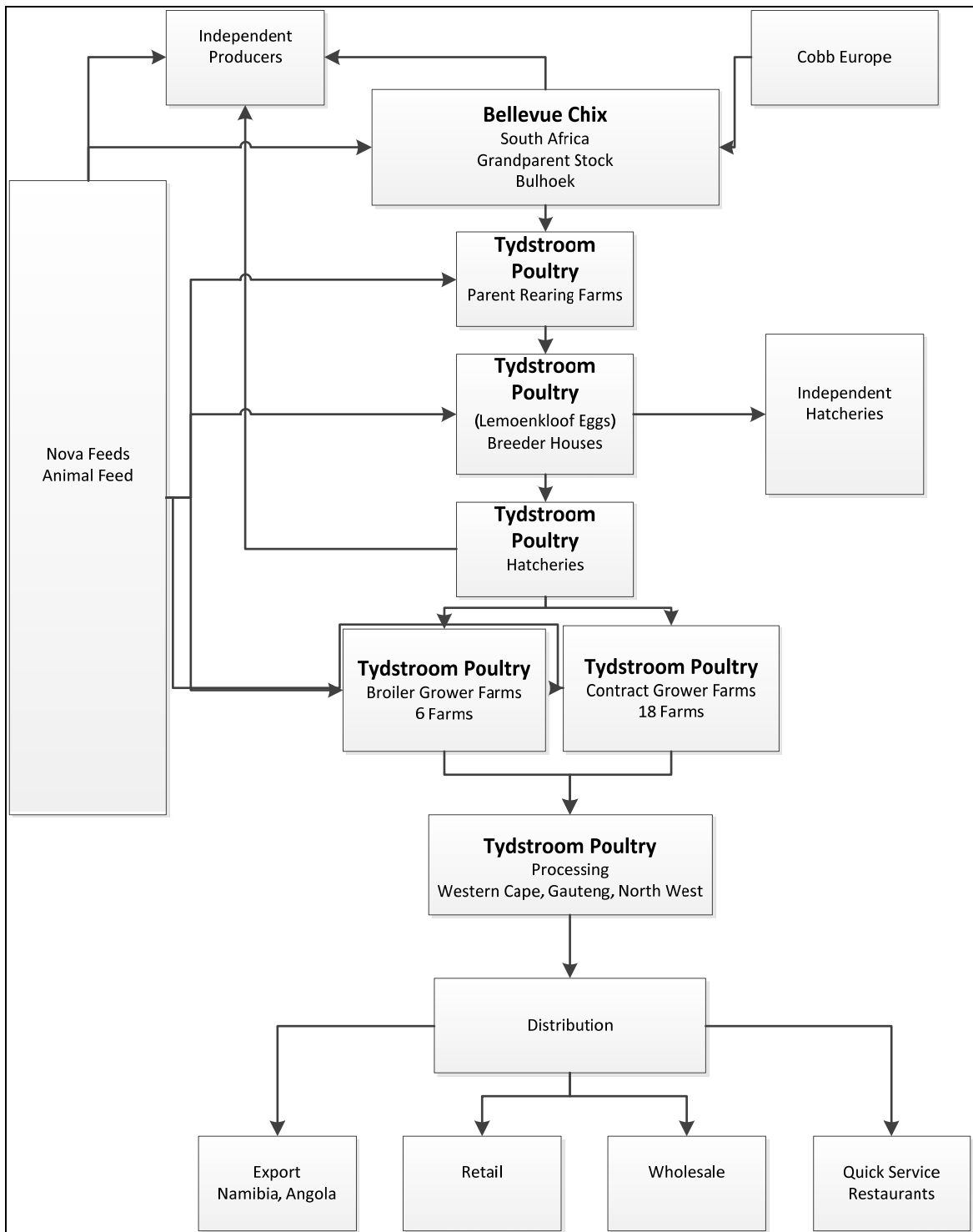


Figure 18: Diagrammatic representation Pioneer Foods' poultry operations

Source: Pioneer Foods (2012)

The grandparent operations of Tydstroom Poultry are handled by Bellevue Chix, on its Bulhoek grandparent farm between Rustenburg and Swartruggens. After years of using Hybro genetics, Bellevue signed an agreement handing them sole distribution rights to the CobbAvian48 in South Africa, Namibia, Lesotho and Swaziland from 2009 onwards. The

Bulhoek grandparent facility consists of three quarantine facilities for importing CobbAvian48 genetic lines from Cobb Europe, as well as five breeding facilities, including hatcheries. Bellevue Chix provides parent stock to Tydstroom Poultry, as well as other independent producers in Southern Africa.

Parent rearing and laying facilities of Tydstroom Poultry are situated in Western Cape, with hatcheries outside Atlantis and Riebeek kasteel. Day old chicks are supplied to 24 broiler farms all located within a 50km radius of the companies processing facilities. Of the 24 broiler farms currently in operation, six are company owned, while the remaining 18 are operated by contracted growers who receive inputs from Tydstroom Poultry. Fertilised eggs are sold to independent hatcheries under the Lemoenkloof brand.

At all stages of grandparent, parent and broiler rearing, feed inputs are provided to the Bellevue Chix, Tydstroom Poultry and contract growers from Nova Feeds, another division of Pioneer Foods agribusiness segment. Nova provides specialised rations for the various stages of the broiler supply chain, ensuring optimal returns along the supply chain.

Processing of Tydstroom's mature broilers takes place at four processing facilities located in the Western Cape and Gauteng. The first abattoir is located outside Durbanville, at Tydstroom's head office. It produces Tydstroom fresh and frozen products, as well as dealer own brands in the Western and Eastern Cape. The second abattoir is located close to Atlantis in the Western Cape. It produces mainly value added Tydstroom products, as well as dealer own brands for customers in the Western and Eastern Cape. A third facility near Hartebeespoort in Gauteng produces mainly fresh products for the local market and supplies fresh products to the Edenvale facility, which produces mainly frozen products for the Gauteng market, as well as dealer own brands in the region.

Tydstroom Poultry products are distributed through export, retail, wholesale and quick service restaurant chains to Gauteng, the Western Cape and the Eastern Cape. Products are marketed under Tydstroom Poultry's fresh and frozen brand, as well as value added brands like a deboned and marinated braai range, as well as the groovy range consisting of offal and chicken polonies.

2.6.6 South African Poultry Association

Another very important actor in the South African broiler industry is the Southern African Poultry Association (SAPA). SAPA was established in 1904, as a producer organisation that serves to provide an instrument to voice the feelings of the industry. Within the NIE framework, SAPA can be seen as a collective action, a producer organisation that represents both small scale and commercial poultry farmers and lobbies for policies that would benefit and advance the industry (SAPA, 2011:4). SAPA consists of four subsidiary organisations, the egg organisation, the broiler organisation, the chick producer's organisation and the developing poultry farmer's organisation. While each of these organisations serves to improve and advance the branch of the industry that it represents, SAPA also has a technical committee that comprises work groups to cover issues such as animal health and welfare, training, research and food safety.

SAPA engages in different activities, including administration and lobbying on behalf of its members. SAPA serves to overcome the problem of imperfect information by providing industry information through its website and a monthly publication called the Poultry Bulletin. This greatly reduces the cost of finding information for its members. As a collective action body, SAPA has been successful in having import tariffs approved for the industry. In 2000, SAPA applied successfully on behalf of its members for anti-dumping duties on frozen bone-in portions of chicken imported from the USA. In 2011, SAPA lodged an application on behalf of its members for a sunset review regarding the expiry of these anti-dumping duties and was again successful in having the application of these anti-dumping duties extended. Following the application, ITAC recommended that anti-dumping duties on frozen bone-in pieces of chicken (tariff sub-heading 0207.14.90) originating from the USA be increased to 945c/kg (ITAC, 2012b:15).

In 2011, SAPA lodged an application for anti-dumping duties on imports of whole frozen chicken (tariff sub-heading 0207.12.90) and boneless cuts of chicken (tariff sub-heading 0207.14.10) originating from Brazil. Though a preliminary report recommended that provisional anti-dumping duties be instituted (ITAC, 2012a:41), these duties were not implemented by the Dti following the final report from ITAC. As a result, SAPA applied for a general increase in duties in 2013, as summarised in Table 6.

Table 6: Import tariffs applied by South Africa

HS Code	Description	Current tariff	SAPA Application
02071100	Fowls, not cut in pieces: fresh or chilled	0	0
02071210	Fowls, not cut in pieces, frozen: mechanically deboned meat	0	0
02071220	Fowls, not cut in pieces, frozen: carcasses	27%	991c/kg, Max 82%
02071220	Fowls, not cut in pieces, frozen: carcasses: EU origin	0	0
02071290	Fowls, not cut in pieces, frozen: other	27%	1111c/kg, Max 82%
02071290	Fowls, not cut in pieces, frozen: other: EU origin	0	0
02071300	Fowls, cuts and offal, fresh or chilled	0	0
02071410	Fowls, cuts and offal, frozen: boneless cuts	5%	12% or 220c/kg, Max 82%
02071410	Fowls, cuts and offal, frozen: boneless cuts: EU origin	0	0
02071420	Fowls, cuts and offal, frozen: offal	27%	67% or 335c/kg, Max 82%
02071420	Fowls, cuts and offal, frozen: offal: EU origin	0	0
02071490	Fowls, cuts and offal, frozen: other (includes bone-in portions)	220c/kg	56% or 653c/kg, Max 82%
02071490	Fowls, cuts and offal, frozen: other (includes bone-in portions): EU origin	0	0

Source: SARS (2013:8).

Apart from representing the industry in the cases stated above, SAPA also lobbied on behalf of its members to have general sales tax (GST) on livestock removed, as well as having value added tax (VAT) on eggs removed at a later stage. SAPA is involved in training operations and was successful in reducing the surcharge on imported breeding material and equipment (SAPA, 2011:4).

The examples listed above are an indication of the success that SAPA has had as a collective action group that is well organised in representing its members and lobbying for policies that are likely to improve and advance the industry.

2.7 CONCLUSION

The South African poultry industry was recently labelled by the Dti as an industry in distress. As described in this chapter, strong increases in the demand for chicken products over the past decade have not always been met by increased domestic production, but instead were met by large increases in imports from South America and the EU. While the price of feed grains has

increased significantly in the past three years, the domestic chicken price has been capped by the flow of imports that are produced cheaper in South America, placing pressure on producer profit margins. The price of imported soya oilcake was highlighted as a key reason for South African producers' lack of economic competitiveness in the world market, despite high technical efficiency.

Apart from illustrating the key trends in the fundamentals of the South African broiler industry, the chapter also served to illustrate the highly integrated and concentrated nature of the broiler market in South Africa. This concentrated market structure is arguably a result of extreme cost pressures and narrow margins that have forced smaller producers out of the market, while large, integrated holding companies have survived as a result of economies of scale benefits, as well as reduced costs as a result of vertical integration. At the same time, these companies have been able to stay in business by diversifying production and improving efficiency constantly. The five largest integrated companies were discussed as the key players in the market.

From Chapter 2, it is clear that the structure described does not match the assumptions associated with econometric models as illustrated in Chapter 1. The institutions that govern exchange within this market structure will be detailed in Chapter 3.

CHAPTER 3

INSTITUTIONAL DIMENSIONS AND CONTRACTUAL ARRANGEMENTS IN BROILER MARKETS

3.1 INTRODUCTION

Broiler markets worldwide exhibit similar structure. With great improvements in technology over the past decades, the biological cycle of production has changed drastically (Kapombe & Colyer, 1998:1). These improvements in production technology has led to the development of various levels of coordination in order to facilitate exchange and manage the increasing risk of transaction failure associated with investment in improved technology (Dimitri, Jaenicke & Effland, 2009:30). In the coordinated market of modern broiler production, a true understanding of price discovery cannot be achieved without an analysis of the institutional arrangements that govern exchange within the market.

As understanding the price formation mechanism is one of the main objectives of this study, the institutional arrangements that govern exchange in both the international and South African broiler supply chain must be better understood. While Chapter 2 highlighted the structure of the industry, identifying high levels of vertical coordination and integration, Chapter 3 will concern the understanding of the institutional arrangements within this structure. The arrangements governing exchange must be reviewed in order to determine the true method of price discovery and in turn evaluate plausible scenarios regarding the future of the industry with greater accuracy.

3.2 ECONOMIC COORDINATION AND ORGANISATIONAL FORM IN WORLD BROILER MARKETS

Literature on economic coordination explores the consequences of relaxing certain assumptions of the perfectly competitive paradigm of conventional neo-classical economics (Poulton and Lyne, 2009:143). As these assumptions are relaxed, transaction costs arise due to imperfect information and bounded rationality of economic actors. This has led to the identification of different organisational forms, based on the level of coordination found in

each form. The theory of the firm, as developed by Ronald Coase (1937:390) states that the merits of different organizational forms depend on comparisons of the cost of transacting for the different organisational forms. The organisational form that limits transaction costs in the best way possible will be optimal.

Literature identifies three different organisational forms, characterised by different levels of coordination. These are 1) spot markets, 2) vertical integration or hierarchies and 3) relational contracting (MacDonald & Korb, 2011:1; Menard, 1996:154 and Poulton & Lyne, 2009:150). In spot markets, producers sell their products of the farm based on prevailing market conditions at the time of sale. Prices are typically influenced by supply and demand conditions in the market, with a possible premium or discount being based on quality characteristics. Farmers control all production as well as marketing decisions. In contrast, a vertically integrated market is characterised by the transfer of products between various stages of the supply chain which combines farm and downstream use of the commodity under single ownership (MacDonald & Korb, 2011:1). Menard (1996:154) identifies forms of organisation that are neither spot markets nor hierarchies as hybrids, with distinct properties that are different from spot markets or firms. He argued that these hybrids are characterised by a bilateral dependency that is strong enough to warrant close coordination, but not strong enough for full integration. While identifying many different hybrid forms of organisation, Menard states that the one thing that these hybrid forms have in common is their reliance on relational contracting (Menard, 2006:30). As a result, this study groups these hybrid forms together under the market structure of relational contracting. Under relational contracting transactions are organised through agreements between producer and buyer that are reached before the completion of the production stage. Contracts provide much closer linkages between buyers and sellers and may provide the contractor with greater control over production decisions.

While spot markets are seen as the most effective by conventional neo-classical economists, contracting and vertical integration (hierarchy) are identified by the NIE framework as market structures designed to improve the efficiency of supply chains in delivering certain products. Literature has identified three factors as being decisive in explaining the adoption of different organisational forms. While Poulton and Lyne (2009:150) state that the level of coordination will depend on the level of asset specificity and investment required in order to produce a certain product, Menard (2006:28) also includes the level of uncertainty regarding the

transaction and the frequency of transacting as additional factors impacting on the optimal choice of organisation. Other techno-economic attributes of the product that is produced will also influence the nature of institutions that govern the exchange of a transaction.

In attempting to explain why contractual arrangements have replaced cash market transactions in the US broiler industry, Dimitri *et al.* (2009:30) concluded that increased innovation in the industry increased the available rents to owners of technology, leading to increased contracting despite the larger associated transaction costs. MacDonald (2008:7) suggested that a single broiler house in the USA costs around 300 000 dollars and that the majority of producers make use of multiple houses. Houses with greater technology such as climate control improve productivity significantly, however the nature of the investment required to obtain this technology is considered highly specific, as the use of the technology outside of the broiler industry and to a lesser extent outside of the contractual arrangement is very limited (Vukina & Leegomonchai, 2006:589). Macdonald and Korb (2011:4) indicated that contracts are favourable in the broiler industry due to 1) the high levels of specific investment required and 2) the nature of mature broilers. In order to capture economies of scale benefits, huge numbers of broilers are produced per cycle and as broilers lose value if they have to be transported large distances when sold, the number of potential buyers is often limited. This could lead to the buyer forcing very low prices on the producer knowing that he has no viable alternatives and increases the risk of transaction failure. Dorward and Omamo (2009:99) stated that in cases where actors are exposed to high risk of loss from transaction failure due to significant investment in specific assets and uncertainty in trading partners, they often wish to engage in bilateral contracts in order to reduce risks. Contracts therefore protect farmers against price risk and provide assurance that highly specific capital investments can be recouped.

International studies regarding the structure of world broiler markets suggest that highly integrated supply chains are the norm, except for the broiler growing stage, which is generally contracted to specialist growers who produce mature broilers from day old chicks (MacDonald & Korb, 2011:17). MacDonald and Korb (2011:12) further indicated that contracts covered 90 % of the US broiler industry in 2008. Menard (1996:161) also identified the French poultry industry as having the characteristics necessary for the establishment of hybrid organisational forms that rely on relational contracting. Menard (1996:157) argued that contractual arrangements have the advantage that they maintain long term relationships

necessary for high levels of specific investment, reducing the risk of opportunism, without the bureaucratic costs involved in vertical integration. Menard (2006:30) also argued that hybrid forms, through relational contracting, organise joint activities between firms, while integration reduces flexibility and weakens incentives. Menard (1996:169) indicated that despite this complex supply chain, almost all significant variability in productivity was found on the part of the growers, making them most important in the chain. The use of contracted growers therefore allows for specialisation at this crucial stage and as a result maximises efficiency. Vukina and Leegomonchai (2006:592) suggested that contractual production also reduces the risk of disease for the integrated producer, as production is spread over a greater area and a disease outbreak could be contained on a specific farm, without affecting the other growers, thus reducing the impact on throughput at the processor.

While contractual arrangements could reduce risk and improve quality, their use is not without critique. One critique of contracting has been that the issue of market power is not fully considered (Poulton & Lyne, 2009:157). James, Klein and Sykuta (2007:7) indicated that large processors use their market power to force producers to accept contracts. Katchova (2010:262) raised the additional concern that contractors, as a result of their market power, may deter other contractors from entering a local market. Transport costs and commodity perishability restricts producers to a limited geographical area and as such, the local market for specific producers may be even more concentrated than on national level. Katchova (2010:262) used propensity score matching to evaluate the consequence of increased processor concentration on agricultural contracts and found that contract prices for most commodities did not differ significantly depending on the availability of alternative marketing options. This would provide evidence that most contractors do not offer lower prices in the absence of competition from other local buyers. These findings by Katchova (2010:274) are consistent with the explanation that the increased trend in agricultural contracting is due to improved efficiency associated with a coordinated supply chain as opposed to price setting due to increased market power by integrated processors.

3.3 CONTRACTUAL ARRANGEMENTS IN WORLD BROILER MARKETS

The increased use of contracting and processor concentration was identified by Katchova (2010:274) as a key trend in the industrialisation of agriculture. From a farmers perspective however, price transparency is of crucial importance as consolidation in the processing industry may lead to decreased bargaining power for the farmers. Broiler contracts have two major components, the division of responsibility in providing inputs, as well as the determination of grower compensation (Leegomonchai & Vukina, 2005:853). Understanding these two components is prioritised in section 3.3.

3.3.1 Characteristics of broiler contracts in world markets

Various types of contracts are used in broiler markets around the world. These contracts can be grouped according to similar structure, but no market makes use of a standard contract, with many differences found amongst different integrators. Individual integrators, however, do not offer customised contracts to individual growers, as the cost of gathering information and implementing customised contracts would be excessive (Tsoulouhas & Vukina, 2001:1065). Menard (1996:170) stated that most broiler contracts are purposefully incomplete, simply defining a general framework, with most technical provisions determined on a yearly basis. In studying contracts used in the French poultry industry, Menard (1996:170) identified three different types of contracts: 1) 'Fixed price contracts', where growers are fully independent and commit to delivering a certain number of chickens by a certain date. These contracts specify the characteristics of the chicken to be delivered and a fixed amount of money to be paid. Only about five percent of growers used this type of contract and most of those were small producers. 2) 'Buy and sell' contracts, where growers buy chicks and sell chickens, dealing with the same company as input supplier and buyer of chickens, while payments are made on a cost plus system. Growers usually remain in charge of intermediate products, though some had restrictive clauses allowing them to only purchase feed from a specific company for example. Buying prices in this type of contract were found to be per chicken or per square meter, or alternatively based on a cost-plus system, with a margin added on cost of production. About one third of growers surveyed for Menard's (1996:170) study operated under such contracts. 3) 'Contracts of the putting out type', where

growers are provided with all inputs and equipment, while chicken is bought from them at a price determined on a yearly basis covering expenditures and a margin. The margin is usually flexible with built in incentives based on performance indicators like feed conversion and final weight. This type of contract dominates in the French industry with more than 50 % of growers.

In their study of agricultural contracts in the USA, MacDonald and Korb (2011:1-2) suggested that contracts used to govern the exchange of agricultural products can be split into two broad categories namely production contracts and marketing contracts. Marketing contracts tend to focus on the final product, specifying price, quantity and often quality characteristics, whereas production contracts specify services provided by the farmer for a contractor who owns the commodity that is being produced. Production contracts tend to be more popular in livestock and particularly broiler markets. James *et al.* (2007:4) further indicated that production contracts have remained relatively similar in the last fifty years, with the integrated processor providing crucial inputs while the grower supplies labour and chicken houses, getting paid per chicken produced. Due to the cost of shipping and the risk of mortality, contract growers and integrators are typically located within 100 miles of the integrators facilities, which normally includes hatcheries, abattoirs and processing plants (MacDonald & Korb, 2011:17-18). The typical features of broiler contracts in the USA are summarised in Figure 19.

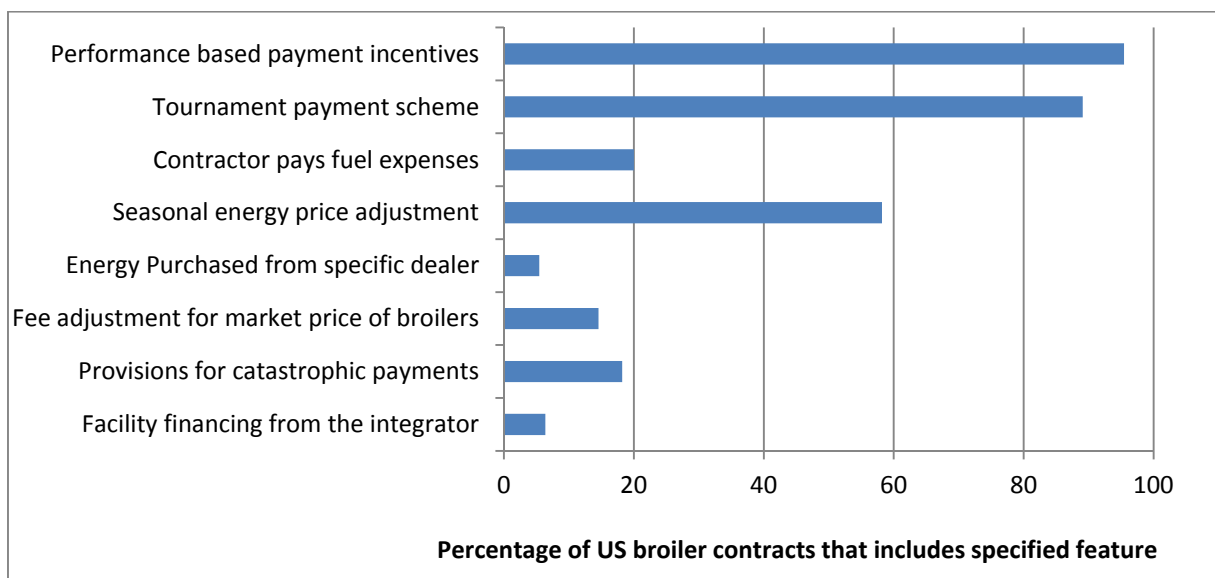


Figure 19: Features included in USA broiler contracts

Source: MacDonald and Korb (2011:21)

Macdonald and Korb (2011:18) further suggested that contract growers in the USA receive a price that consists of a base payment, as well as additional variable payments based on efficiency and mortality performance. The most common form of pricing mechanism is that where producers are compensated in a two part tournament. They receive a basic fixed compensation, together with a variable incentive based on their production efficiency as compared to other producers. The tournaments are not merely about the rank order however, with the winning margin also being significant. In other words, if a grower wins by a greater margin, his compensation will increase more. Some contracts introduce a market price clause where base payment is affected by the market price of broilers (Hedge & Vukina 2003:2). Flocks with lower mortality rates and higher feed conversion will therefore generate higher payments. In the USA, the strongest performers can be paid up to 50 % more than the weakest performers (MacDonald, 2008:14-15). Tournament pricing was however not universal with 13 % of farms receiving payments that were not based on a tournament scheme.

Despite the long term investment required in highly specific assets, broiler contracts in the USA are generally short term, valid for one flock at a time and generally do not specify the number of flocks that a grower will receive per year (Leegomonchai & Vukina, 2005:854). In most instances however, the contract is tacitly renewed and it is not unusual for contract growers to grow for the same integrator for their entire career, as unilateral contract terminations are very rare. These dynamic contracts with a lack of long term commitment can also be seen as a source of implicit incentive (Leegomonchai & Vukina, 2005:854).

3.3.2 Comparing different pricing methods in world broiler markets

Production risks can be separated into common production risk, defined as risk faced by all producers due to external conditions like the weather and idiosyncratic production risk, defined as risk that can be ascribed to a single producer alone, such as an equipment failure on the farm. The essence of grower compensation based on the tournament scheme, as described in 3.3.1, is that it eliminates common production risk for the growers, by shifting it on to the integrator (Hedge and Vukina, 2003:24; Tsoulouhas & Vukina, 2001:1063). When considering the efficiency of different pricing mechanisms, both the manner in which risks are transferred as well as the welfare effects on growers and integrators are important considerations (Tsoulouhas & Vukina, 2001:1064).

Tournament pricing, as described in section 3.3.1, rewards growers for improving their efficiency of input use in relation to their competitors (Goodhue 2000:607). By calculating the average performance of a group that has faced similar weather conditions, used the same feed and the same genetic strains and determining grower compensation based on relative performance, common production risk is shifted entirely onto the integrator (Tsoulouhas & Vukina, 2001:1066). If the feed batch for instance was of inferior quality, results will be worse across the board, but individual growers will still receive the same payment based on their relative performance in the group. Thus the only remaining risk for the grower is the idiosyncratic risk.

Despite these benefits, growers have been opposed to a system where their compensation depends on the performance of others. Growers claim that tournament outcomes could be biased due to the fact that the quality of essential inputs like day-old chicks and feed are exclusively under the control of the integrator (Tsouhoulas & Vukina, 2001:1062). Integrators are unable to monitor all individual growers constantly and so opportunistic behaviour by other growers to take advantage of the bonus system cannot be excluded. Growers in the USA have complained about unfair distribution of variable quality inputs in the past, leading to an investigation by Leegomonchai and Vukina (2005:850) with the objective of finding evidence that integrators allocate inputs strategically after observing the performance of growers over time. Leegomonchai and Vukina were however unable to find any empirical evidence of strategic input allocation among growers of varying ability (Leegomonchai & Vukina, 2005:874).

An additional concern voiced by growers is that consecutive flocks facing similar input costs and performance could lead to different incomes due to the performance of other growers. As tournament group composition is based entirely on time of slaughter, the group composition changes continually as integrators place flocks with unequal rotation length in order to maintain control of output quantities (Tsoulouhas & Vukina, 2001:1063). This changing group composition can lead to substantial differences in income from one term to the next and is defined by Tsoulouhas and Vukina (2001:1063) as group composition risk. The concern for growers is the fact that estimating possible income in advance is rather complicated when group composition keeps changing and individual compensation depends on the performance of others (Tsoulouhas & Vukina, 2001:1063).

An alternative pricing mechanism considered by Tsoulouhas and Vukina (2001:1063) was for the portion of grower compensation that depends on a grower's performance to be calculated as relative performance compared to a fixed standard comparable with technology during the period of production. The questions that Tsoulouhas and Vukina (2001:1064) sought to answer was whether replacing tournament pricing with pricing based on fixed performance standards would a) increase grower welfare and b) increase or decrease social surplus. They concluded that the answer to these two questions would depend on the magnitude of the group composition risk faced by the growers in relation to the common production risk faced by the same growers. In a situation where common production risk dominates group composition risk, as deemed the most likely scenario by Tsoulouhas and Vukina (2001:1064), a pricing mechanism based on fixed performance standards would decrease social surplus unless the piece rate is regulated. Though group composition risks are decreased, grower welfare will not necessarily increase, as greater bargaining power allows integrators to extract maximum rent (Tsoulouhas & Vukina, 2001:1067). With a regulated piece rate, integrator welfare decreased, while grower welfare increased, resulting in a change in social surplus that is dependent on the magnitude of the relative increase in grower welfare and decrease in integrator welfare. While fixed performance standards shield growers from group composition risk, insurance against common production shocks is reduced. Investigation of the same problem by Wu, Nazaryan, Roe and Sporleder (2004:1-3) by means of an experiment to determine the effect of the two different incentive schemes on players with heterogeneous abilities found that high ability growers benefit from tournament pricing, while low ability growers lose under tournament pricing. The same study found no statistical difference in the effort implemented by the same growers under a tournament or fixed performance incentive scheme. The difference in average compensation received was less under a tournament pricing scheme, while inequality of compensation across different growers was reduced under a fixed performance pricing scheme (Wu *et al.*, 2004:2-3). Fixed performance standards will therefore result in a more even income distribution.

Tsoulouhas and Vukina (2001:1062) concluded that two part tournament schemes are a linear approximation of the optimal payment scheme and that they alleviate the moral hazard problem of the integrator. Though both payment mechanisms have strengths and weaknesses, tournament pricing schemes seem to be of superior efficiency from an integrators point of

view, whilst the most efficient method from a grower's perspective would depend on the relative ability and risk appetite of the grower under consideration.

3.4 CONTRACTUAL ARRANGEMENTS IN THE SOUTH AFRICAN BROILER MARKET

Contracting is the preferred form of organisation in broiler markets around the world and the South African broiler industry is no exception. According to the Department of Agriculture, Forestry and Fisheries (DAFF) in South Africa (2010:7), 51% of commercial broiler production is by contract growers (commercial production accounting for 72% of total production). This is a smaller percentage than is the norm in international markets, but is still the majority. The balance of commercial broilers is produced by subsidiaries of holding companies, while 28% of total production is by small, medium and micro enterprises (SMMEs), most of which use contractual arrangements in order to secure input supply like feed and day old chicks (Louw *et al.*, 2011:232). As in the rest of the world, the heavy reliance on contracting and integration in the South African broiler industry can be ascribed to the high level of specific investment required in order to capture technological and economies of scale benefits. Louw *et al.* (2011:227) indicated that the typical capital outlay required for a broiler unit in South Africa varies between R1.9 million and R3 million, depending on capacity and the level of technology involved.

3.4.1 Characteristics of broiler contracts in South Africa

The commercial broiler market in South Africa is highly concentrated, as reflected in the fact that the five largest broiler producers account for almost 70% of production. As contracts used within the same integrated company are standard, this section will be based on the contracts between the five major producers and their contract growers – as discussed in confidential interviews with producers that grow on contract for these companies.

Broiler contracts in South Africa are structured much the same as international broiler contracts with the two major components being the responsibility in providing inputs as well as the method of determining grower compensation. Though small differences are evident, the major components of the contracts used by the different integrated companies were found to

be of similar nature, with the responsibility for providing major inputs resting with the integrator. The variable input costs per production cycle, as stipulated within South African broiler contracts are summarised in Table 7.

Table 7: Variable production cost breakdown of South African broiler producers

Variable cost component	Average share of variable production cost
Feed	71.3%
Day old chicks	20.0%
Labour	1.3%
Heating and Electricity	3.3%
Bedding, waste removal and cleaning	1.7%
Vitamins and vaccinations	0.6%
Maintenance	0.7%
Catching	0.4%
Other	0.7%

Source: Compiled from confidential interviews

The variance on the day old chick component was found to be the greatest between integrators as some integrators provide day old chicks to contract growers at cost, while others provide day old chicks at market value. Across integrators however, feed and day old chicks as the two major inputs accounted for an average of 91% of variable costs and are always provided by the integrator. As a result, growers have no input in terms of quality and price of inputs that account for more than 90% of variable production costs per cycle. This control of essential inputs by the integrator was also one of the main concerns voiced by growers in the South African supply chain in the survey by Louw *et al.* (2011:230-231). Along with these two major inputs, the integrator provides bedding, vaccinations and catches the mature birds, while the grower provides housing, labour and other infrastructure in order to grow the broilers to maturity. Electricity, heating and cleaning costs are the responsibility of the grower; while some integrators provide these services, the grower may source them from independent providers if the price or quality is preferred.

While input responsibility is very similar to the system described for international markets, broiler contracts in South Africa tend to be for a longer term than found in the rest of the world. Section 3.3 indicated that broiler contracts in the USA are generally valid only for one cycle at a time. In South Africa however, contract terms were found to be fixed for between

five and fifteen years. This is in line with the time required to finance the broiler houses. After expiry of the initial contract length, the contract becomes indefinite, while both the integrator and the grower have the option of ending the agreement with a stipulated notice period which ranges from 60 days to three production cycles. International contracts are generally also renewed and most growers produce for the same integrator for years, yet the South African contracts are more ‘grower friendly’ in that they are fixed for the period required to pay off the initial investment. This provides greater incentive for South African producers to make the necessary investment in order to enter the industry and produce competitively.

3.4.2 Compensation within broiler contracts in South Africa

The second important component of broiler contracts in South Africa is the method used to compensate growers. Understanding compensation within these contracts is crucial in understanding price formation within the industry, which is one of the main objectives of this study.

Louw *et al.* (2011:233) stated that the price paid to contract farmers in South Africa is determined by the contractor, after which the cost of supplied inputs like feed is deducted. Literature regarding the method of price determination within these contracts is however not abundantly available as is the case with literature on the tournament pricing schemes used in the USA. Louw *et al.* (2011:233) indicated however that incentives and bonus schemes are only available to certain producers. As integrators use a standard contract for all producers, the only difference in compensation method will be across different integrators. The differences in compensation methods between integrators as discussed in confidential interviews with producers were however less than expected. The majority of integrators use the same basic system, with differences found mainly in the system used for payment of bonuses, as indicated by Louw *et al.* (2011:233).

Compensation in South African broiler contracts consists of three components; a fixed margin per kg, a cost recovery component based on the tournament pricing structure illustrated in section 3.3.2 and an optional bonus payment based on a fixed performance standard. While the margin and cost component is used by all integrators, with small differences in the size of the margin as well as the formula used to adjust the margin over time, the bonus payment is not available to all producers, as some integrators base compensation only on the fixed margin

and cost recovery component. The price determination process is illustrated diagrammatically by Figure 20.

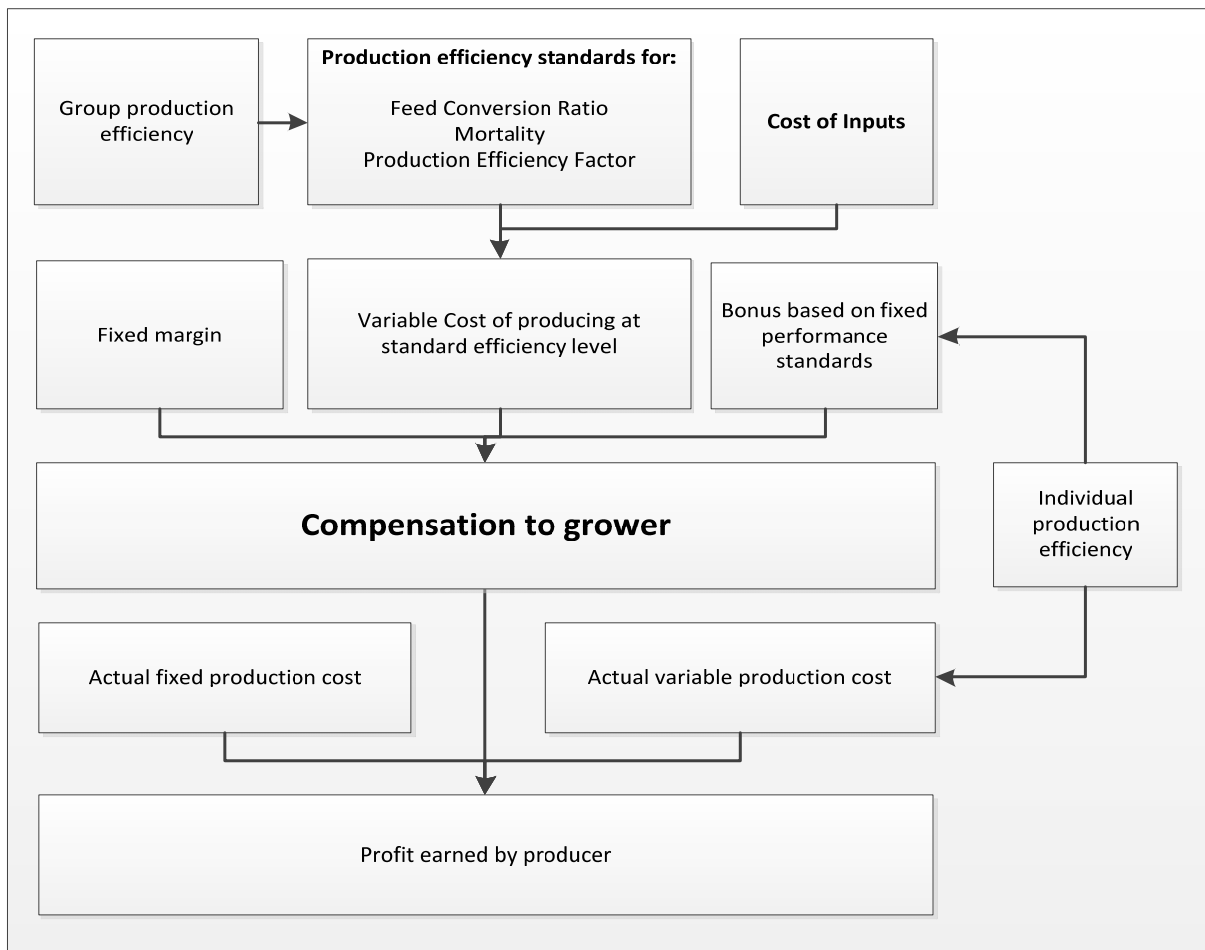


Figure 20: Price determination process in South African broiler production contracts
 Source: Compiled from confidential interviews

The cost recovery component of compensation is comparable with the tournament pricing schemes used in the USA, as each producer’s compensation for production costs depends not only on his own performance, but also on the performance of other contract growers as well as the performance of the integrator’s own farms. While small differences are found amongst integrators in the calculation of the cost component, the basic structure is unchanged across integrators. The integrator makes use of pre-stated formulae in order to calculate the average costs that a producer should entail given a set of performance standards relating to feed conversion, mortality, slaughter mass and the production efficiency factor at a given age. When broilers are not caught at the exact age specified due to the integrators catching schedule, the performance indicators are adjusted to the desired age as per a published schedule.

The standard performance indicators are calculated based on the average performance of all producers for a stated time period preceding the cycle in question. These standard indicators in turn are used to calculate the amount of inputs that the grower should have used in the production process. The grower is compensated based on these quantities, regardless of the actual amount of inputs used. The key differences in this system as applied by different integrators are the length of time that the average performance standard is based on, as well as different inclusions within the group creating the standard.

Some integrators base average performance on the historic performance of the entire group of contract growers as well as their own farms, while others use only the top 75% of contract growers to determine the standard. Some integrators in turn use only the performance of their own farms in order to set the production standard. The time period considered for determining performance standards differs among integrators, with some integrators opting for a moving average of three to six months, while other opt for a moving average of one to five cycles. The use of a moving average performance standard as opposed to comparing performance in the cycle in question or a fixed standard has advantages for both integrators and growers. The use of historic data enables growers to have better information with regards to expected payment than would be the case if only the current cycle was used, decreasing the group composition risk, without losing the protection against common production risk provided by the use of a tournament scheme. The integrator benefits due to the fact that, as technology and performance improves, the performance standards are automatically adjusted over time. Producer compensation will be unable to increase indefinitely as technology improves. The use of average historic performance as opposed to the cycle in question addresses some of the concerns voiced in the system used in the USA, as group composition risk is decreased, without losing protection from common production risk. Group composition risk is not only addressed by the use of historic data, but also by the inclusion of the entire group, or a fixed percentage of contract growers in order to determine average performance.

In addition to refunding the producer for the variable costs that should have been incurred in the production process if the standard performance indicators were to be achieved, the integrator also pays the producer a pre-determined margin per kilogram. The purpose of the margin is for the producer to be able to cover fixed costs, such as the financing of broiler houses, while at the same time allowing the producer to earn a profit.

The third component of grower compensation is the performance bonus, based on fixed performance standards. The greatest variation in compensation across integrators is found in the structure of the performance bonus payment. While some integrators choose not to use a bonus system at all due to the fact that better performance is already rewarded through the tournament pricing scheme, others supplement the basic compensation with bonus payments based on fixed standards related to size and quality of the final product in relation to what is required by the integrator. Bonus payments used by some of the integrators are based on the performance efficiency factor, with higher efficiency factors leading to higher bonus values paid, while others relate the payment of bonuses purely to desired characteristics like a target weight for the final product as desired by the integrator. Some integrators will limit the weight paid for per bird to a specific value, while others pay higher values depending on how close the final weight is to target, with greater deviation from the desired weight leading to decreased bonus payments.

After calculation of the amount due to the producer based on summation of the variable cost component calculated, the fixed margin and the bonus, the integrator will subtract the actual costs of feed, day old chicks and services provided to the producer, before transferring the balance to the producer. The difference between the actual costs incurred by the producer and the costs that should be incurred given the standard performance indicators will vary based on the specific producers production efficiency. Essentially, any producer that exceeds the standard performance indicators will be over compensated for costs incurred, while producers that do not achieve the standard performance indicators will be under compensated for costs incurred.

Compensation to broiler producers in South Africa can be described as a ‘best of both’ compensation system, based on a system of cost plus margin and including an optional bonus. All components used in international markets have been integrated to allow for a system that incorporates both the tournament pricing scheme used so successfully in the USA, combined with a bonus based on fixed performance standards, as requested by growers in the USA. Differences between integrators are apparent, but these differences are minor calculation adjustments, with the basic structure remaining the same.

3.4.3 Pricing at integrator level

The formation process of the price paid by the integrator to the producer within the contracting framework has been described at length. The result of the coordinated nature of the chain and pricing within this framework is that the price paid by integrators for live birds is confidential in nature and not reported or published. Key and MacDonald (2008:3) suggested that the broiler market at primary producer level is no longer a market for live birds, but rather a market for growing services rendered, with the tournament pricing system being used due to its greater success in improving production efficiency over time. The producer price quoted by SAPA is the price at first point of sale, in other words the price received by the integrator for slaughtered birds. The broiler producer price is negotiated between integrated producers and retailers, where concentration levels are high on both sides. The negotiation process between a few large producers and retailers, as opposed to an open market system with large numbers of buyers and sellers suggests that the price levels of key inputs like feed will be significant factors in the price negotiation process, yet other factors must also be considered. International studies like Demir, Aral, Cevger and Aydin (2010:225) suggested that input costs are an important component within broiler price determination, but that other factors such as the prices of substitutes should also be considered.

At wholesale level, imported products provide significant competition, essentially capping the price that domestic producers can receive at import parity levels. The price of imported products is therefore another key consideration that is expected to influence the broiler price. De Beer (2009:32) further indicates that South African consumers have a traditional preference for beef and as such, the cross price elasticity associated with beef is also expected to be significant in influencing the chicken price. The significance of these factors, as well as the extent to which increased input costs can be recovered from the broiler price will be tested empirically in Chapter 4 by determining the elasticity of the broiler price to changes in input costs. A more elastic response to changes in import prices than changes in feed prices would suggest that the presence of imported products in the market make the assumption of perfect competition more realistic.

3.4.4 Implications of the price formation process in the South African broiler market

The price formation mechanism described for the South African broiler market has implications that are beneficial both to the producer and the integrator. There is great incentive for individual producers to improve efficiency, as improved individual efficiency in relation to the group's performance allows the individual producer to increase his profit. At the same time, the result of continued improved efficiency by individual producers is improved efficiency for the entire group, which betters the standard efficiency parameters and thereby decreases the cost for the integrator.

The system further benefits the contract grower through the shifting of price risk onto the integrator. The producer is essentially protected from increasing input costs by the formula used to calculate the price and the only factor that concerns the producer is his individual performance compared to the performance of the group. As long as he is able to maintain or better the standard performance indicators as achieved by the entire group, he is ensured of recovering production costs, regardless of the price received by the integrator at wholesale level. Critically for the integrator, imported products provide competition at wholesale level, essentially meaning that the wholesale price of chicken will not increase above the import parity price for extended periods, regardless of the price of inputs.

The implications for the industry as a whole are that when significant feed price increases are not accompanied by increased chicken prices at wholesale level, the integrators must absorb this cost. The pressure placed on the chicken price at wholesale level by imported products therefore squeezes the margins of the large integrated companies, rather than the primary producer. The pressure exerted on the integrator by increased production costs is clearly illustrated in Figure 21, where a real production cost index based on the cost allocations described by Table 7 is illustrated from 2004, along with a real price index for chicken and the average performance of the three largest broiler producer companies in South Africa, as published in company annual reports. Figure 21 clearly illustrates the decreased margins of integrators at times when input cost increases in real terms were greater than output cost increases.

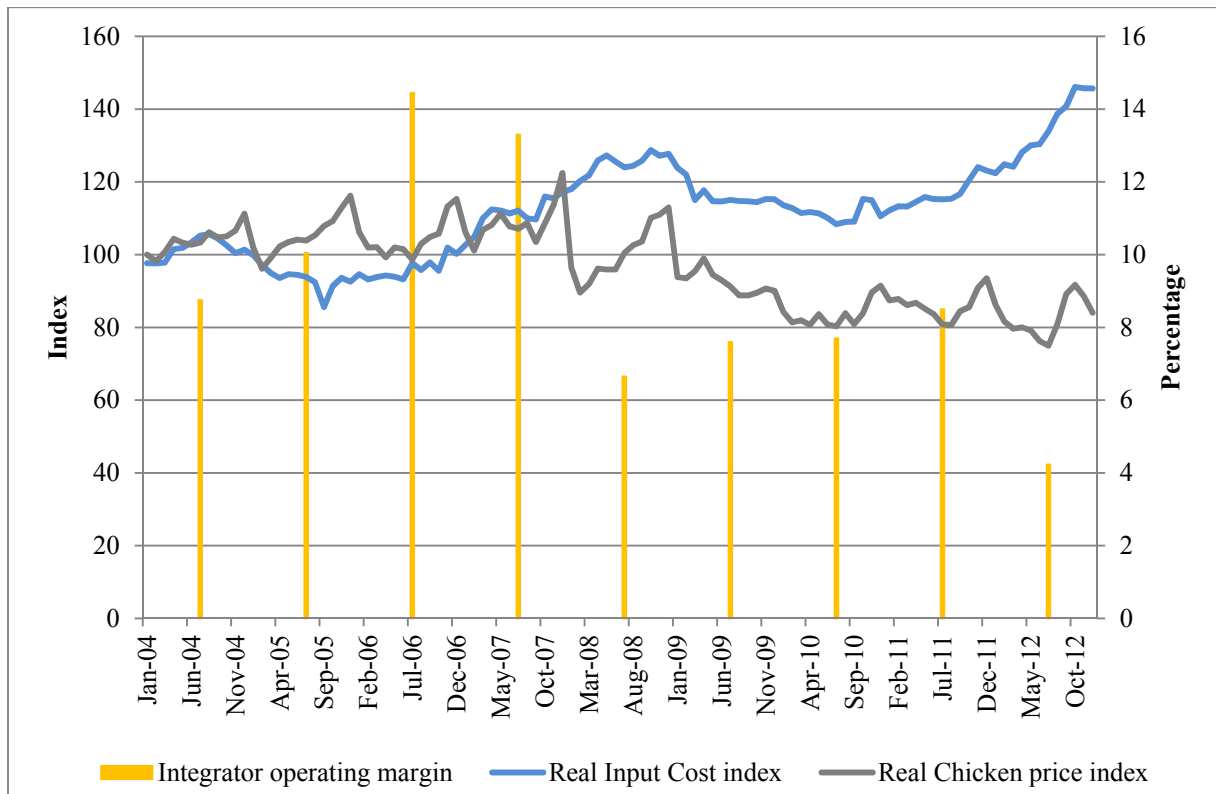


Figure 21: Input cost index, chicken price index and integrator performance

Source: SAPA (2012b), Rainbow Chicken Ltd. (2012), Astral Foods (2012) & Country Bird Holdings (2012)

The industry as a whole benefits from the described price formation system in that large, diversified companies are much better equipped to absorb increasing costs than smaller individual producers. Commodity cycles are common in agriculture and when high feed prices are not accompanied by increased chicken prices, integrators absorb the bulk of the effect. While the effect does reach the primary producer indirectly through the fact that margin increases may be limited and placements may be reduced in severe circumstances, they are not required to bear the entire impact as is often the case in an open market environment. The fact that large, diversified companies are better equipped to absorb the costs means that the effect on the entire industry is reduced, while the certainty regarding both the market and price implied for the producer encourages investment in technology that optimises production efficiency. Integrators in turn are assured of the required level of throughput at abattoir and processor level. While their size and diverse structure renders integrators better equipped than producers to absorb the cost squeeze through difficult cycles, the fact remains that integrators cannot record losses indefinitely, as they are required to perform in order to maintain shareholder confidence. In the long run, feed prices would therefore have to be co-integrated with broiler prices, allowing integrators to recover costs in order to keep producing.

When the costs escalate to the extent that an integrator exits the business, contract growers will be left with no income and significant capital expenditure. When under pressure, integrators may also be forced to reduce the number of contract growers.

3.5 CONCLUSIONS

Chapter 3 provided an understanding of different levels of coordination and the reasons for their popularity in broiler markets around the world. Broiler production contracts in South Africa were analysed in the context of international broiler contracts. Broiler contracts used in the South African market were found to be similar in structure to the ‘buy and sell’ contracts described by Menard (1996:170) for the French broiler industry and are very efficient at increasing production efficiency at primary producer level, through the use of tournament pricing. Compared to the structure used in the USA, South African contracts address some of the concerns highlighted in various studies regarding the compensation structure in USA contracts effectively.

The price formation mechanism used within South African broiler contracts was detailed, laying the theoretical foundation for modelling the broiler producer price in Chapter 4. The levels of coordination and integration within the market were found to be so high, however, that the market at primary producer level has essentially changed from a market for live birds to a market for grower services. The compensation mechanism used within broiler contracts has significant implications for ensuring efficient production, but the broiler producer price is determined higher in the value chain, through negotiations between integrated producers and retailers. Though the price paid to the primary producer for live birds is based on a cost of production formula, with significant benefits from improved efficiency, the price received for the chicken by the integrated processor must compete with imported products at wholesale level, implying that the integrated processor faces significant risk regarding the price that must be paid for mature broilers and the price received for chicken.

Contrasting the compiled input cost index with the broiler price index provides a clear illustration of why the South African broiler industry is troubled, with feed cost increases being significantly greater over the past three years. Though the efficiency of the organisational structure within the industry has allowed it to keep producing through difficult

cycles in the past, a significant decrease in the average operating margins in 2012 indicates that integrated companies are under severe pressure. Increased costs can be absorbed in the short run, but in the long run, integrated companies require a profit margin in order to keep producing. If integrators are no longer able to absorb the increased costs despite their size and diversified structure, the sustainability of the industry will be in danger if the input cost to broiler price ratio does not improve, hence the need to evaluate policy options that would promote the sustainability of the industry.

CHAPTER 4

MODELLING THE SOUTH AFRICAN BROILER MARKET

4.1 INTRODUCTION

Qualitative, as well as quantitative techniques have been used to conduct policy analysis and aid decision making in the past. Quantitative modelling is a popular approach due to its ability to provide objective results by means of quantifying the welfare effects of possible policy decisions and has been used extensively for agricultural policy research (Calcaterra, 2002; Meyer, 2002; De Beer, 2009; Van Zyl, 2010). According to Strauss (2009:10), several research papers use stochastic modelling in order to inform decision making in conditions of risk and uncertainty. Piermartini and Teh (2005:3) further indicated that models are based on economic theory and therefore argued that modelling ensures policy making is guided by a correct understanding of how economies function. Poonyth *et al.* (2000:607) argued that quantitative models can be used for three different levels of analysis, namely market analysis, forecasting of future prices and quantities, and policy analysis.

While a strong theoretical foundation has been laid in Chapters 2 and 3 regarding the structure and price formation dynamics within the South African broiler market, empirical verification is necessary for price formation to be quantified. In order to be used for quantitative policy analysis, the structure and price formation mechanism must be integrated into a simulation framework that accurately represents the industry structure. Different modelling techniques have been used for policy research in the past and these techniques will be discussed in the section that follows, after which the merits and limitations of these approaches will be reviewed. An empirical model of the South African broiler industry is then constructed that captures the market structure and price formation mechanism described in earlier chapters.

In the construction of the model that simulates the South African broiler market, greater emphasis is placed on empirical verification of the price formation mechanism described in Chapter 3 and the estimated price functions are therefore evaluated both statistically and economically, as implemented by Meyer (2006:58-60). Economic evaluation relates to the prior expectation regarding the effect of explanatory variables, as well as the ability of the

model to simulate and capture the turning points within the actual data. Statistical evaluation on the other hand relates to the statistical properties of the model, such as goodness of fit, statistical significance of explanatory variables and diagnostic tests related to violation of the assumptions concerning classic linear regression models.

The new price equations are integrated into the existing partial equilibrium framework of the BFAP sector model in order to simulate a baseline scenario and validate the models forecasting ability. Detailed policy scenarios can then be compared to the baseline projection in Chapter 5. While the equations relating to domestic supply and demand as well as exports of broilers were not re-estimated in this study, the equations are included for the sake of completeness. The equations are however not evaluated to the same extent as the price equations that were estimated in this study, as they have performed well within the BFAP sector model (De Beer, 2009:73).

4.2 TRADITIONAL APPROACHES TO MODELLING COMMODITY MARKETS

Models used for quantitative analysis can be divided into two broad categories namely time series projection models and market equilibrium models (Calcaterra, 2002:22). While time series projection models tend to focus on the statistical behaviour of time series data, market equilibrium models focus on the response of economic agents to changes in prices and other shifters of supply and demand (Van Tongeren *et al.*, 2001:152). Market equilibrium models therefore have the advantage of considering the behaviour of economic agents, as opposed to relying purely on statistical correlation, which does not necessarily imply causation (Gujarati, 2003:23).

Market equilibrium models can be further categorised into partial equilibrium or economy wide models, such as general equilibrium models (Calcaterra, 2002:23). Piermartini and Teh (2005:4) indicate that general equilibrium models account for all the links between various sectors of an economy, while partial equilibrium models usually focus on a single sector of the economy. By considering a certain sector in isolation from the rest of the economy, partial equilibrium models are able to capture that sector in much greater detail than economy wide models (De Beer, 2009:3; Meyer, 2006:21). The ability to capture more detail into the model

will in turn make the simulation more realistic (Piermartini & Teh, 2005:5). According to Piermartini and Teh (2005:5), partial equilibrium models are most suited to policy analysis when sectoral policies are being analysed, or when the sector being studied represents a small share of total income, as is the case with the South African agricultural sector.

4.2.1 Merits and limitations of the traditional modelling approach

Quantitative modelling has many advantages, the greatest of which is arguably the ability to quantify welfare effects of certain policies, thereby providing an objective view of the results of certain decisions. Strauss (2009:38) indicated that regression models (partial equilibrium models are categorised into this group) have a major strength in that they are accurate in representing actual interrelationships and trends based on historic data. These models are therefore applicable in order to guide understanding of causality that could cause variation in the market. Strauss (2009:38) also argued that as a result, these models add significant value when analysing the impact of risk on a market system. As decision making is normally based on the analysis of risk, these models are particularly useful as tools to inform decision making.

Though modelling has been proven useful in order to inform decision making, the approach is by no means perfect. According to Soregaroli and Sckokai (2011:1), the high volatility in world cereal markets between 2008 and 2011 brought the models used for predictive purposes in agricultural commodity markets under scrutiny, as these models had difficulty in predicting the volatility that was experienced. Soregaroli and Sckokai (2011:1) argued that the structure and characteristics of these models are often too simplified to represent the complexities of agricultural markets. They have not however been the only authors to question the predictive power of these models. Binfield *et al.*, (2002:6) indicated that models are simplifications of reality and as some factors are not incorporated into these models, even the best models can fail. Strauss (2009:10) also argued that discontinuities in either endogenous or exogenous variables included in the model could cause the model to over or underestimate probabilities, thereby leading to erroneous decisions.

Soregaroli and Sckokai (2011:1) argued that a good starting point when discussing the simplified structure of agricultural models could be the assumptions that underly these models. Market equilibrium models are based on certain structural assumptions, like constant

returns to scale technology, homothetic consumer preferences and perfectly competitive markets (Soregaroli *et al.*, 2011:196; Calcaterra, 2002:22; Van Tongeren *et al.*, 2001:152). When considering some of the structural characteristics of the South African poultry industry that were discussed in Chapter 2, it is clear that in reality, these assumptions are not always valid.

Partial equilibrium models are based on historic data and as such, model projections rely on the assumption that the structure of the market is a) correctly specified and understood and b) remains unchanged. If a significant change occurred in the structure of the market, the simulation provided by the model might cease to be accurate. It is therefore important to use recent data, which captures the current dynamics of the industry for empirical analysis.

4.2.2 Adjusting models in order to capture the reality of coordinated markets

Strauss (2009:12) argued that, despite the insufficiencies discussed in section 4.2.1 regarding modelling, the technique should still be used to inform decision making. This is due to the fact that modelling often works well when change and rate of change is well understood. Strauss (2009:13) also argued that a better representation of reality would lead to an improved decision making environment. The NIE framework has the advantage that it is able to better capture the reality in the market. The industry analysis conducted in earlier chapters within the NIE framework would therefore lead to the specification of a model that better represents the reality in the market. As change will be better understood, the relating model should provide accurate simulations and lead to a better decision making environment, provided that the factors identified in price formation are captured into the modelling framework.

Adjustments have been made to traditional modelling techniques in order to enable models to capture the reality within certain markets more efficiently. Meyer (2006) developed a model that, through regime switches, is able to accurately simulate various market conditions and thereby account for structural changes in the market. Meyer considers three different regimes termed as “import parity regime”, “near autarky regime” and “export parity regime”. Depending on the regime found in the market, the method used to “close” the model is different. Considering the institutional arrangements identified in the South African poultry industry, closing the model with an import identity will allow for the estimation of a price equation, instead of relying on equilibrium price formation. This would be more realistic,

given the coordinated nature of the value chain. The function to estimate domestic prices would have to be specified in order to account for the factors that influence prices, as identified in Chapter 3. This method of model closure based on an import identity was used successfully by De Beer (2009:98) in order to achieve stability in the model. The price equation in the model estimated by De Beer was synthetic in nature however, suggesting that the true price formation mechanism within the South African broiler industry has not been proven empirically. If the theoretical insight gained from the review of institutions that govern exchange within the South African broiler market can be captured empirically into the modelling framework, a better representation of reality will be achieved.

4.3 MODELLING THE SOUTH AFRICAN BROILER INDUSTRY

Considering the mismatch between the structures described for the South African poultry industry in Chapter 2 and the assumptions of traditional quantitative modelling as described in Chapter 4.1, a combination of the described methods emerges for modelling the South African broiler market. Using a model based on the “import parity regime” described by Meyer (2006:51), where model closure is based on imports, allows for the estimation of a price equation based on the price formation process described in Chapter 3. A well specified price equation will capture the theoretical price formation process described in Chapter 3 empirically, improving forecasting accuracy. Considering the concentration in the market however and the associated possibility of uncompetitive behaviour, the possibility of estimating a price equation at retail level, where the market structure better resembles the assumptions on which modelling approaches have traditionally been based and transmitting the estimated retail price back to the producer price should also be considered. The first question to be answered therefore relates to the level of the value chain where prices should be specified.

4.3.1 Causality between prices at different levels of the value chain

The level in the value chain at which the price equation should be estimated depends on the direction of causality between retail and producer prices in the South African broiler market. Tests for causality have been developed by Granger (Gujarati, 2003:696-702) whereby one variable (x) is considered to cause another variable (y) if x is able to increase the accuracy of forecasting y as opposed to only lagged terms of y.

Gujarati (2003:696-702) indicates that a simple Granger causality test relates to two variables and their lags. A simple Granger causality test between the retail and producer price for whole chicken in South Africa would therefore depend on both prices, as well as lagged prices for both series. Two equations can be specified:

$$\text{Retail Price}_t = \alpha + \sum_{i=1}^m \beta_i (\text{Ret Price})_{t-i} + \sum_{j=1}^n \tau_j (\text{Prod Price})_{t-j} + u_t \quad (1)$$

$$\text{Producer Price}_t = \theta + \sum_{i=1}^p \phi_i (\text{Ret Price})_{t-i} + \sum_{j=1}^q \psi_j (\text{Prod Price})_{t-j} + \eta_t \quad (2)$$

Based on the estimated OLS coefficients for the equations stated above, four different hypotheses can be formulated as follows:

- Unidirectional Granger causality from the producer price to the retail price. Producer prices will improve the prediction of retail prices in this case, but not vice versa. Therefore $\sum_{j=1}^n \tau_j \neq 0$ and $\sum_{j=1}^q \psi_j = 0$.
- Unidirectional Granger causality from the retail price to the producer price. Retail prices will improve the prediction of producer prices in this case, but not vice versa. Therefore $\sum_{j=1}^n \tau_j = 0$ and $\sum_{j=1}^q \psi_j \neq 0$.
- Bidirectional causality, whereby retail prices increase the predictability of producer prices and vice versa. Therefore $\sum_{j=1}^n \tau_j \neq 0$ and $\sum_{j=1}^q \psi_j \neq 0$.
- Independence between retail and producer prices, whereby there is no Granger causality in either direction. In this case $\sum_{j=1}^n \tau_j = 0$ and $\sum_{j=1}^q \psi_j = 0$.

Obtaining one of the above results will result in the detection of the direction of causality between retail and producer prices in the South African broiler market. The results of a simple Granger test, compiled using monthly data of the producer price for whole frozen chicken, as well as the retail price for whole frozen chicken from 2004 to 2012 are illustrated in Table 8.

Table 8: Results of Granger causality test

Null Hypothesis	F - Statistic	P-Value	Conclusion
No unilateral causation from producer prices to retail prices	2.568	0.082	Reject null hypothesis at a 10% level of significance
No unilateral causation from retail prices to producer prices	1.154	0.320	Don't reject null hypothesis

From the results provided in Table 8, it is concluded that unilateral Granger causality is present from the producer price to the retail price. As such, retail prices can be estimated from producer prices, but not vice versa.

4.3.2 Empirical estimation of the South African broiler producer price

The implication from the Granger causality test conducted in section 4.3.1 is that the broiler price should be estimated at producer level, based on the price formation mechanism described in Chapter 3. These producer prices can then be transmitted to retail level. As indicated in Chapter 3, the price paid by the processor to contract growers for mature broilers is based on a formula which considers the cost of producing at standard efficiency parameters. Producer prices are negotiated between integrated producers and retailers, yet the price paid to contract growers is an important factor in the negotiation process. At the same time, the price of imported products has a significant impact on the negotiated price as a result of the competition that imported products provide.

As a net importer of chicken products, changes to the international price of chicken are expected to transmit to the South African market. The correlation between a monthly weighted average FOB price and the monthly weighted average producer price in South Africa from 2007 to 2012 is illustrated in Figure 22. Both prices are illustrated in real terms, having been deflated with the Consumer Price Index for Food (CPIF) in order to remove the effect of inflation.

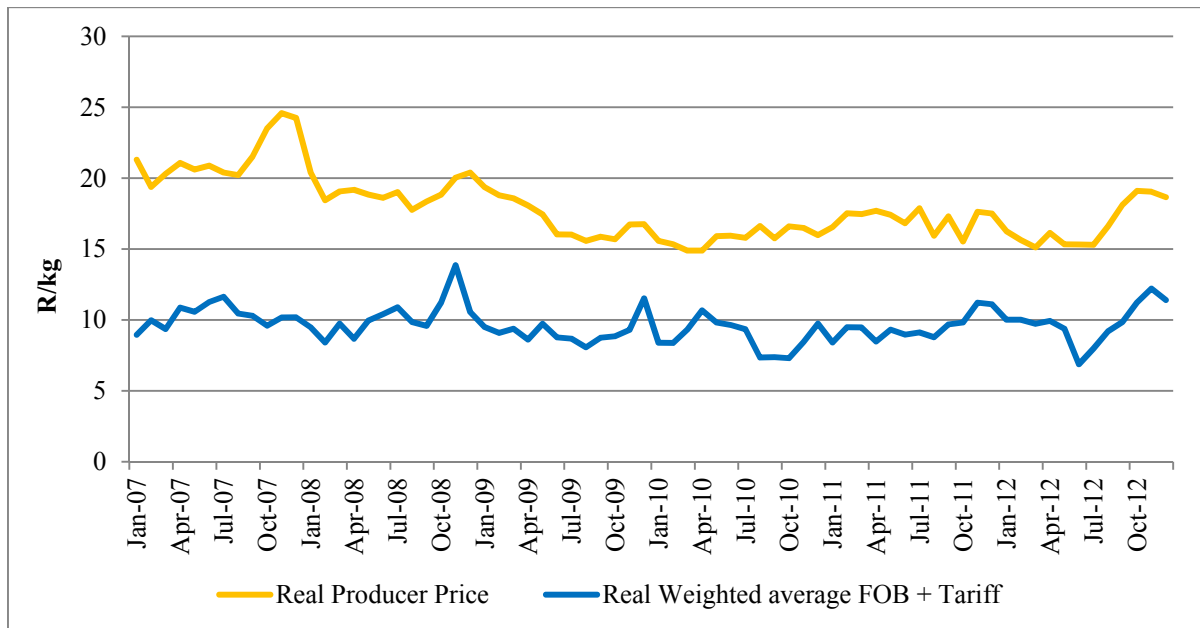


Figure 22: Real broiler producer price in South Africa compared to FOB price + tariff

Source: SAPA (2012b), Trademap (2013c) & SARS (2013)

A positive correlation exists between the real broiler producer price in South Africa and the real weighted average FOB price to which import tariffs have been added, as illustrated by a correlation coefficient of 0.43. Import tariffs were added to the FOB price on a weighted average basis, using shares in total imports of the different tariff classification as weights. De Beer (2009:32) further indicates that South African consumers have a traditional preference for beef, suggesting that the cross price elasticity related to the price of beef as a substitute for chicken is another important consideration. The South African broiler producer price equation can therefore be conceptualised as follows:

$$RBPPSA = fn(RBFPSA, RWAF0BT, RBEEFPSA)$$

Where:

RBPPSA is the real broiler producer price

RBFPSA is the real broiler feed price

RWAF0BT is the real weighted average FOB price plus tariff

RBEEFPSA is the real beef price

The competitiveness dynamics within the South African broiler market changed significantly following the entry of Arbour Acres (Country Bird Holdings) at the breeding level of the

value chain in 2007 (Grimbeek & Lekeswa, 2012:14), as well as the re-entry of Afgri Poultry into the broiler market in 2006. This period also coincided with significant increases in world feed grain prices, causing fundamental shifts in price formation within the industry. As a result, the domestic broiler price is estimated based on monthly data from January 2007 to December 2012, ensuring that the dynamics regarding price formation that are captured into the model are recent and accurate.

Prior to being used for empirical estimation, the time series properties of the data is evaluated for stationarity, as the presence of a unit root could render a normal Ordinary Least Squares (OLS) regression spurious. The results of an Augmented Dickey-Fuller (ADF) test for stationarity are summarised in Table 9.

Table 9: Results of ADF test for stationarity

Series	Model	ADF	ADF First Difference	Conclusion
Real broiler producer price in South Africa	Intercept	-2.24	-8.21***	Integrated of order 1
	Trend and Intercept	-2.22	-8.16***	
	None	-0.57	-8.26***	
Real broiler feed price in South Africa	Intercept	-0.31	-6.90***	Integrated of order 1
	Trend and Intercept	-0.23	-6.95***	
	None	1.37	-6.82***	
Real weighted average fob plus tariff	Intercept	-4.26***	-9.82***	Integrated of order 1
	Trend and Intercept	-4.27***	-9.77***	
	None	-0.21	-9.88***	
Real beef price in South Africa	Intercept	-3.70***	-6.53***	Integrated of order 1
	Trend and Intercept	-3.86**	-6.49***	
	None	-0.09	-6.58***	

Significance level: ***1%, **5% and *10%

When variables containing a unit root are used in an OLS regression, the results could be spurious, yet using variables in differenced form results in some of the long run theory and goodness of fit being lost (Ferris, 2005:311). As all variables are integrated of order one, an error correction model (ECM) is estimated in order to account for the long run relationship between the broiler producer price and the explanatory variables, as well as the short run variations around this long run relationship. The first step in the estimation of an ECM is to quantify the long run relationship through the estimation of a co-integration equation, after

which the Engle-Granger test is performed on this equation in order to confirm the co-integrating relationship between the dependant and explanatory variables. The co-integration equation is specified in log linear format in order to correct for autocorrelation and can therefore be conceptualised as follows:

$$\ln RBPPSA = \alpha + \beta_1 \ln RBFPSA + \beta_2 \ln RWAF0BT + \beta_3 \ln RBEEFPSA + \mu$$

Where:

lnRBPPSA is the natural log of the real broiler producer price in South Africa

lnRBFPSA is the natural log of the real broiler feed price in South Africa

lnRWAF0BT is the natural log of the real weighted average FOB price plus tariff

lnRBEEFPSA is the natural log of the real beef price in South Africa

μ is the associated error term

Estimation of an OLS regression yields the results summarised in Table 10. The dependant variable was the natural log of the real broiler producer price in South Africa. From the estimated results, it is noted that the real broiler feed price and the FOB price are significant variables at a 5% level of significance, while the F-statistic of 8.76 would render the model as a whole significant. Taking note of these facts provides an initial guide as to the relevance of the chosen variables, but no statistical inference can be drawn from them due to the fact that the variables are not stationary. The OLS regression could therefore yield spurious results (Ferris, 2005:307).

Table 10: Estimation results of the Engle-Granger co-integration equation

Variable	Coefficient	T-Statistic
<i>lnRBFPSA</i>	0.2921	2.25**
<i>lnRWAF0BT</i>	0.2944	2.62**
<i>lnRBEEFPSA</i>	0.22308	1.34
Constant	-1.0018	

Significance level: ***1%, **5% and *10%

The adjusted R^2 value is low at 0.25; however the goodness of fit is not evaluated critically at this point, as no statistical inference can be drawn from it due to the presence of a unit root in

the data. As the model was specified in log-linear format, elasticities can be deduced directly from the coefficients of the explanatory variables. An elasticity of 0.29 on broiler feed prices suggests that an increase of 10% in the real broiler feed price would lead to an increase of 2.9% in the real broiler producer price. Similarly, an increase of 10% in the real weighted average FOB price or the real beef price would lead to an increase of 2.9% and 2.2% respectively in the real broiler producer price. These elasticities are not final, as adjustments will be made in order to account for short run effects and initial bias following the estimation of the ECM, however the signs of these elasticities are in line with priori expectations and seem plausible. Final interpretations of these elasticities can however only be meaningful after the Engle-Yoo third step adjustment, following estimation of the ECM.

An Engle-Granger co-integration test, performed in order to test for a long run co-integrating relationship between the dependant and independent variables statistically yielded the results illustrated in Table 11. As the residual series is stationary, it is concluded that a significant long run co-integrating relationship exists between the dependant and independent variables.

Table 11: Results of the Engle-Granger co-integration test

Series	Model	ADF	Null Hypothesis	Conclusion
Residual of the co-integration equation	Intercept	-3.085**	Residual series has a unit root – no co-integration	Residual series does not have a unit root
	Trend and Intercept	-3.876**		
	None	-3.104***		

Having established that a long run co-integrating relationship does exist, an error correction model is then estimated in order to account for the short run variation around this long run co-integrating relationship. A generic representation of the error correction model to be estimated is represented below:

$$\Delta \ln RBPPSA_t = \alpha + \beta_1 \Delta \ln RBFPSA_{t-i} + \beta_2 \Delta \ln RWAFOB_{t-i} + \beta_3 \Delta \ln RBEEFPSA_{t-i} + \theta EC_{t-1} + \varepsilon_t$$

Where:

$\Delta \ln RBPPSA_t$ is the natural log of the real broiler producer price in first difference form

$\Delta \ln RBFPSA_t$ is the natural log of the real broiler feed price in first difference form

$\Delta \ln RWAFOBT_t$ is the natural log of the real weighted average FOB price plus tariff in first difference form

$\Delta \ln RBEEFPSA_t$ is the natural log of the real beef price in first difference form

EC_{t-1} is the error correction term

ε_t is the associated error term

The estimated results of the model represented above are summarised in Table 12, with the dependant variable as the natural log of the real broiler producer price in first difference form. For the ECM estimation, all variables are used in first differenced form, in order to render them stationary.

Table 12: Estimation results of the ECM

Variable	Coefficient	P-Value
$\Delta \ln RBFPSA_t$	0.5237	0.0104**
$\Delta \ln RWAFOBT_t$	0.1271	0.0155**
$\Delta \ln RBEEFPSA_t$	0.0505	0.7126
EC_{t-1}	-0.1718	0.0036***

Significance level: ***1%, **5% and *10%

The coefficient on the error correction term gives an indication of how long a shock that causes dis-equilibrium needs to move through the system. The negative coefficient indicates that the system converges back to equilibrium status following an external shock, while the magnitude of the coefficient indicates the time required for the system to return to equilibrium. An error correction term of -0.17 therefore indicates that a shock causing disequilibrium would need 5.9 months before the system returns to equilibrium status. The negative sign of the error correction term is an important component when evaluating the ECM, as a positive sign would indicate that error terms are diverging from equilibrium, rendering the error correction model invalid. Evaluation of t-statistics indicates that the real broiler feed price, as well as the weighted average FOB price are statistically significant at a 5% level of significance, while the error correction term is statistically significant at a 1% level of significance. The real beef price is not statistically significant within the ECM, yet its economic significance, as well as the fact that it improves the models goodness of fit (R^2) results in it being maintained as explanatory variable. In this instance, some statistical

significance is lost in order to improve the models ability to simulate well (Pindyck & Rubinfeld, 1998).

As with the co-integration equation, evaluation of the adjusted R^2 in order to measure the goodness of fit yields a low value at 0.22, yet graphical examination in Figure 23 illustrates that the estimated function captures the turning points relatively well, which is an important consideration when evaluating a model economically (Meyer, 2006:58). Further Ferris (2005:311) also indicates that the use of differencing often reduces the goodness of fit in agricultural models.

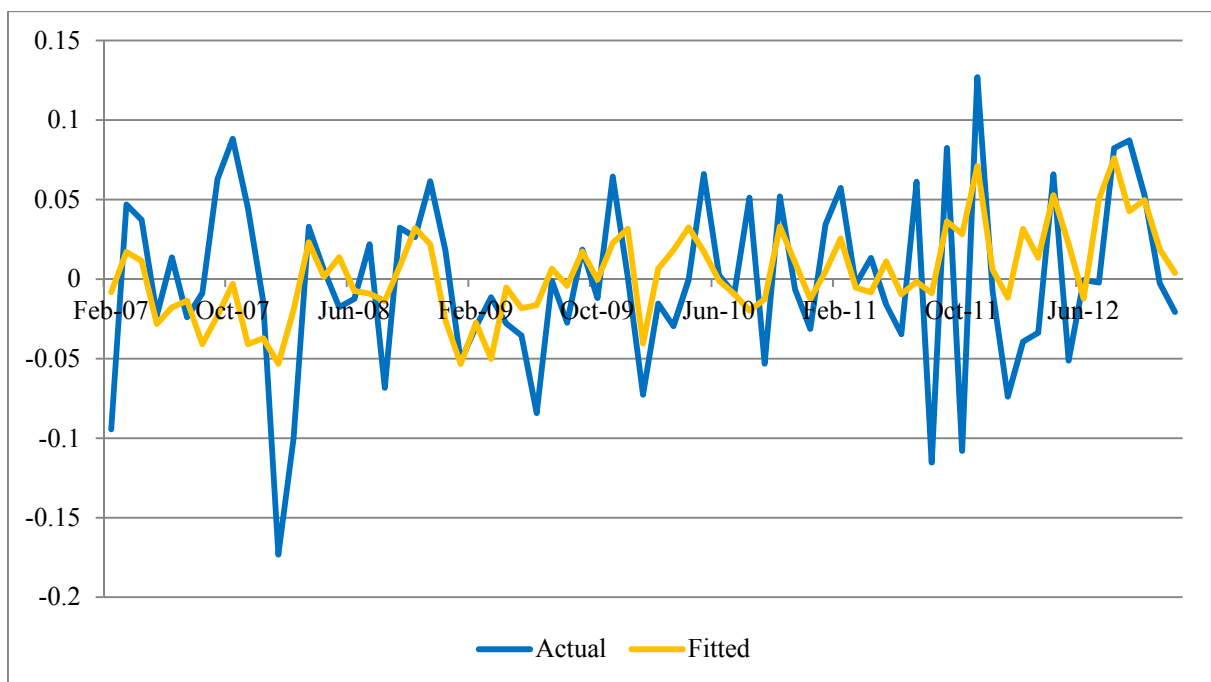


Figure 23: Comparing actual and fitted values from the ECM

In order to test for violations of the assumptions associated with classic normal linear regression models, such as normality, heteroscedasticity, auto correlation and misspecification, a series of diagnostic tests are performed. The results of these diagnostic tests are summarised in Table 13. The ECM is validated by the fact that none of the assumptions tested for are violated.

Table 13: Diagnostic test results

Test	Null Hypothesis	Test Statistic	P-Value	Conclusion
Jarque-Bera	Normal Distribution	2.24	0.33	Error terms are normally distributed
ARCH LM	No ARCH	2.42	0.12	No 1 st order ARCH
White	No Heteroscedasticity	11.61	0.31	Homoscedasticity
Breusch-Godfrey	No serial correlation	2.40	0.30	No 2 nd order serial correlation
Durbin-Watson	No serial correlation	1.94		No serial correlation
Ljung-Box	No serial correlation	3.39	0.76	No 6 th order serial correlation
Ramsey Reset	No misspecification	1.87	0.60	Correct specification

Having validated the ECM, the Engle-Yoo third step is performed in order to adjust the long run parameters estimated in the co-integration equation for initial bias, allowing quantification of long run elasticities which can be used to integrate the monthly price equation into the annual BFAP sector model. The Engle-Yoo third step allows for accurate conclusions to be drawn regarding the magnitudes and statistical evaluations of the long run coefficients. The results of the Engle-Yoo adjustment are summarised in Table 14.

Table 14: Engle-Yoo third step adjustment

Variable	Coefficient adjustment
$0.1718*(lnRBFPSA_t)$	$0.292081 - 0.0985 = 0.1936$
$0.1718*(lnRBEEFPSA_t)$	$0.230817 + 0.0463 = 0.2708$
$0.1718*(lnRWAFOBT_t)$	$0.294382 + 0.2808 = 0.5750$

Following the Engle-Yoo third step adjustment, long run elasticities, as well as the associated t-statistics are illustrated in Table 15. Following the Engle-Yoo adjustment, the variables in the long run co-integrating equation can be evaluated for statistical significance, based on the adjusted t-statistics. From Table 15, both the real broiler feed price and the real beef price are statistically significant at a 10% level, while the real weighted average FOB price is statistically significant at a 1% level of significance. From interpretation of the long run elasticities it follows that a 10% increase in the real broiler feed price would lead to a 1.9% increase in the real broiler producer price. Similarly, a 10% increase in the real weighted

average FOB price would lead to an increase of 5.75% in the real broiler producer price. The estimated elasticities clearly illustrate the effect that imported products have on the price of domestic products, despite the fact that integrated producers pay contract growers based on a cost of production formula. The extent to which integrated producers can pass increased production cost up the value chain is limited as a result of the competition provided by imported products.

Table 15: Long run elasticities and t-statistics following Engle-Yoo adjustment

Variable	Elasticity	T-Stat
$RBFPsA_t$	0.1936	1.61*
$RWAFOBT_t$	0.575	5.11***
$RBEEFPsA_t$	0.2708	1.59*

Significance level: ***1%, **5% and *10%

4.3.3 Transmission from producer to retail prices

In order to simulate the effect of proposed changes or different policies on the South African broiler market, the extent to which changes in producer prices are transmitted to retail level is an important factor, as the effect on consumers should be measured at retail level. The same error correction modelling approach is therefore used in order to quantify the transmission of producer prices to retail level. Before empirical estimations are conducted, the time series properties of the variables to be used are evaluated. The results of an ADF test for stationarity are illustrated in Table 16.

Table 16: Results of ADF test for stationarity

Series	Model	ADF	ADF First Difference	Conclusion
Real broiler producer price	Intercept	-2.24	-8.21***	Integrated of order 1
	Trend and Intercept	-2.22	-8.16***	
	None	-0.57	-8.26***	
Real chicken retail price	Intercept	-1.89	-8.46***	Integrated of order 1
	Trend and Intercept	-2.37	-13.12***	
	None	-1.64*	-8.29***	

Significance level: ***1%, **5% and *10%

Using the same methodology employed in the estimation of the producer price equation, the estimation of an error correction model essentially involves three steps. Firstly, a co-integration equation is estimated in order to test for a long run co-integrating relationship between the real broiler producer price and the real chicken retail price. The theoretical function can be conceptualised as follows:

$$RCRETPSA = \alpha + \beta_1 RBPPSA + \mu$$

Where:

RCRETPSA is real retail prices

RBPPSA is real producer prices

μ is the associated error term.

The estimation output for the long run co-integration equation is presented in Table 17. The dependant variable is the real retail price of chicken.

Table 17: Estimation results of the Engle-Granger co-integration equation

Variable	Coefficient	Elasticity	t-statistic
<i>RBPPSA</i>	1.08	0.62	10.70***

Significance level: ***1%, **5% and *10%

The calculated elasticity of 0.62 indicates that a 10% increase in the real broiler producer price would lead to a 6.2% increase in the real retail price of chicken. This value is however not definitive, as it will be adjusted in an Engle-Yoo third step to account for bias following the estimation of the ECM. The R^2 of 0.62 associated with the co-integrating equation indicates a reasonable goodness of fit, while the t-statistic of 10.70 renders the real broiler producer price statistically significant in explaining changes in the real retail price of chicken. While these statistical evaluations are noted in order to guide understanding, no inference can be drawn from them however, as the variables used are not stationary. Statistical inference will therefore need to be confirmed following the Engle-Yoo adjustment.

Meaningful statistical evaluation of the co-integration equation includes an Engle-Granger co-integration test, performed in order to test for the existence of a long run co-integrating relationship between the real broiler producer price and the real retail price of chicken. The

results of the co-integration test are presented in Table 18. As the residual series is stationary, it is concluded that a significant long run co-integrating relationship exists between the real broiler producer price and the real retail price of chicken.

Table 18: Results of the Engle-Granger co-integration test

Series	Null Hypothesis	Model	ADF	Conclusion
Residual of the co-integration equation	Residual series has a unit root	Intercept	-3.93***	Residual series does not have a unit root
		Trend and Intercept	-4.77***	
		None	-3.97***	

Significance level: ***1%, **5% and *10%

The second step is the estimation of an ECM to account for the short run variations around the long run relationship. The following is a generic representation of the model to be estimated:

$$\Delta RCRETPSA_t = \alpha + \beta_1 \Delta RBPPSA_{t-i} + \theta EC_{t-1} + \varepsilon_t$$

Where:

$\Delta RCRETPSA_t$ is chicken retail prices in first difference form

$\Delta RBPPSA_t$ is broiler producer prices in first difference form

EC_{t-1} is the error correction term

ε_t is the associated error term

The estimation results of the ECM are presented in Table 19. The dependant variable is the real retail price of chicken in first differenced form, in order to render it stationary.

Table 19: Estimation results of the ECM

Variable	Coefficient	P-Value
$\Delta RBPPSA_t$	0.4249	0.0051***
EC_{t-1}	-0.2925	0.0004***

Significance level: ***1%, **5% and *10%

The coefficient of the error correction term (-0.29) indicates that a shock to the producer price would require 3.44 months in order to transmit through the value chain, before prices return to equilibrium levels. The fact that the coefficient on the error correction term is negative is an

indication that the model converges back to equilibrium. Both the real broiler producer price and the error correction term are statistically significant variables at a 1% level of significance. The F-statistic of 9.59 validates the overall significance of the ECM, while the goodness of fit remains low with an adjusted R^2 of 0.2. Differencing agricultural variables however often leads to low R^2 values (Ferris, 2005:311) and hence the ECM is maintained in its current form.

In order to adjust the long run parameter and quantify the extent to which producer prices are transmitted to retail prices, the Engle-Yoo third step adjustment is performed on the coefficients of the co-integration equation. In order to make this adjustment, a regression analysis is computed with the residual series of the ECM as dependant variable. The results of the Engle-Yoo third step adjustment are summarised in Table 20.

Table 20: Engle-Yoo third step adjustment

Variable	Coefficient adjustment
$0.292544*(RBPPSA_t)$	$1.079643 - 0.001380 = 1.078263$

Following the Engle-Yoo third step adjustment, long run elasticities, as well as the relevant t statistics are illustrated in Table 21. The real broiler producer price remains statistically significant at a 1% level, while the elasticity of 0.62 indicates that an increase of 10% in the real broiler producer price will be accompanied by an increase of 6.2% in the retail price of chicken.

Table 21: Long run elasticities and t-statistics following Engle-Yoo adjustment

Variable	Elasticity	T-Stat
$RBPPSA_t$	0.6224	10.70***

Significance level: ***1%, **5% and *10%

Incorporation of the price transmission equation into the BFAP sector model allows for policy analyses to be conducted at different levels of the value chain, measuring the effect of policy changes on producers and consumers at the same level of the chain where their respective decisions regarding prices are made.

4.3.4 Domestic supply and demand equations

The equations simulating domestic supply and demand, as estimated by De Beer (2009:60-73) and integrated into the BFAP sector model are not re-estimated for this study, due to the fact that they have performed well to date within the BFAP sector model framework. Due to the fact that no changes were made to these equations, they are not evaluated to the same extent as the price equations in the previous sections, yet they are included and interpreted for the sake of completeness.

4.3.4.1 Domestic consumption estimate

Domestic consumption of chicken in South Africa is estimated in per capita terms, calculated as the amount of chicken (kg) consumed per capita on an annual basis. The estimated function is illustrated as follows:

$$PCCONSA = f(RBPPSA, MBFP, \ln(RPCGDP))$$

Where:

PCCONSA is per capita consumption of chicken in South Africa

RBPPSA is the real broiler producer price in South Africa

MBFP is an index that captures the sum of cross commodity effects

$\ln(RPCGDP)$ is the natural log of real per capita GDP in South Africa

The MBFP index is calculated as the ratio of the real carcass prices (c/kg) to the respective annual production levels (1000 ton) for mutton, beef and pork. The real GDP per capita is used in natural logarithmic form in order to ensure that the elasticity decreases as income rises (De Beer, 2009:61). The estimation results are provided in Table 22.

Table 22: Estimation results of the per capita consumption equation

Explanatory variable	Estimated coefficient	T-statistic	P-value	Elasticity
Intercept	-368.36	-5.982	0.000	
RBPPSA	-0.018	-10.842	0.000	-0.37
MBFP index	0.186	1.121	0.273	0.144
Ln(RPCGDP)	41.661	-2.118	0.000	2.114

Source: De Beer (2009:61)

Economically, the estimated coefficients are in line with prior expectations, with both per capita GDP and the prices of substitute products affecting chicken consumption positively, while the real broiler producer price affects chicken consumption negatively. Statistical evaluation of the model also yields satisfactory results, with an R^2 value of 0.9 indicating a good fit, while the F statistic (52.25) renders the equation as a whole significant. Further all variables are significant at a 1% level, apart from the MBFP index, which was still maintained due to its economic relevance.

Elasticity values are in line with prior expectations, apart from the income elasticity, which is particularly high, especially considering the fact that chicken is the cheapest source of protein available to South African consumers. De Beer (2009:61) also noted this and adjusted the elasticity synthetically (to 0.26) in order to improve the model's ability to make future projections. Own price elasticity is inelastic, which is expected due to the lack of cheaper alternatives. An increase of 10% in the real broiler producer price in South Africa results in a 3.7% decrease in per capita consumption of chicken.

Following estimation of the per capita consumption, domestic demand for chicken in South Africa is calculated by multiplying per capita consumption with the number of people in the South African population.

4.3.4.2 Domestic production estimate

An important determinant of broiler production in South Africa is the price of input costs, which is captured into the broiler production equation in the form of an input cost index. The most important component of the input cost index is the price of feed, as it comprises approximately 70% of input costs, as illustrated in Chapter 3. The cost of feed is estimated based on feed inclusion rates allocated by De Beer (2009:70). Feed inclusion rates were verified for the purpose of this study and as changes were minimal, the feed price calculation was not altered. The feed inclusion rates are summarised in Table 23.

Table 23: Broiler feed inclusion rates

Feed ingredient	Inclusion Rate (De Beer)	Inclusion rate verified
Maize	0.65	0.65
Sunflower Cake	0.03	0.00
Soybean Cake	0.18	0.19
Full fat Soya	0.05	0.06
Fishmeal	0.03	0.01
Vegetable oil	0.02	0.02
Vitamins and minerals	0.04	0.04
Rendering	0.00	0.03

Source: De Beer (2009:61)

The price of feed is calculated on a weighted average basis, using the prices of raw materials and the inclusion rates as weights. In the construction of the input cost index, the calculated feed price is weighted as 70%, while the remaining 30% is represented by a proxy variable in the form of the GDP deflator. While the method is the same as that used by De Beer (2009:70), the weights are altered in order to provide an updated picture.

The nature of broiler production, given the intensive use of technology in production and the cost of establishing this technology means that lagged production is an important variable in explaining current production. In order to capture the improvement in production technology however, lagged production is multiplied by a trend variable influenced by the number of production cycles per year. The estimated equation is presented below, while the estimation results are presented in Table 24.

$$BRPRDSA = f(RBPPSA, RCKIPISA, \ln(LBRPRDSA * CYCLES))$$

Where:

BRPRSA is broiler production in South Africa

RBPPSA is the real broiler producer price in South Africa

RCKIPISA is the real chicken input cost index calculated

$\ln(LBRPRDSA * CYCLES)$ is the natural log of lagged production multiplied by a cycles per year trend

Table 24: Estimation results of the broiler production equation

Explanatory variable	Estimated coefficient	T-statistic	P-value	Elasticity
Intercept	-5261.70	-8.616	0.00	
RBPPSA	0.285	1.944	0.063	0.19
RCKIPISA	-0.168	-0.234	0.817	-0.05
$\ln(LBRPRDSA * CYCLES)$	670.070	11.042	0.000	0.62

Source: De Beer (2009:61)

Economic interpretation of the estimated coefficients is in line with prior expectations, as lagged production as well as the real broiler producer price affects broiler production positively, while input cost increases affect broiler production negatively. Broiler production is inelastic to changes in the broiler producer price, with an increase of 10% in the broiler producer price leading to an increase of only 1.9% in broiler production. This is in line with expectation however, given the capital intensive nature of production, as well as the cost of production technology. Due to the significant investment required in highly specific assets, as well as the duration of the production cycle from grandparent level, producers are not able to decrease production suddenly when the price decreases. For the same reasons, the inelastic response to increased input costs is also in line with expectations.

From a statistical perspective, the F-statistic (191.87) renders the equation as a whole significant, while the R^2 value of 0.96 indicates a very good fit. While the real broiler producer price is statistically significant at a 10% level, lagged production is statistically significant at a 1% level of significance. The input cost index is not significant when evaluated statistically, but is maintained due to its economic relevance (De Beer, 2009:73).

4.3.4.3 Exports and stock levels

The remaining equations that need to be estimated in order to represent the entire broiler industry in South Africa are exports and beginning / ending stocks. The nature of the product however, in addition to South Africa's limited cold storage capacity means that stock levels are insignificant and are therefore not estimated (De Beer, 2009:63).

The majority of South Africa's chicken exports are destined for neighbouring African countries like Mozambique and Zimbabwe (Trademap, 2013a), however the quantity of

annual exports has never exceeded 16 thousand tons. Average exports over the past decade have amounted to only 7 thousand tons annually, representing an average of less than 0.5% of domestic demand. Although exports are estimated within the BFAP sector model, it represents an insignificant component of the broiler market in South Africa and is therefore not evaluated in the context of this study.

4.3.5 Model closure and baseline simulation

The technique used to “close” a recursive simulation model determines the manner in which equilibrium is achieved within the market. Literature identifies different model closure techniques; however the choice of technique depends on the structure of the market (Meyer, 2006:49). In order to capture the reality of the market structure and price formation mechanism described in earlier chapters into a recursive simulation modelling framework, the model would have to be closed on trade, allowing for the estimation of price equations (as described in section 4.3.3). South Africa’s status as a net importer of chicken further illustrates that model closure based on trade is the appropriate method of establishing market equilibrium (Meyer, 2006:51).

The BFAP sector model is used to produce an annual outlook and as such, the equations used to simulate the demand and supply of broilers within the model are based on annual data. The price equation in Chapter 4 however was estimated based on monthly data for two reasons. The use of monthly data provides sufficient observations in order to generate a credible error correction model, while simultaneously accounting for the fact that the most recent market conditions are considered when evaluating the price formation mechanism. This accounts for the fact that structural breaks in the data make the projection of future scenarios based on a historic annual time series unreliable. In order to close the model and achieve equilibrium, the monthly price equations are integrated into the annual model using the long term elasticities generated from the Engle-Yoo third step adjustment. The average elasticities from the monthly ECM were used in order to calculate an annual coefficient as indicated below.

$$\begin{aligned}\text{Elasticity} &= \frac{\partial Y}{\partial x} \times \frac{Y}{x} \\ &= (\text{coefficient of } x) \times \frac{Y}{x}\end{aligned}$$

Rearranging the terms above, it follows that:

$$(\text{coefficient of } x) = \text{Elasticity} \times \frac{x}{Y}.$$

Following the conversion of the price equations to an annual frequency, an import identity is used in order to close the modelling system, forcing it into an equilibrium situation. Imports are therefore calculated as follows:

$$\text{Imports} = \text{Domestic consumption} + \text{exports} - \text{domestic production}$$

A flow diagram representing the recursive simulation model of the South African broiler market, affected by fundamental, as well as institutional (highlighted in blue) factors and closed on imports to achieve equilibrium is illustrated in Figure 24.

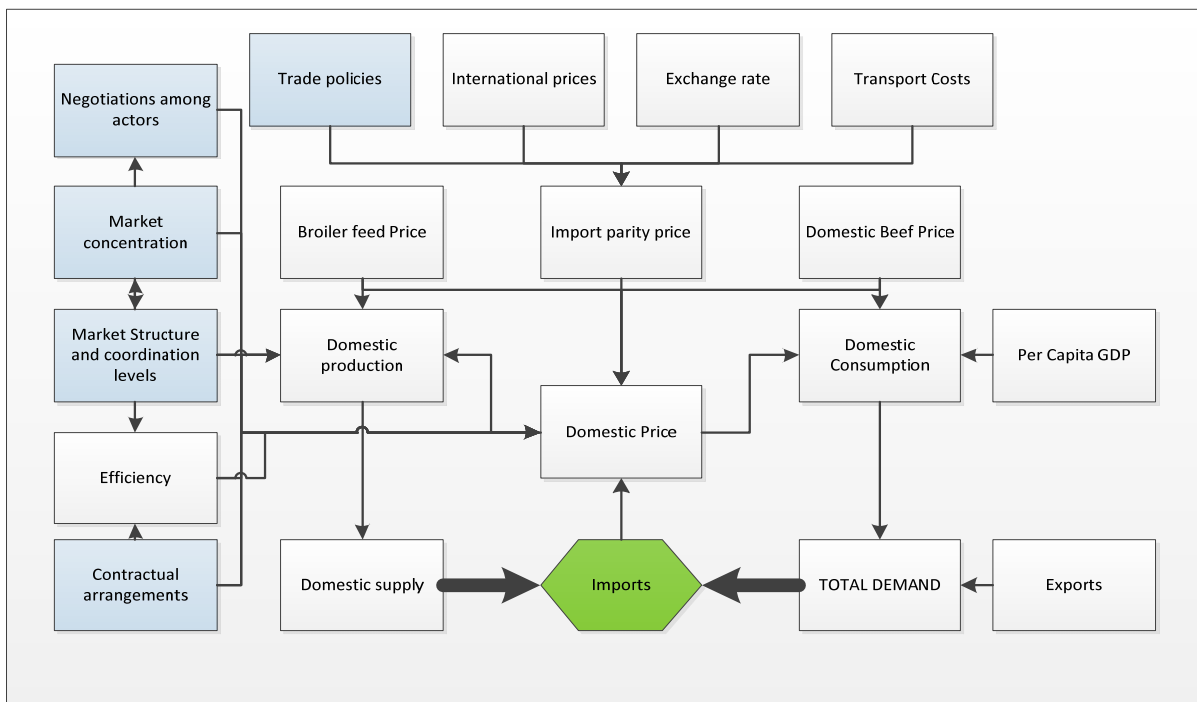


Figure 24: Model of the South African broiler market

Integration of the closed simulation model into the BFAP sector model enables the simulation of a baseline outlook, in order to validate the forecasting accuracy of the estimated model. A baseline outlook does not constitute a forecast, but instead represents a single possible scenario in the future, based on specific macro-economic and policy assumptions illustrated in Tables 25 and 26. The baseline outlook presented in this study further relies on the Food and

Agricultural Policy Research Institute (FAPRI) and OECD-FAO outlook regarding world prices. Uncertainties regarding policy changes and other market disruptions, as well as the reliance on macro-economic projections for exogenous variables ensure that the future is unlikely to match the baseline outlook. The baseline is useful however in that it presents a “reference scenario” to which other scenarios that involve specific policy changes can be compared. A baseline outlook therefore also forms a part of the validation procedure (Meyer, 2006:97). The baseline outlook for the South African broiler industry is presented in Figure 25.

Table 25: Key macro-economic assumptions associated with the baseline simulation

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	Millions									
Total population of SA	51.0	51.2	51.4	51.7	51.9	52.1	52.3	52.6	52.8	53.1
	US \$/barrel									
U.S. refiners acquisition oil	104	101	95	100	105	110	114	118	121	124
	SA cents / Foreign currency									
Exchange rate (SA cent/US\$)	924	918	952	984	1016	1052	1089	1128	1168	1210
Exchange rate (SA cent/Euro)	1174	1163	1204	1244	1285	1331	1379	1429	1481	1535
	Percentage change									
Real GDP per capita	2.50	3.10	3.25	3.60	3.80	3.89	3.60	3.50	3.60	3.70
GDP deflator	5.30	5.11	4.86	4.74	4.70	4.85	4.85	4.85	4.85	4.85
	Percentage									
Weighted prime interest rate	9.61	9.67	9.74	9.80	9.86	9.92	9.99	10.05	10.11	10.18

Source: BFAP (2013:24)

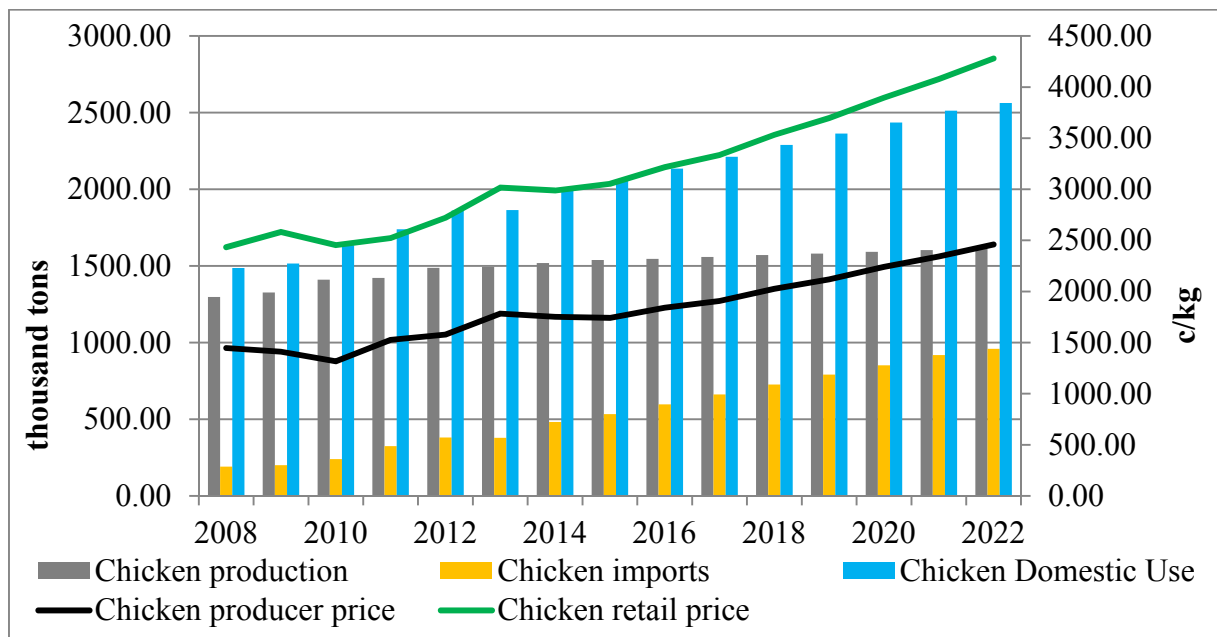


Figure 25: Baseline outlook for the South African broiler industry

Table 26: Key policy assumptions associated with the baseline simulation

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	R/ton									
Maize tariff: (Ref. price = US\$ 110)	0	0	0	0	0	0	0	0	0	0
Wheat tariff (Ref price = US\$ 294)	0	64	408	509	504	472	418	405	430	460
Sunflower seed tariff: 9.4 % of fob	470	404	403	409	425	449	469	483	498	514
Sunflower cake tariff: 6.6 % of fob	141	96	104	111	115	122	126	130	134	139
Sorghum tariff: 3 % of fob	78	62	60	63	66	69	72	74	77	79
Soybean tariff: 8 % of fob	384	317	309	324	338	356	367	377	389	401
Soybean cake tariff: 6.6 % of fob	276	181	192	207	215	227	233	245	254	263
Beef tariff: max (40 %* fob,240c/kg)	1069	1065	1107	1133	1148	1172	1197	1270	1349	1433
Lamb tariff: max (40 %* fob,200c/kg)	1473	1424	1412	1420	1434	1477	1554	1642	1736	1793
Chicken tariff (Whole frozen): 27%	236	229	234	243	254	269	283	297	311	325
Chicken Tariff (Carcass): 27%	120	117	119	124	130	137	144	151	158	166
Chicken Tariff (Boneless Cuts): 5%	108	105	107	111	116	123	129	136	142	149
Chicken Tariff (Offal): 27%	157	153	156	162	169	179	188	198	207	217
Chicken Tariff (Bone in portions): 220c/kg	220	220	220	220	220	220	220	220	220	220
Pork tariff: max(15 %* fob, 130c/kg)	190	189	187	183	184	197	211	219	224	229

Source: **BFAP (2013:22-23)**

Its performance in generating a credible baseline outlook validates the model to an extent, however the stability of the model when shocked will be tested in Chapter 5 when different policy scenarios are simulated.

4.4 CONCLUSION

Following the theoretical foundation describing the South African broiler industry in Chapters 2 and 3, the purpose of Chapter 4 was the construction of a simulation model that represents the market structure and price formation mechanisms described in Chapters 2 and 3 accurately.

Despite the mismatch between the assumptions associated with traditional quantitative modelling techniques, a partial equilibrium model where equilibrium is achieved through an import identity instead of price equilibration allows for the estimation of a price equation. Estimation of a price equation allows for the relaxation of the perfect competition assumption in that factors other than the domestic supply and demand balance influence the domestic broiler price. Despite the fact that prices are negotiated in a concentrated market, the price formation process described in Chapter 3 was validated empirically through the estimation of an ECM based on monthly data.

The estimated elasticities indicated that despite the fact that integrated producers pay contract growers based on a cost plus principle, the competition provided by imported products prevents them from pricing their products in the same way. Though the price of broiler feed was significant in explaining the broiler price, the associated elasticity was much smaller than that of the import price. The limited extent to which changes in feed costs are transmitted to the broiler price provides an indication as to why integrated broiler producers are in trouble. With economic efficiency lacking due to high feed costs, domestic producers struggle to compete with international counterparts and proposed tariff protection should be evaluated objectively in order to ensure the long run sustainability of South African broiler production.

The price equation estimated in Chapter 4 incorporates a weighted average import tariff, as opposed to the aggregated tariff used previously within the BFAP sector model, allowing for the simulation of detailed tariff scenarios. Integration of the estimated price equations into the BFAP sector model yields a realistic baseline outlook to which detailed tariff scenarios can be compared in Chapter 5.

CHAPTER 5

EVALUATION AND QUANTIFICATION OF THE EFFECT OF PROPOSED TARIFF PROTECTION ON THE SOUTH AFRICAN BROILER INDUSTRY

5.1 INTRODUCTION

The price formation mechanism described in Chapter 3 and 4 has significant implications for the long run sustainability of the South African broiler industry. Though increased production cost does affect the broiler price positively, the effect of imports in limiting the extent to which these increasing costs can be recovered implies that integrated companies must absorb increased feed costs to a large extent. The hybrid organisational form described in Chapter 3 has allowed these companies to continue producing despite the fact that a 157% increase in feed prices from 2001 to 2012 was accompanied by an increase of only 61% in the broiler producer price. With Rainbow Chicken, Astral Foods Poultry division and Afgri Poultry reporting losses in 2013 the application by SAPA for increased tariffs should be evaluated objectively, considering both the sustainability of the broiler industry as the greatest contributor to South African agriculture and the sensitive nature of chicken as the cheapest source of animal protein to South African consumers.

Agricultural trade protection is a topic that has been researched and discussed at length around the world (Salvatore, 2007:251-255). Despite many arguments describing the benefits of free trade, protectionism is still widely practiced worldwide, particularly in agriculture. The main arguments for the use of trade protection have been the protection of strategic industries, deterring unfair competition, saving jobs and maintaining an extent of self-sufficiency (Laroche & Postolle, 2011:1; Salvatore, 2007:302-304; Houck, 1986:21-24).

Its role of providing the cheapest form of animal protein to South African consumers would qualify the South African poultry industry as a strategic industry, with a strong contribution towards food security in South Africa. Food security is a pressing topic, not only in South Africa, but also in the rest of the world. In South Africa, the right to access sufficient and affordable food is embedded in the constitution, with the Department of Agriculture, Forestry

and Fisheries (DAFF) mandated to develop policies and support programmes that ensure South African citizens are given agricultural opportunities that will enable them to meet their basic food needs. DAFF's major role, amongst others, is to ensure that opportunities are created that encourage South Africans to participate in agriculture, producing food and reducing food insecurity in the country (Du Toit, 2011:1-3).

According to the world food summit, food security exists when all people, at all times, have physical and economic access to sufficient, safe, nutritious food to meet their dietary needs and food preferences for an active lifestyle (FAO, 1996). Access therefore implies not only availability, but also affordability of food. If imported chicken offers a more affordable alternative to domestically produced chicken, protective trade policy will have a negative effect on the affordability of food for the poorest segment of the population. At the same time, if this strategic industry is not able to compete economically, a lack of protection may lead to its downfall, leading to a decrease in employment opportunities while also negatively impacting on self-sufficiency. Laroche and Postolle (2011:1) in fact argued that long term food security cannot rest on dependence of food imports, but should rather be built on the development of domestic production, sheltered from world price fluctuations and unfair competition by appropriate policies.

Strategically, self-sufficiency is an important consideration, as factors beyond national control could influence the constant availability of imported food. In the case of poultry, a disease outbreak in the country of origin could lead to mandatory closure of imports, leaving consumers vulnerable should domestic production not occur. At the same time, macro-economic variables like exchange rates could cause great volatility in the price of imported food, affecting affordability adversely. Laroche and Postolle (2011:3), through the concept of 'food sovereignty' promoted the idea that developing countries should have the right to protect themselves from food imports when these imports compete with and risk destabilizing local production. At the same time, the cost to the consumer cannot be ignored, particularly when the cost will be borne by the poorest segment of the population.

The identification of agriculture as a strategic sector in terms of employment by the National Development Plan is another worthwhile consideration when protective policy is considered. Though protective policy may increase domestic poultry prices and therefore affect food security of the poorest segment of the SA population, the loss of jobs should the industry

remain distressed would be catastrophic. As such, the effect of protective trade policy must be considered on poultry prices, as well as the ability of the domestic industry to create and maintain jobs, both in poultry production, poultry processing and related industries such as maize and soya for poultry feed. Integration of the broiler price equation that was estimated empirically in Chapter 4 into the BFAP sector model will enable quantification of the effect of protective trade policy on the South African broiler industry, as well as other related industries within the agricultural sector. The ideal policy framework should consider a balance between consumer prices and support of the domestic industry in order to create and maintain employment opportunities.

5.2 THEORETICAL EFFECTS OF TRADE PROTECTION

When considering support to a critical industry such as the South African broiler industry, various policy options are available to government. These options include tariffs, quotas, price support and deficiency payments (Houck, 1987:45). The focus of this Chapter will however be on tariffs alone, as the objective is to evaluate the effect of increased tariffs, as applied for by SAPA in 2013. This section will provide some theoretical background to the effect of increased tariffs within the partial equilibrium framework, before quantifying the effect using the updated BFAP sector model.

Within the partial equilibrium setting, the effect of policies on production, consumption and trade is considered for a specific sector, keeping other influences constant. Partial equilibrium analysis has clear advantages in that it keeps the analysis simple, allowing for the effects on an industry to be indicated in a clear, simple manner, sharply indicating the different effects of certain policy decisions. Salvatore (2007:250) further indicated that a partial equilibrium analysis is most appropriate when a small nation imposes a tariff on imports that will not affect world prices. Disadvantages however are that it does not account for substitution effects between commodities (Houck, 1987:29). The BFAP sector model can be described as a system of equations, where partial equilibrium models from various industries within the South African agricultural sector are linked in order to account for these cross substitution effects. Within this closed system of equations, grains are linked to livestock through feed in order to capture the effect of external shocks on the entire sector. The linked system of models

can still be described as a partial equilibrium framework, as the entire economy is not included, but rather the agricultural sector.

Traditionally, import tariffs have been important mechanisms used to shield domestic industries from international competition. An import tariff essentially taxes foreign products as they enter the country and as such have the additional effect of generating substantial government revenue (Houck, 1987:45). In order to illustrate the effect of a tariff on social welfare, the effect of applying a tariff must be considered on both the producer and the consumer. The theoretical effect on both producer and consumer surplus of applying a tariff on South African chicken imports is illustrated in Figure 26.

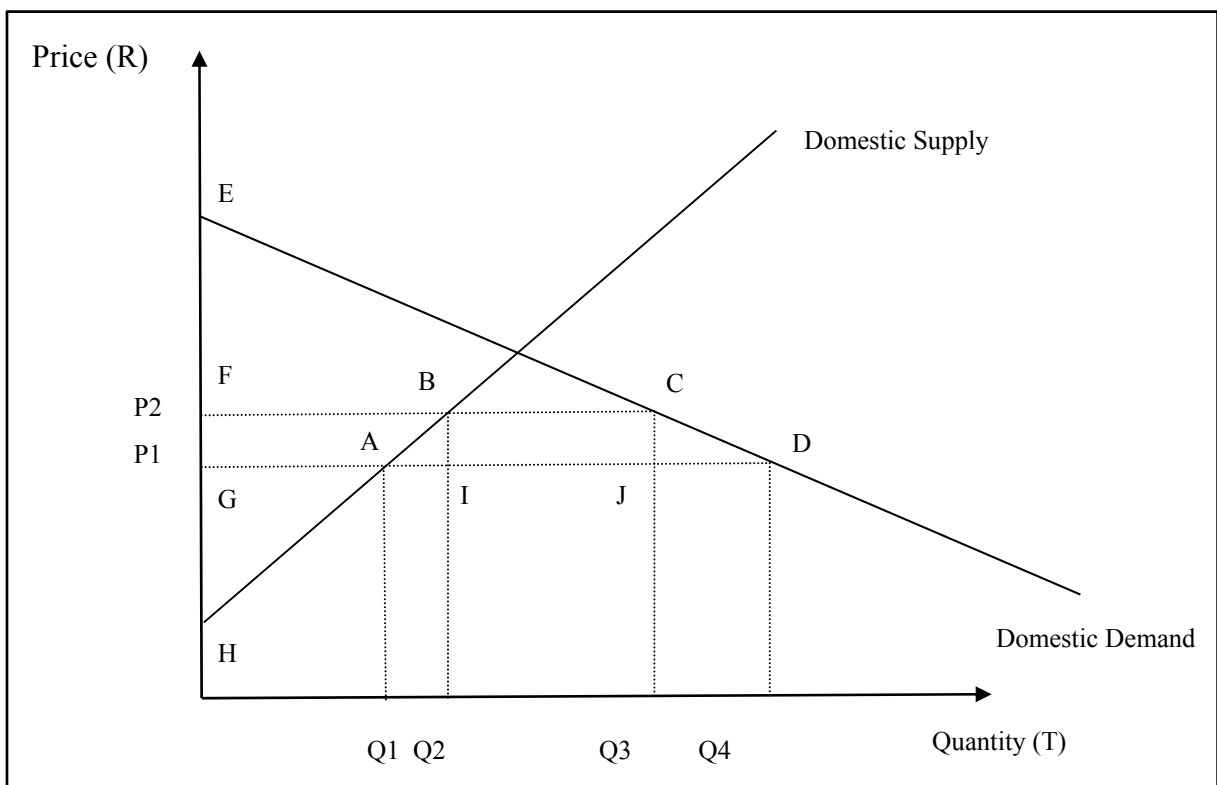


Figure 26: Effect of a tariff increase on South African chicken imports

Source: Adapted from Salvatore (2007:251)

Without the proposed interventions, the South African broiler industry can be described as follows:

At a price of P1, domestic consumption is Q4, of which Q1 is produced domestically and the difference between Q4 and Q1 is imported. Producer surplus can be illustrated as triangle GAH, while consumer surplus can be illustrated as triangle EGD. If tariffs were to increase,

the price would move to P2, while domestic use would decrease to Q3, of which Q2 would be produced domestically and the difference between Q3 and Q2 would be imported. Producer surplus can now be illustrated by triangle HFB, leading to a gain in consumer surplus of area FBAG. Consumer surplus can now be indicated as triangle EFC, a decrease of area FCDG. This would lead to a net loss to society of area ABCD. While the area represented by rectangle IBCJ will be gained in the form of government revenue resulting from the tariff, triangle ABJ and triangle ACD will be a net loss to society as a result of the tariff.

From Figure 26, it is clear that producers will gain from the tariff while consumers will lose, however quantification of the amount that producers will gain and consumers will lose depends on the price elasticity of supply as well as the price elasticity of demand. If consumers are more elastic to price changes than producers, as is the case in the South African chicken industry, then the loss of consumption would be greater than the gain in production.

Economically, supporting producers at the cost of consumers does not make sense, yet tariffs are still used by many countries worldwide, especially in agriculture. Salvatore (2007:304) suggested that as a few producers stand to gain a great deal from protection, they have a strong incentive to lobby for support. On the other hand, since losses will be spread over a much greater number of consumers, each individual consumer would lose much less. As such, consumers are much less likely to organise and oppose tariffs.

When the case of a critical industry is used as justification for support, it can be argued that the importance of the industry to food security in South Africa as well as the need for self-sufficiency would justify support to the industry, even if the support is at the cost of the consumer. In order to make the decision of whether this would be justified however, the benefit to producers as well as the cost to consumers must be quantified. Another matter to consider is which part of the population consumes chicken and whether these consumers are able to bear the cost of supporting the domestic industry.

5.3 AN HISTORIC PERSPECTIVE ON SOUTH AFRICAN CHICKEN IMPORTS

Before simulating the effect of increased tariffs, chicken imports must be considered from an historic perspective in order to gain a better understanding of import patterns related to specific cuts as well as different countries of origin. South Africa has been a net importer of chicken since markets were liberalised, but it is after the financial crisis in 2009 that imports have reached concerning levels. With single exceptions, imports remained below 200 thousand tons per annum prior to 2009. In the past three years however, imports have increased from 200 thousand tons in 2009, to 380 thousand tons in 2012 – an increase of 90%. Though imports contributed only 20.39% of domestic consumption in 2012, giving it the third largest market share behind the two biggest companies in South Africa, it is the effect of imports on domestic prices that is a greater concern for the continued sustainability of the industry. South African imports of broiler meat were illustrated in Figure 5 (Chapter 2). Of great concern when considering Figure 5 is that an increase of 13.89% in consumption from 2010 to 2012 was only accompanied by a 5.5% increase in production, with imports providing the balance of chicken consumed.

Chicken imports into South Africa are classified by the Harmonised System classification codes, with eight different tariff codes currently in use. The only significant imports however are frozen chicken, which is split into six different classifications. The different classifications of chicken imported to South Africa, as well as the current tariffs are indicated in Table 27 below. Imports originating from the EU however are duty free, due to the Trade Development and Cooperation Agreement (TDCA) currently in place.

Table 27: Classification of chicken meat imports into South Africa

Classification Code	Harmonised System Description	Current tariff
02071100	Fowls, not cut in pieces: fresh or chilled	0
02071210	Fowls, not cut in pieces, frozen: mechanically deboned meat	0
02071220	Fowls, not cut in pieces, frozen: carcasses	27%
02071290	Fowls, not cut in pieces, frozen: other	27%
02071300	Fowls, cuts and offal, fresh or chilled	0
02071410	Fowls, cuts and offal, frozen: boneless cuts	5%
02071420	Fowls, cuts and offal, frozen: offal	27%
02071490	Fowls, cuts and offal, frozen: other (includes bone-in portions)	220c/kg

Source: SARS (2013:8)

The tariff classification that experienced the greatest increase in imports over the past three years was bone-in portions (02071490), with a 112% increase from 2010 to 2012. The composition of South Africa's chicken imports according to these tariff classifications are indicated in Figure 27:

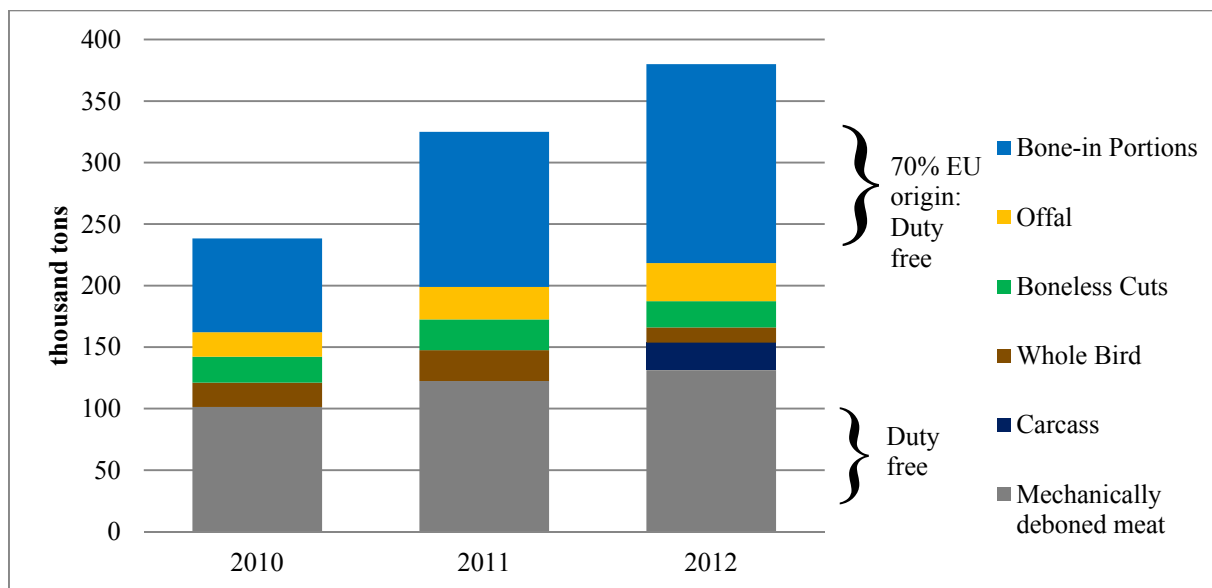


Figure 27: Composition of South Africa's chicken imports per tariff classification

Source: Trademap (2013c)

Historically, imports have originated from Brazil and Argentina, who have a strong comparative advantage in producing chicken due to relatively cheaper feed production costs and their status as net exporters of maize and soya cake. In the past two years however, the EU has come to the fore as a major player when the origin of imported chicken is concerned.

The change in market share of partnering countries in the origin of South African imports is indicated in Figure 8 (Chapter 2). Due to a change in import tariff classification codes in 2009, the composition of imports is shown only for 2010 to 2012.

While Brazil was the origin of 75% of South African imports in 2010, only 40% of imports originated in Brazil in 2012. The share of imports originating from the EU has increased from 5% in 2010 to 46.95% in 2012. This represents an increase from 12.29 thousand tons in 2010 to 137.51 thousand tons in 2012. The change in patterns concerning the country of origin is of great importance, as imports from the EU do not carry a tariff. As such, an increase in the general rate of duty will not affect the portion of total imports originating in the EU. With imports originating from the EU not being affected by the application for higher tariffs, strict implementation of rules of origin would be necessary in order to ensure that goods imported under the TDCA are produced in the EU.

5.4 SIMULATING THE EFFECT OF INCREASED TARIFFS

An empirical simulation of the effect of different tariff scenarios was done using the BFAP sector model, incorporating the price equations estimated empirically in Chapter 4. The BFAP sector model links grains to livestock through feed and therefore simulates the result of an exogenous shock through different industries in the agricultural sector. Simulating the effect of increased tariffs in this way allows for quantification of changes to the fundamentals of the South African poultry industry, as well as related industries within the sector. Different scenarios are compared to the baseline outlook in order to quantify the effect of specific shocks to the system, while other variables remain unchanged.

The simulation involved three scenarios, with different rates of duty for each scenario, while keeping all other assumptions regarding exogenous variables constant. The effect of increased tariffs is then compared to the baseline scenario. Scenario 1 represents the tariffs applied for by SAPA, while these tariffs are reduced slightly in Scenario 2. Important to note is that for the first two scenarios, imports originating from the EU were not subjected to a tariff due to the TDCA currently in place. As imports of EU origin are an important component of total imports as illustrated in Figure 8 (Chapter 2), the third scenario considered the effect of

placing the lower tariff scenario on all imports, including those of EU origin. The different scenarios simulated are indicated in Table 28.

Table 28: Tariffs used for baseline and simulated scenarios

HS Code	Description	Baseline	Scenario 1	Scenario 2	Scenario 3
02071100	Fowls, not cut in pieces: fresh or chilled	0	0	0	0
02071210	Fowls, not cut in pieces, frozen: mechanically deboned meat	0	0	0	0
02071220	Fowls, not cut in pieces, frozen: carcasses	27%	991c/kg Max 82%	673c/kg Max 82%	673c/kg Max 82%
02071220	Fowls, not cut in pieces, frozen: carcasses: EU origin	0	0	0	673c/kg Max 82%
02071290	Fowls, not cut in pieces, frozen: other	27%	1111c/kg Max 82%	1017c/kg Max 82%	1017c/kg Max 82%
02071290	Fowls, not cut in pieces, frozen: other: EU origin	0	0	0	1017c/kg Max 82%
02071300	Fowls, cuts and offal, fresh or chilled	0	0	0	0
02071410	Fowls, cuts and offal, frozen: boneless cuts	5%	12% or 220c/kg, Max 82%	11.5% or 217c/kg, Max 82%	11.5% or 217c/kg, Max 82%
02071410	Fowls, cuts and offal, frozen: boneless cuts: EU origin	0	0	0	11.5% or 217c/kg, Max 82%
02071420	Fowls, cuts and offal, frozen: offal	27%	67% or 335c/kg, Max 82%	51% or 170c/kg, Max 82%	51% or 170c/kg, Max 82%
02071420	Fowls, cuts and offal, frozen: offal: EU origin	0	0	0	51% or 170c/kg, Max 82%
02071490	Fowls, cuts and offal, frozen: other (incl. bone-in portions)	220c/kg	56% or 653c/kg, Max 82%	38% or 445c/kg, Max 82%	38% or 445c/kg, Max 82%
02071490	Fowls, cuts and offal, frozen: other (incl. bone-in portions): EU origin	0	0	0	38% or 445c/kg, Max 82%

Figure 28 illustrates the effect of the different tariff scenarios on the chicken producer price in South Africa. The most extreme scenario (scenario 3) resulted in an 8.4% increase in the chicken producer price in 2013, with a long run increase of 8.2% in the chicken producer price.

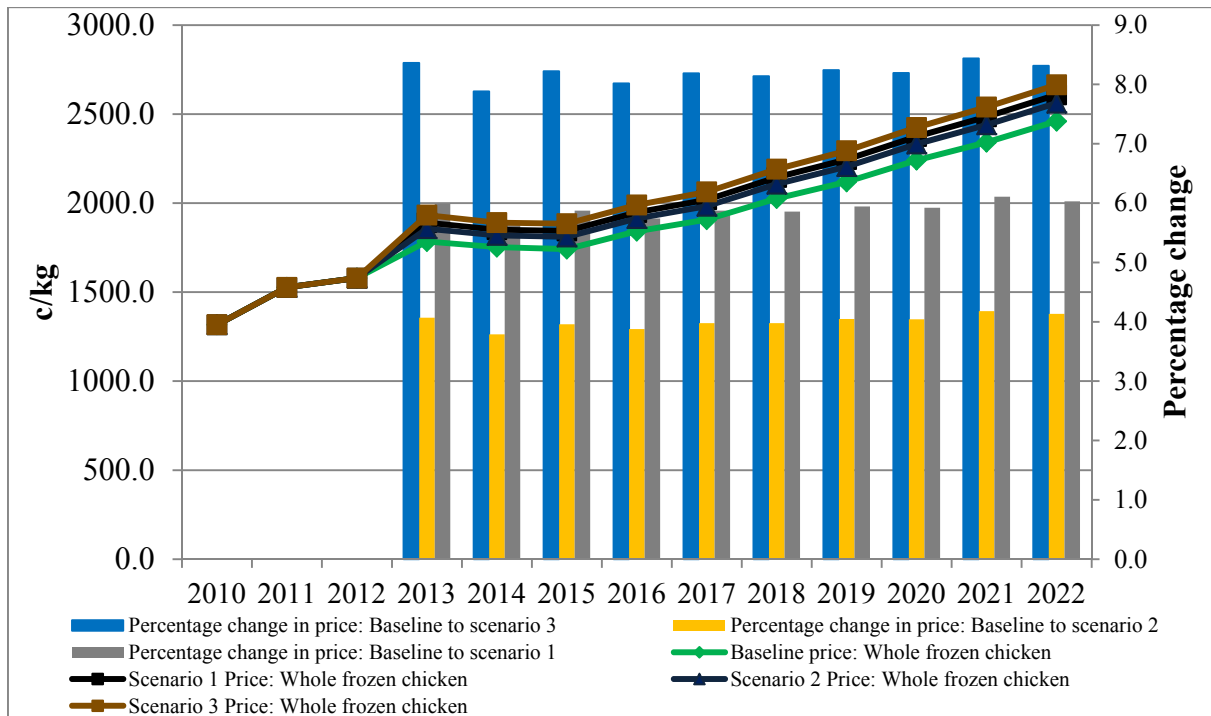


Figure 28: Nominal chicken producer price comparison: Baseline vs. Scenarios

When considering the effect of the proposed tariffs on the consumer however, the producer price is only important in considering its effect on the retail price, which remains the ultimate consideration as the price that consumers must pay. The effect of the proposed tariff on retail prices is quantified through the error correction model used to estimate price transmission from producer to retail level in Chapter 4. The estimated transmission elasticity of 0.64 implies that a 10% increase in the producer price will be accompanied by an increase of 6.4% in the retail price of chicken. The effect of the three simulated scenarios on the price of chicken at retail level is therefore illustrated in Figure 29.

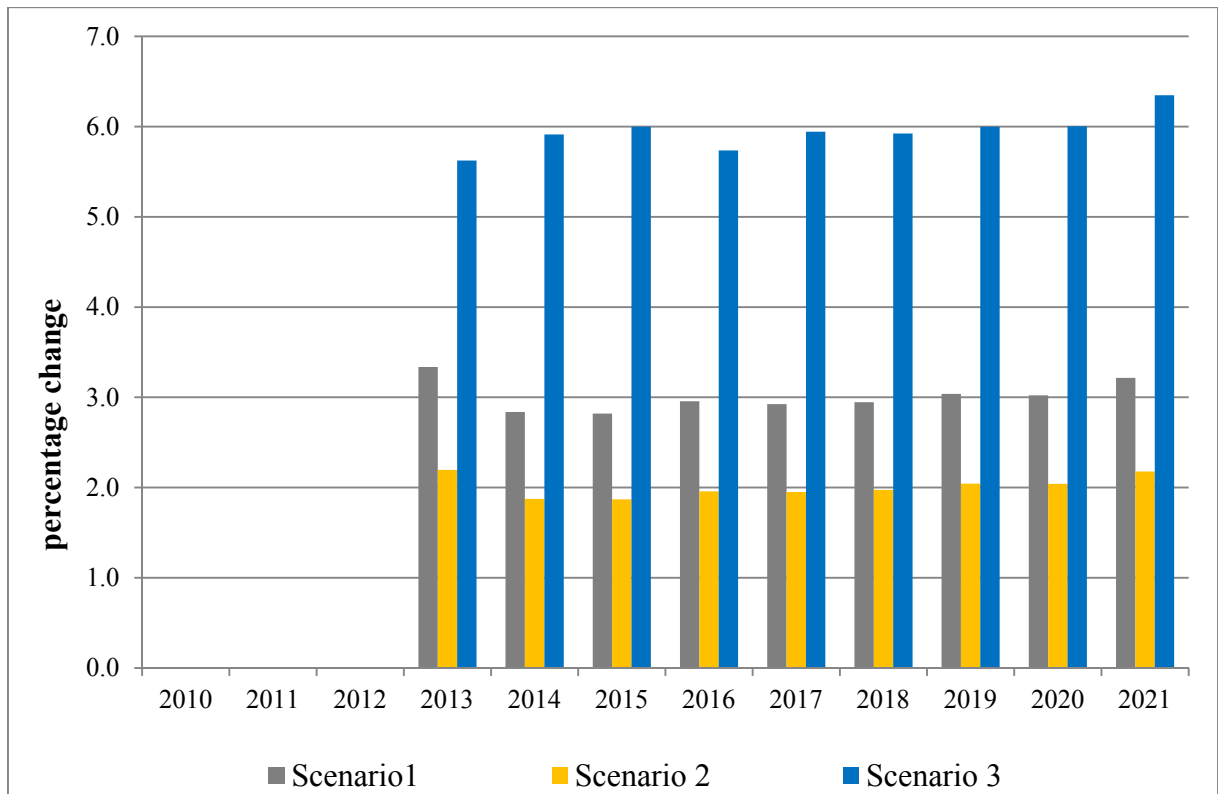


Figure 29: Percentage change in the nominal chicken retail price for three scenarios

The changes to production, domestic consumption and imports are illustrated in Table 29.

Scenario 1 results in an increase of 7.1 thousand tons in 2013, 11.61 thousand tons in 2014 and a long run average increase in production of 19.92 thousand tons. Under the same scenario, domestic use is projected to decrease by 10.76 thousand tons in 2013, with a long run decrease of 10.05 thousand tons. Imports under the same scenario would decrease by 17.6 thousand tons in 2013, with a long run average decrease of 29.29 thousand tons, which is a 6% decrease.

Important to note is that the tariff on fresh chicken imports as well as mechanically deboned meat remains zero across all scenarios. The inclusion of tariffs on imports of EU origin in scenario 3 clearly illustrates the greater effect achieved by applying the tariff to total imports. Though the tariffs are smaller than in scenario 1, the effect on price and as a result production and consumption is greatly increased.

Table 29: Summarizing the effect of different tariff scenarios on the fundamentals of the South African broiler industry

	2013				2014				AVG 2015-2020			
	Baseline	Scenario 1	Scenario 2	Scenario 3	Baseline	Scenario 1	Scenario 2	Scenario 3	Baseline	Scenario 1	Scenario 2	Scenario 3
Production (1000 tons)	1494.14	1501.24	1498.97	1504.06	1519.04	1530.64	1526.88	1535.27	1564.61	1584.53	1578.10	1592.39
Absolute change from baseline		7.10	4.83	9.91		11.61	7.85	16.23		19.92	13.49	27.78
% change from baseline		0.48%	0.32%	0.66%		0.76%	0.52%	1.07%		1.27%	0.86%	1.78%
Domestic Use (1000 tons)	1864.57	1853.81	1857.24	1849.57	1992.81	1983.10	1986.26	1979.25	2249.94	2239.89	2243.09	2236.04
Absolute change from baseline		-10.76	-7.32	-14.99		-9.71	-6.55	-13.56		-10.05	-6.85	-13.90
% change from baseline		-0.58%	-0.39%	-0.80%		-0.49%	-0.33%	-0.68%		-0.45%	-0.30%	-0.62%
Imports (1000 tons)	378.77	361.18	366.75	354.32	482.12	460.80	467.73	452.32	693.68	663.70	673.34	651.99
Absolute change from baseline		-17.60	-12.02	-24.46		-21.32	-14.40	-29.81		-29.97	-20.34	-41.68
% change from baseline		-4.65%	-3.17%	-6.46%		-4.42%	-2.99%	-6.18%		-4.32%	-2.93%	-6.01%

Apart from the effects on the domestic broiler industry, increased tariffs will also affect other industries, such as maize and soya, through broiler feed. The scenario applied for by SAPA (scenario 1) results in an increase of 0.32% in maize as feed consumption in 2013, with an average increase of around 0.69% in the long run. This amounts to 14.7 thousand tons in 2013 and a long run average of 40.7 thousand tons. Including EU imports in scenario 3 results in an increase of 0.44% in maize as feed consumption in 2013, with an average increase of around 0.96% in the long run. This amounts to 20.6 thousand tons in 2013 and a long run average of 56.7 thousand tons.

Industries that produce meat in competition to chicken are also affected by the increase in the domestic chicken price. Scenario 1 resulted in an increase of 2.24% in the beef price in 2013, as well as a 2.81% increase in the pork price in 2013. The long run average increase in the beef and pork price 1.59% and 1.97% respectively under scenario 1.

An opportunity for employment creation due to increased production in both the poultry and related feed industries is another factor that should be considered. According to Lovell (2012:10), the poultry industry employs approximately 48 118 employees in primary and secondary production, excluding the primary producers of their raw feed component (maize and soybeans producers). Given the fact that poultry is not a labour intensive industry, and the relatively small increase in production resulting from the proposed tariffs, implementation of the proposed tariffs will not lead to large scale job creation. In the context of this analysis however, increased job creation is not the only consideration, as considerable job losses could be experienced if the industry is not competitive and sustainable over the long run.

5.5 CONSIDERING THE IMPACT OF INCREASED TARIFFS ON CONSUMERS

The effect of increased import tariffs on the profitability and therefore long run sustainability of producers is clearly positive, as described in section 5.4, but in order to provide a balanced perspective of the effect on social welfare, the position of the consumer should also be considered. The simulation in section 5.4 clearly illustrated the negative effect of increased tariffs on consumers through increased prices and decreased consumption. This section

evaluates chicken consumption from an historic perspective, with the aim of identifying the segment of the South African population that would bear the cost of increased tariffs.

As the cheapest source of animal protein in South Africa, chicken is also dominant when comparing consumption of different meat products. Of total meat consumed in South Africa in 2011, 55% was chicken. As per capita income has increased over time, chicken consumption has outpaced consumption growth in all other meat products, increasing its share in total meat consumption on a continuous basis. The composition of meat consumption in South Africa is illustrated in Figure 30.

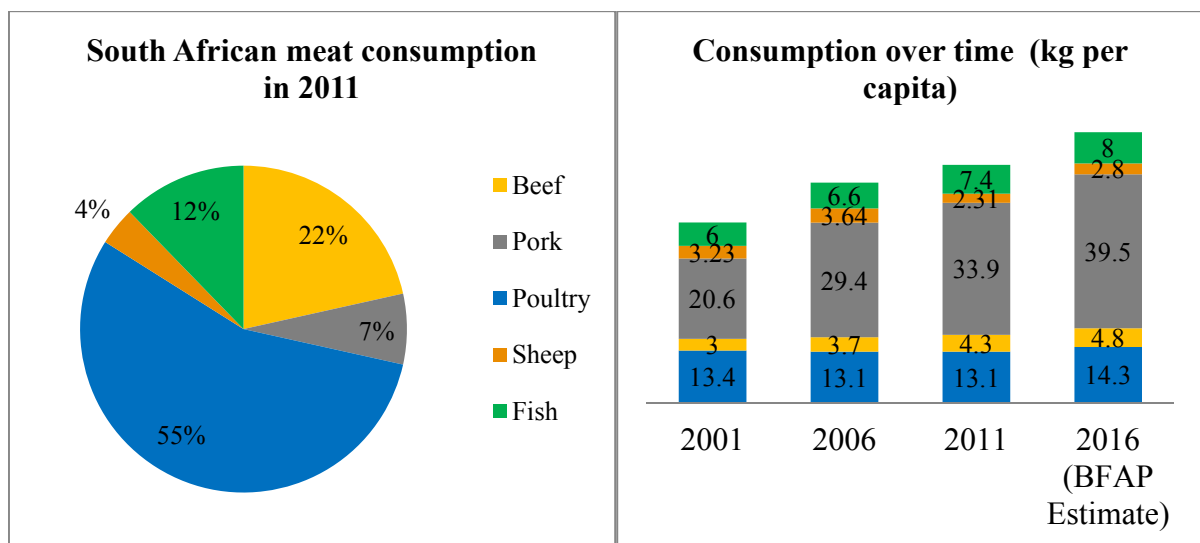


Figure 30: Meat consumption pattern in South Africa
 Source: BFAP (2013), DAFF (2013) & OECD-FAO (2013)

Chicken is popular not only due to the price, but also due to the fact that it is healthy and convenient. As the cheapest source of animal protein available, aggregate national chicken consumption is inelastic to changes in price, mainly due to a lack of alternatives. In order to gain a clearer picture of the consumer segment that would bear the cost of increased tariffs, chicken consumption is further disaggregated based on household income, as illustrated in Figure 31. Total expenditure on chicken is disaggregated at household level, based on total household income, giving an indication of the total value of chicken bought by poor, middle class and wealthy consumers. From Figure 31, 28.25% of the total value of chicken bought was by the highest earning quintile (average expenditure of R124175.50 per annum) in 2010, while 9.13% of the total value was spent by consumers in the lowest earning quintile (average expenditure of R4208.56 per annum). Considering the value spent in isolation can be

misleading regarding quantities however, as the value per kg chicken is likely to be greater at higher income levels, but the lack of statistics regarding volume consumed makes value the only available indication of consumption at various income groups.

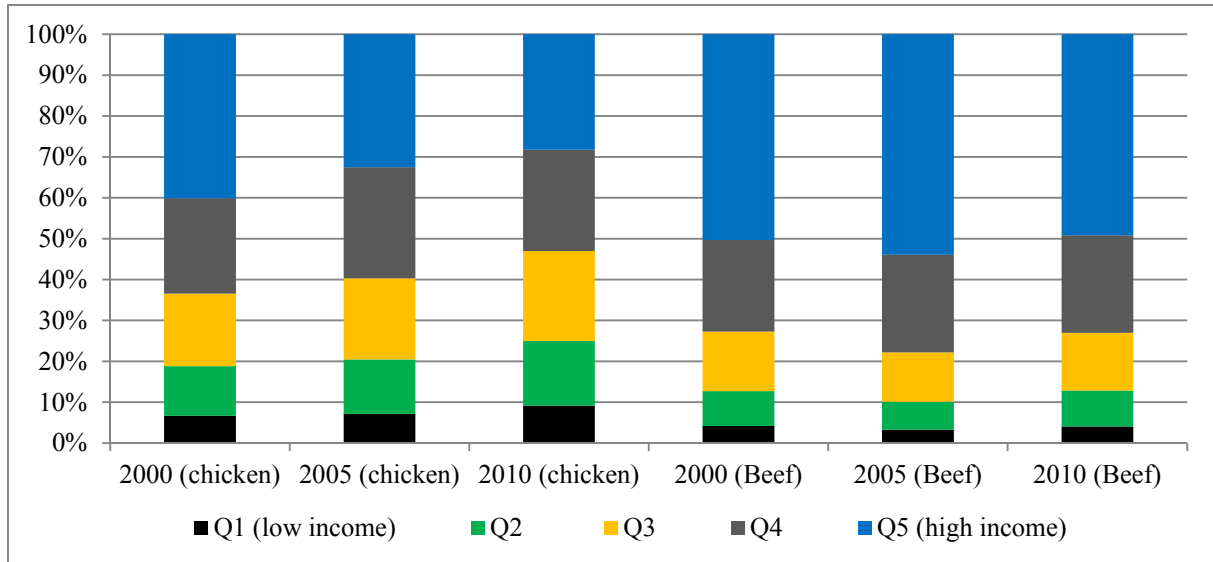


Figure 31: Chicken and Beef consumption per income quintile: 2000-2010

Source: Stats SA (2012)

Of the total value of chicken consumed in 2010, 46.98% was by households earning less than R50 000 per annum (Quintile 1-3). Despite the lack of alternatives, these consumers may be more elastic to price changes than the consumers in quintile 4 and 5, simply due to unaffordability if the price goes up. As consumers in quintile 1 spend 34.75% of total expenditure on food (of which 12.72% is spent on chicken), the effect of an increase in the price of chicken will be the greatest for this group. When considering beef as a more expensive alternative, 49.17% of the total value spent on beef is by consumers in the 5th quintile that earn the most. In order to illustrate the importance of chicken as protein source to lower income groups, the composition of the food consumption basket at household level in 2010 is illustrated in Figure 32.

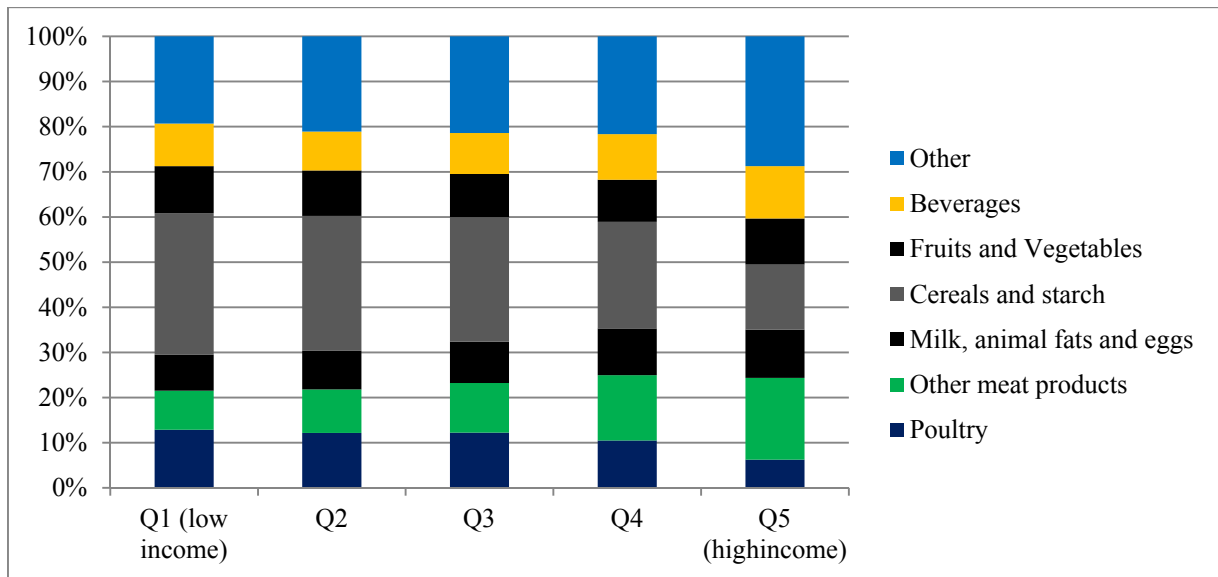


Figure 32: Poultry as percentage of the food consumption basket in 2010

Source: Stats SA (2012)

5.6 CONCLUSION

Broiler production is a very important industry within South African agriculture, not only due to its substantial contribution to food security in providing the cheapest form of animal protein, but also as one of the greatest contributors to agricultural GDP. Earlier chapters illustrated the structure (Chapter 2) of the South African broiler market, as well as the price formation mechanism (Chapter 3) within the South African broiler market. As the industry struggles to compete in the international market due to higher feed costs relative to other producing countries, import protection could be warranted based on the importance of the industry. Chapter 3 highlighted the difference in price formation at producer level and wholesale level, as a result of the coordinated nature of the supply chain, in which integrated companies pay contract growers based on a formula incorporating cost of production. At the same time, imports entering South Africa compete at wholesale level, limiting the extent to which these integrated companies can pass increased feed costs up through the value chain, forcing them to absorb these costs, which they cannot do indefinitely. Increased tariffs will increase the price, however, adversely affecting the poorest segment of South African consumers. The empirical estimations conducted in Chapter 4 were integrated into the BFAP sector model in order to simulate the effect of various tariff scenarios on both producers and consumers of chicken in South Africa. The simulation provides an objective quantification of different tariff scenarios, allowing for sound policy decisions.

The South African poultry association claims that the tariffs applied for were not designed to close South Africa's borders to imports, but simply to place South African producers on level footing, allowing them to compete with international competitors. From the simulated results, this could be validated, as total chicken imports under scenario 1 decrease by only 3.58%. When considering the aggregate effect of higher tariffs on both producers and consumers, the positive effect of a 6% increase in the producer price must be weighed against the negative effect of a 3.3% increase in the retail price, which is likely to affect the poorest consumers. In deciding whether increased support to producers should be implemented, the key questions to be answered is whether the 6% increase in the producer price is enough for producers to re-invest and continue producing chicken, while at the same time considering whether South African consumers, specifically consumers with a low income would be able to absorb a 3.3% increase in the retail price. Mechanically deboned chicken, as used in various processed meats, will not be affected by the increased tariffs and therefore remains as a low cost alternative if an increase in the price of chicken pieces cannot be absorbed by consumers.

Alternative measures or policy interventions could also be considered in order to achieve a balanced outcome between producers' need for support and the effect of that support on consumers. The chicken to feed price ratio remains an important indicator of the international competitiveness of the industry and the possibility of a tariff triggered by a specific ratio of international prices to domestic feed prices could be considered. This would minimise the effect on consumers, while supporting producers when necessary. A zero VAT rating on chicken could also achieve a more balanced affect, as producer prices could increase without increasing the retail price, yet the knock-on effects on other meat industries and the drop in government revenue has to be considered. An innovative approach is no doubt necessary to achieve the balanced outcome and ensure the long run sustainability of South Africa's largest agricultural industry.

CHAPTER 6

SUMMARY AND RECOMMENDATIONS

The South African broiler industry finds itself in a troubled position, due in large to significant increases in feed prices since 2010 that have not been accompanied by similar increases in the broiler producer price. At the same time, chicken provides the cheapest form of animal protein available to South African consumers, making proposed tariff protection an extremely sensitive issue. Given the fact that the South African broiler industry (the greatest contributor to the South African agricultural sector) was classified as an industry in distress by the Department of Trade and Industry (Dti) in 2013, as well as the associated tariff increases that SAPA have applied for, the need for a simulation model that is able to quantify the effect of the proposed tariffs on the South African agricultural sector, as well as the South African consumer becomes evident. The BFAP sector model is an available tool to simulate policy scenarios, yet due to the aggregate nature of the broiler model within the BFAP sector model, refinement was necessary in order to conduct accurate simulations that consider both producers and consumers.

An industry analysis based on the New Institutional Economic (NIE) framework, highlights the integrated nature of the market, while illustrating the need for market coordination and integration in order to promote significant investment in highly specific assets required to produce broilers efficiently. Considering the integrated nature of the South African broiler market, the study questions the ability of traditional quantitative modelling techniques to simulate the market accurately, given the assumptions associated with traditional modelling techniques, such as the assumption of a perfectly competitive market. Considering this mismatch between the structure of the industry and the assumptions related to traditional quantitative modelling techniques, the study presents an updated version of the broiler model within the BFAP sector model. The updated version of the model is closed on imports as proposed by Meyer (2006:51), allowing for the estimation of a price equation that is specified to represent the true price formation mechanism within the South African broiler market.

The primary objective of the study was therefore to determine the true method of price discovery within the South African broiler market, in order to ensure the correct specification

of the price equation, given the integrated nature of the supply chain and high levels of concentration present in the market. From the industry analysis, it was clear that the industry is integrated to the extent that the market for live broilers at primary production level should rather be considered as a market for grower services. Broiler production by contracted growers takes the form of a production tournament, where growers are compensated based on their performance relative to the average efficiency parameters from the entire group. Contract growers are provided with inputs and compensated based on a formula that considers the average cost of production within the group. The constant competition provided ensures that individual producers must continually improve production efficiency in order to ‘beat the average’ and increase individual profits, yet the continued improvement of the average efficiency decreases the cost of production and therefore also the price received, as calculated from the cost of production. The result has been a constantly declining trend in the real broiler producer price over the past decade.

Despite their contractual commitment to pay contract growers based on cost of production, the price received by integrated broiler producers like Rainbow Chicken and Astral Foods is negotiated in a concentrated market between integrated producers and retailers. The competition provided by imported products limits the extent to which increased costs like feed can be recovered, leading to a significant decline in profitability levels after significant increases in feed prices following the drought in the USA. Empirically, the domestic broiler producer price was found to be more elastic to changes in international prices than changes in feed prices. From the estimated elasticities, it was clear that the price of imported products remains the biggest driver of domestic prices, regardless of the cost of producing chicken in South Africa. The fact that domestic producers are unable to compete at the price levels dictated by the price of imported products raises concern regarding the long run sustainability of the South African industry and led to the consideration of the underlying factors that drive competitiveness within the industry.

The coordinated structure of the market, where the majority of production is governed by production contracts relying on compensation based on broiler production tournaments is similar to international markets and encourages investment in order to improve production efficiency on a continuous basis. It was therefore not surprising that the technical efficiency of South African producers is on par with international standards. Consideration of economic

efficiency, which also accounts for the cost of production, presents a different picture however. It was found that the cost of raw feed materials, particularly the cost of Soya oilcake as the main source of protein in broiler feed is the most significant driver of South African producers' lack of competitiveness. As a net importer of Soya oilcake, the price trades at import parity levels, while the price of Soya oilcake in Brazil, the USA and Argentina trades at export parity levels. Export tariffs in Argentina, the origin of South African imports, further increases the cost to South African producers.

The fact that the domestic producer price is more elastic to the international price than the feed price suggests that domestic producers are not able to push increased production costs up the value chain, suggesting that the presence of imports prevents uncompetitive behaviour. At the same time, higher production costs in South Africa suggests that unless producers are able to compete with the import parity price, the long run sustainability of South African broiler production is questionable. The fact that the competitiveness of South African producers is driven by higher costs of production, rather than a lack of technical efficiency suggests that if the sustainability of the industry in the future is to be prioritised, increased support to the industry should be considered objectively, weighing the producers need for protection against the possible cost to the consumer. The updated BFAP sector model provides the tools to conduct this analysis and was therefore used to conduct a simulation of the effect of increased tariffs, both at producer and retail level.

In applying for increased tariff protection, SAPA claimed that increased tariffs were not designed to stop imports completely, but rather to allow South African producers to compete on level footing, ensuring sustainability and preventing job losses. From the simulations conducted, this seems to be justified in that the effect of increased tariffs on imports was small. Applying the tariffs as applied for by SAPA resulted in a long run decrease of only 4.32% in imports, as a result of a producer price increase of 6%. Transmission of the broiler producer price to the retail price of chicken results in an increase of only 3.3% at retail level. In order to make plausible recommendations regarding tariff protection, the positive effect of a 6% increase in the producer price must be weighed against the negative effect of a 3.3% increase in chicken prices for South African consumers. Consideration of specific consumers that will bear the cost of increased tariff protection is also necessary.

The updated sector model provides a useful tool for policy simulation and while the re-estimation of the producer price equation allows for the simulation of detailed tariff scenarios thanks to the disaggregation of the tariff structure, additional improvements can be made to the model in future in order to provide an even better tool for policy analysis. Chicken is not a homogenous product and disaggregation of total consumption into specific categories such as whole chicken, offal or individually quick frozen pieces would provide a more accurate picture in that different elasticities could be estimated for different chicken products. Elasticities will differ for various products, as the response to price changes for cheaper cuts will be greater due to the fact that these cuts are consumed by poor consumers who spend a significant part of their budget on food and chicken provides the cheapest source of animal protein to them. On the other hand, the response to more expensive cuts would be less elastic. Disaggregation of total consumption within the model would however require detailed data on the consumption levels of different cuts.

Estimation of a farm or producer level financial simulation model, as used by Strauss (2005:66-72) would provide a better picture of the effect of different levels of price increases on sustainability and investment at producer level. Linking a producer level financial simulation model to the updated BFAP sector model would complete the policy scenario analysis, as the level of price change that needs to be generated to ensure sustainable production would be clearer. The decision of whether to implement increased tariffs, as well as the level of tariff required will also be better informed, allowing minimization of the negative effect on South African consumers.

In conclusion, the highly integrated market structure and the institutions that govern exchange within the South African broiler market are similar in nature to some of the most efficient broiler industries around the world. Broiler production contracts reduce the risks faced by primary producers while the tournament based compensation mechanisms within these production contracts results in constant improvement in technical efficiency. Concentration in the market is a result of economies of scale benefits, as well as the benefits accruing from vertical integration and South African producers' lack of competitiveness in the global context can be attributed to relatively higher feed costs, rather than inefficient institutional structures. Within the context of South African agriculture however, where the development of emerging, small scale producers is prioritised, the question remains where the small scale

producer can be integrated into vertically integrated commercial supply chains. Considering the fact that large, diversified companies with economies of scale benefits are unable to compete with imported products, it is unrealistic to expect small scale emerging producers to compete in the same market. Though small scale emerging producers will benefit from the reduced risk associated with contract farming, lack of experience and access to advanced technology leaves them vulnerable to tournament based compensation, as producers are required to beat the average in order to increase their compensation. In addition, integrated companies are unable to support and integrate emerging farmers when they are struggling to make a profit themselves. The successful integration of emerging farmers into the commercial value chain will therefore be dependent on the creation of an enabling environment, under which domestic production is able to grow. Different support structures are available to government in order to create this enabling environment. Additional research simulating possible support mechanisms that will enable emerging producers to enter the commercial value chain in a sustainable manner will make a significant contribution to the industry; however estimation of a farm level financial simulation model that can be linked to the sector level output from this study will be necessary to simulate such scenarios successfully.

The fact that the Dti has classified the South African broiler industry as an industry in distress acknowledges the fact that the industry is troubled and presents an admission from government that support is necessary. In light of the National Development Plan's stated goal of creating a million jobs within South African agriculture, the sustainability of the greatest contributor to the South African agricultural sector must no doubt be prioritised. The issue of how to ensure this sustainability remains sensitive however, due to the effect of increased prices on the poorest South African consumers. This study has however gone a long way towards providing the quantitative tools necessary to inform decisions that are clearly sensitive, but no doubt critical.

List of References

- Afgri. 2012. *Integrated annual report 2012*. [Online] Available from:
http://afgri.investoreports.com/afgri_ar_2012/downloads/afgri_ar_2012.pdf [Downloaded: 2012-10-30].
- Astral Foods. 2012. *Integrated annual report 2012 for the year ended 30 September*. [Online] Available from:
<http://www.astralfoods.co.za/PDF/Annual%20Report%202012/ANNUAL%20REPORT%20012%20FULL.pdf> [Downloaded: 2012-10-30].
- Aviagen. 2012. *Arbour Acres plus broiler performance objectives 2012*. [Online] Available from: http://en.aviagen.com/assets/Tech_Center/AA_Broiler/AA-BroilerPerfObj2012R1.pdf [Downloaded: 2012-11-15].
- Binfield, J. Adams, G. Westhoff, P. & Young, R. 2002. *A stochastic analysis of proposals for the new US farm bill*. Paper presented at the 10th congress of the European Association of Agricultural Economics, Zaragoza (Spain), 28-31 August 2002.
- Bureau for Food and Agricultural Policy. 2011. *The South African agricultural baseline 2011*. Pretoria: University of Pretoria.
- Bureau for Food and Agricultural Policy. 2013. *The South African agricultural baseline 2013*. Pretoria: University of Pretoria.
- Calcaterra, M.C. 2002. *Econometric analysis of the structure of the regional maize sector in Southern Africa*. MSc(Agric) dissertation. University of Pretoria. [Online] Available from UPeTD: <http://upetd.up.ac.za/thesis/available/etd-09062006-103626>. [Accessed: 2012-03-16].
- Coase, R. H. 1937. The Nature of the Firm, *Economica* (N.S.) 4: 386-405 (November).

- Cobb Vantress. 2012. *Cobb 500 broiler performance and nutritional supplements 2012*. [Online] Available from: [http://67.43.0.82/docs/default-source/cobb-500-guides/cobb500-broiler-performance-nutrition-supplement-\(english\).pdf](http://67.43.0.82/docs/default-source/cobb-500-guides/cobb500-broiler-performance-nutrition-supplement-(english).pdf) [Downloaded: 2012-11-15].
- Country Bird Holdings. 2012. *Integrated annual report 2012 Expanding into Africa*. [Online] Available from: http://www.cbh.co.za/downloads/2012/CBH_AR_2012.pdf [Downloaded: 2012-10-30].
- De Beer, J. 2009, *A partial equilibrium model for the South African broiler industry*. MSc(Agric) dissertation. University of Pretoria. [Online] Available from UPeTD: <http://upetd.up.ac.za/thesis/available/etd-02222010-114800>. [Accessed: 2012-03-01].
- Demir, P., Aral, Y., Cevger, Y. & Aydin, E. 2010. An economic assessment of the chicken meat / feed price interactions in the Turkish Broiler Sector. *Journal of Animal and Veterinary Advances*, 9 (9): 1366 – 1369.
- Dimitri, C., Jaenicke, E. C. & Effland, A. B. 2009. Why did contracts supplant the cash market in the broiler industry? An economic analysis featuring technological innovation and institutional response. *Journal of Agricultural & Food Industrial Organisation*, 7(1): Article 9.
- Dorward, A. R. & Omamo, S. W. 2009. A framework for analyzing institutions. In: Kirsten, J. F., Dorward, A. R., Poulton, C. & Vink, N. (eds.) *Institutional economics perspectives on African agricultural development*. Washington DC: International Food Policy Research Institute.
- Du Toit, C. 2011. *Food Security*. South African Department of Agriculture, Forestry and Fisheries, Directorate Economic Services, Production economics unit. [Online] Available from: <http://www.nda.agric.za/docs/GenReports/FoodSecurity.pdf> [Downloaded 2013-05-15].
- Ferris, J. N. 2005. *Agricultural prices and commodity market analysis*. Michigan: Michigan State University Press.

Food and Agricultural Organisation of the United Nations. 1996. *Rome declaration on world food security*. [Online] Available at: <http://www.fao.org/docrep/003/w3613e/w3613e00.HTM> [Accessed 12-06-2013].

Food and Agricultural Policy Research Institute. 2011. *FAPRI-ISU 2011 World agricultural outlook*. Fapri Staff Report 11-FSR 1. Ames, Iowa: FAPRI.

Grimbeek, S. & Lekeswa, B. 2012. *The emergence of more vigorous competition and the importance of entry – comparative insights from flour and poultry*. Paper presented at the Sixth Annual Conference on Competition Law, Economics and Policy, Johannesburg, 6-7 September 2012

Goodhue, R. E. 2000. Broiler Production Contracts as a Multi-Agent Problem: Common Risk, Incentives and Heterogeneity. *American Journal of Agricultural Economics*, 82(3) 606-622.

Gujarati, D.N. 2003. *Basic Econometrics*. New York: McGraw-Hill.

Hedge, S. A. & Vukina, T. 2003. *Risk sharing in broiler contracts: A welfare comparison of payment mechanisms*. Paper presented at the annual meeting of the American Agricultural Economics Association, Montreal, Canada, 27-30 July 2003.

Houck, J.P. 1987. *Elements of agricultural trade policies*. Illinois: Waveland press.

International Trade Administration Commission of South Africa. 2012a. *Investigation into the alleged dumping of frozen meat of the species gallus domesticus, whole bird and boneless cuts, originating in, or imported from Brazil: Preliminary determination*. ITAC Report Nr. 389. [Online] Available from: <http://www.itac.org.za/docs/Report%20No.%20389.pdf> [Downloaded: 2012-02-20].

International Trade Administration Commission of South Africa. 2012b. *Sunset review of anti-dumping duties on frozen meat of fowls of the species gallus domesticus, cut in pieces with bone in, originating in or imported from the United States of America: Final determination*. ITAC Report Nr. 390. [Online] Available from: <http://www.itac.org.za/docs/Report%20No.%20390.pdf> [Downloaded: 2012-02-20].

Jafee, S., & Morton, J. 1995. *Marketing Africa's high value foods*. Dubuque, Iowa, U.S.A.: Kendall Hunt.

James, H. S., Klein, P. G. & Sykuta, M. E. 2007. *Markets, contracts or integration? The adoption, diffusion and evolution of organisational form*. Contracting and Organisations Research Institute working paper nr 2007-01 [Online] Available from SSRN: <http://ssrn.com/abstract=980301> [Accessed: 2012-06-02].

Kapombe, C. M. & Colyer, D. 1998. Modelling U.S. broiler supply response: a structural time series approach. *Agricultural and Resource Economics Review*, October: 241-251.

Katchova, A. L. 2010. Agricultural contracts and alternative marketing options: A matching analysis. *Journal of Agricultural and Applied Economics*, 42(2).

Kherallah, M. & Kirsten, J.F. 2002. The new institutional economics: applications for agricultural policy research in developing countries. *Agrekon*, 41(2):110-133.

Laroche, D.C. & Postolle, A. 2011. Food sovereignty and agricultural trade policy commitments: what are the margins of manoeuvre for West African states? Paper prepared for presentation at the *European Association of Agricultural Economists (EAAE) Congress*, Zurich, Switzerland, 30 August – 2 September, 2011.

Leegomonchai, P. & Vukina, T. 2005. Dynamic incentives and agent discrimination in broiler production tournaments. *Journal of Economics and Management Strategy*, 14(4):849-877.

Liang, J., Fabiosa, J. F., Jensen, H. H. & Miller, G. Y. 2010. *Potential HPAI shocks and welfare implications of market power in the U.S. broiler industry*. Paper presented at the annual meeting of the Agricultural and Applied Economics Association, Denver, Colorado, 25-27 July 2010.

Louw, A., Schoeman, J.J. & Geysers, J.M. 2011 *Pork and Broiler industry supply chain study with emphasis on feed and feed-related issues*. National Agricultural Marketing Council,

South Africa. [Online] Available from

<http://www.namc.co.za/dnn/PublishedReports/CommodityProductStudies/PerCategory.aspx>
[Downloaded 2012-05-10].

Lovell, K. 2012. *The South African broiler industry and its outlook going forward*. [Online] Available from: <http://www.afma.co.za/imgs/Mr%20Kevin%20Lovell%20-%20SA%20Poultry%20Industry%20and%20its%20outlook%20going%20forward%20-%20AFMA%20AGM%207%20September%202012.pdf> [Downloaded 2013-02-20].

MacDonald, J. M. & Korb, P. 2011. *Agricultural Contracting Update: Contracts in 2008*. Economic Information Bulletin Nr 72. U.S. Department of Agriculture, Economic Research Service. [Online] Available from www.ers.usda.gov/publications/eib72 [Downloaded 2012-02-12].

MacDonald, J. M. 2008. *The economic organisation of US broiler production*. Economic Information Bulletin Nr 38. U.S. Department of Agriculture, Economic Research Service. [Online] Available from www.ers.usda.gov/Publications/EIB38/EIB38.pdf [Downloaded 2012-02-12].

Menard, C. 2006. Hybrid organisation of production and distribution. *Revista de Analisis Economico*, 21(2):25-41.

Menard, C. 1996. On clusters, hybrids and other strange forms: the case of the French poultry industry. *Journal of Institutional and Theoretical Economics*, 152(1):154-183.

Meyer, F. H. 2006. *Model closure and price formation under switching grain market regimes in South Africa*. Phd thesis. University of Pretoria. [Online] Available from UPeTD: <http://upetd.up.ac.za/thesis/available/etd-12082006-105715> [Accessed: 2012-03-16].

Meyer, F. H. 2002. Modelling the market outlook and policy alternatives for the wheat sector in South Africa. MSc(Agric) dissertation. University of Pretoria. [Online] Available at UPeTD: <http://upetd.up.ac.za/thesis/available/etd-09222005-122509> [Accessed: 2012-03-16].

Mouton, J. 2001. *How to succeed in your Master's and Doctoral studies: a South African guide and resource book*. Pretoria: Van Schaik publishers.

National Agricultural Marketing Council & Commark Trust. 2007. *Subsector study: chicken meat*. (NAMC , 2007-03). Pretoria: NAMC.

Organisation for Economic Cooperation and Development & Food and Agricultural Organisation of the United Nations. 2013. *OECD-FAO Agricultural Outlook 2013-2022*. [Online] Available from: <http://www.oecd.org/site/oecd-faoagriculturaloutlook/highlights-2013-EN.pdf> [Downloaded: 2013-08-15].

Piermartini, R. & Teh, R. 2005. *Demystifying modelling methods for trade policy*. WTO Discussion paper nr 10. Switzerland: WTO Publications [Online] available from: http://www.wto.org/english/res_e/booksp_e/discussion_papers10_e.pdf [Downloaded: 2012-04-10].

Pindyck, R.S. & Rubinfeld, D.L. 1998. *Econometric models and economic forecasts*. New York: McGraw-Hill.

Pioneer Foods. 2012. *Integrated report 2012*. [Online] Available from: <http://www.pioneerfoods.co.za/wp-content/uploads/2012/12/ar2012.pdf> [Downloaded: 2012-10-30].

Poonyth, D., Van Zyl, J., & Meyer, F. 2000. Forecasting the market outlook for the South African maize and sorghum sector using econometric modelling. *Agrekon*, 39(4):607-619.

Poulton, C. & Lyne, M. C. 2009. Coordination for market development. In: Kirsten, J. F., Dorward, A. R., Poulton, C. & Vink, N. (eds.) *Institutional economics perspectives on African agricultural development*. Washington DC: International Food Policy Research Institute.

Rainbow Chicken Ltd. 2012. *Integrated annual report for the year ended 30 June 2012*. [Online] Available from:

http://www.rainbowchickens.co.za/%7Dreports/2012_RAINBOW_IAR.pdf [Downloaded: 2012-08-30].

Salvatore, D. 2007. *International Economics*. 9th ed. New Jersey: John Wiley & Sons.

Soregaroli, C. & Sckokai, P. 2011. *Modelling agricultural commodity markets under imperfect competition*. Paper presented at the annual congress of the European Association of Agricultural Economists, Zurich, Switzerland, 30 August – 2 September 2011.

Soregaroli, C., Sckokai, P. & Moro, D. 2011. Agricultural policy modelling under imperfect competition. *Journal of Policy modelling*, 33 (2011):195-212.

South Africa. Department of Agriculture, Forestry and Fisheries (DAFF). 2013. *Abstract of Agricultural Statistics 2013*. [Online] Available from: www.nda.agric.za/docs/statsinfo/Abstact2013.pdf [Downloaded: 2013-08-21].

South Africa. Department of Agriculture, Forestry and Fisheries (DAFF). 2010. *A profile of the South African broiler market value chain*. [Online] Available from: www.daff.gov.za/docs/AMCP/BroilerMVCP2010-11.pdf [Downloaded: 2012-04-27].

Southern African Poultry Association (SAPA). 2013. *Provincial distribution of chickens in South Africa*. [Online] Available from: <http://www.sapoultry.co.za/pdf%20stats%20general/2012%20distribution%20of%20chickens%20in%20SA%20H2012%20-%201.pdf> [Downloaded: 2013-06-14].

Southern African Poultry Association (SAPA). 2012a. *Broiler organisation committee chairmans report 2011*. [Online] Available from: <http://www.sapoultry.co.za/pdf%20avi/tuesday/BO%20REPORT.pdf> [Downloaded: 2012-06-14].

Southern African Poultry Association (SAPA). 2012b. *Broiler price report for the fourth quarter of 2012*. [Online] Available from: <http://www.sapoultry.co.za/pdf%20quarterly%20reports/2%20BO%20PRICE%20REPORT%204Q2012.pdf> [Downloaded: 2013-05-14].

Southern African Poultry Association (SAPA). 2012c. *The South African broiler industry summary for 2011*. [Online] Available from:
<http://www.sapoultry.co.za/pdf%20stats%20general/2011%20SOUTH%20AFRICAN%20BROILER%20INDUSTRY%20ON%20A%20PAGE.pdf> [Downloaded: 2012-06-14].

Southern African Poultry Association (SAPA). 2011. *The South African poultry industry profile for 2010*. [Online] Available from:
<http://www.sapoultry.co.za/pdf%20permanent/2011%20sapa%20industry%20profile.pdf>
[Downloaded: 2012-02-20].

South African Revenue Service. 2013. *Schedules to the customs and excise act*. [Online] Available from: [http://www.sars.gov.za/77133_Part1ofScheduleNo.14May2012\[2\].pdf](http://www.sars.gov.za/77133_Part1ofScheduleNo.14May2012[2].pdf)
[Downloaded: 2013-05-04]

Statistics South Africa. 2012. *Income and Expenditure of households 2010/11*. Statistical release P0100. 6 November. Pretoria: Statistics South Africa.

Strauss, P. G. 2009. *Scenario thinking and stochastic modelling for strategic and policy decisions in agriculture*. Phd thesis. University of Pretoria. [Online] Available from UPeTD: <http://upetd.up.ac.za/thesis/available/etd-06062010-153136> [Accessed: 2012-03-22].

Strauss, P. G. 2005. *Decision making in agriculture: A farm level modelling approach*. MSc dissertation. University of Pretoria. [Online] Available from UPeTD: <http://upetd.up.ac.za/thesis/available/etd-06022005-131248/> [Accessed: 2012-03-24].

Trademap. 2013a. *Exports of Meat and edible offal of poultry meat by South Africa*. [Online] Available from: http://www.trademap.org/Country_SelProductCountry_TS.aspx [Accessed: 2013-05-25].

Trademap. 2013b. *Exports of Soya-bean oilcake and other solid residues*. [Online] Available from: http://www.trademap.org/Country_SelProduct_TS.aspx [Accessed: 2013-05-25].

Trademap. 2013c. *Imports of Meat and edible offal of poultry meat by South Africa*. [Online] Available from: http://www.trademap.org/Country_SelProductCountry_TS.aspx [Accessed: 2013-05-25].

Trademap. 2013d. *Imports of Soya-bean oilcake and other solid residues by South Africa*. [Online] Available from: http://www.trademap.org/Country_SelProductCountry_TS.aspx [Accessed: 2013-05-25].

Tsouluouhas, T. & Vukina, T. 2001. Regulating broiler contracts: tournaments versus fixed performance standards. *American Journal of Agricultural Economics*, 83(4): 1062-1073.

United States of America. Department of Agriculture Foreign Agricultural Service. 2012. *Livestock and poultry: world markets and trade*. [Online] Available from http://www.fas.usda.gov/dlp/circular/2012/livestock_0412.pdf [Downloaded: 2012-05-16].

United States International Trade Commission. 2012. *Brazil: Competitive factors in Brazil affecting US and Brazilian agricultural sales in selected third country markets*. Investigation Nr 332-524. USITC Publication 4310. [Online] Available at: <http://www.usitc.gov/publications/332/pub4310.pdf> [Accessed: 2013-03-16].

Van Tongeren, F., Van Meijl, H., & Surry, Y. 2001. Global models applied to agricultural and trade policies: a review and assessment. *Agricultural Economics*, 26:149-172.

Van Zyl, I. C. J. 2010. *Capturing the dynamics of the South African sunflower seed market in a partial equilibrium framework*. MSc(Agric) dissertation. University of Pretoria. [Online] Available at UPeTD: <http://upetd.up.ac.za/thesis/available/etd-08162010-165526> [Accessed: 2012-03-16].

Vukina, T. & Leegomonchai, P. 2006. Oligopsony power, asset specificity and hold-up: Evidence from the broiler industry. *American Journal of Agricultural Economics*, 88(3):589-605.

Williamson, O. E. 2000. Ronald Harry Coase: Institutional Economist/Institution Builder. In: Menard C (ed), *Institutions, contracts and organizations: Perspectives from New Institutional Economics*. Edward Elgar, Cheltenham, UK.

Wu, S., Nazaryan, N., Roe, B. & Sporleder, T. 2004. *Behavioral and welfare effects of tournaments and fixed performance standard contracts with heterogeneous agents: Some experimental evidence*. Paper presented at the annual meeting of the American Agricultural Economics Association, Denver, 2004.