The Distortions to Incentives in South African Agriculture:

A Case Study of the Wheat Industry

by

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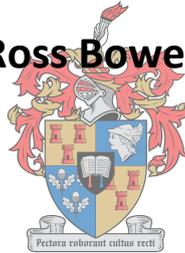
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Thesis presented in partial fulfilment of the requirements for the degree of
Master of Science (Agricultural Economics) in the Faculty of AgriSciences at Stellenbosch University.

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March 2018

Declaration

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Date: March 2018

Abstract

Throughout history, governments across the world have persisted with policy implementation that restricts international trade, including the trade of agricultural products. Although differing across countries in terms of the policy instruments used, market volatility within agricultural markets has been an unwanted product of this intervention and, in the opinion of Williamson (2008), has had an economic growth-retarding effect. Largely considered as a given, however, is that when governments intervene in markets, price wedges develop between the prices facing domestic market agents and the prices that would have prevailed in a free market without intervention. These price wedges are known in the literature as distortions, as they distort the incentives of market agents to transact.

While the contrasting stances of developed nations' governments and developing nations' governments towards their respective agricultural sectors has been widely documented in the literature, empirical studies quantifying the distortions to agricultural producers' incentives caused by the polar policy stances have been dominated by three key global studies. Two of these studies have been conducted under the direction of the World Bank, and the other is an ongoing study by the Organization for Economic Co-operation and Development (OECD).

The World Bank study, headed by Kym Anderson, was concluded in 2009 and included a complete set of distortion estimates for South African primary agriculture and selected secondary agricultural industries. These distortion estimates were estimated on aggregate commodity level from 1965 until 2005,[1] and their long-term trends were documented by Kirsten, Edwards and Vink (2009). However, due to the intense data requirement, these estimates were never estimated in a disaggregated format per agricultural industry/commodity, which implies that there is limited knowledge of the distortions facing the individual market agents in each of the covered industry value chains.

Knowledge of the incentives facing industries, as well as value chain agents within industries, is vital in the formulation of effective agricultural policy. However, just as important as the magnitude of the distortions is the identification of the key drivers impacting the size of the distortions facing aggregate industries or specific value chain agents within industries.

This study is the second comprehensive analysis of the distortions to agricultural producers' incentives in South Africa. The core analysis of this study reapplies the Anderson *et al*. (2006) empirical framework for the time period 2005 until 2014, as was applied by Kirsten *et al*. (2009) in order to estimate the distortions faced by agricultural producers. In addition to the aggregate application, the

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[1] Estimates were based on actual data from 1965 to 2004. Forecasted data was used in order to obtain 2005 estimates. Therefore, this study uses actual data from 2005 to 2014, thus covering 10 complete years.

disaggregated approach to measuring distortions to individual agents' incentives in a vertical value chain is seminally applied in the South African context. The methodology developed by Briones Alonso and Swinnen (2015) is applied to the South African wheat value chain for the marketing years starting in October 2000 and ending in September 2014.

The results of the study highlight the opposing incentives faced by primary agricultural producers depending on the trade status of their commodity. The long-term depreciation of the South African Rand was found to be largely responsible for this, with producers of exportable commodities facing positive incentives to produce (positive distortions) as opposed to producers of importables being faced with negative incentives to produce (negative distortions). Furthermore, within the wheat value chain, the study's results provided critical insight into the manner in which the market power "bulge" at processing level harmed both producer incentives as well as the incentives of consumers to consume wheat flour. The results highlight the need for effective market regulation within the wheat industry, as well as question the core competitiveness abilities of the respective value chain agents.

It is recommended that policy makers and market regulators thus consider the implicit impact of the long-term depreciation of the South African Rand on agricultural producers' incentives, while also focusing on the phasing out of inter-industry distortion differences in order to realise potential efficiency gains. Furthermore, orchestrating an adequate link between the competitiveness and market power of agents within a value chain in relation to their estimated incentive distortions could form an integral part in unpacking the drivers of the inter- and intra-industry distortion differences. Once the key drivers of the respective disparities are identified, a far more informed approach to attempting to eliminate the differences and ensure efficient resource use will be enabled.

Opsomming

Dwarsdeur die geskiedenis het regerings die wêreld oor volhou met beleid wat handel in landbougoedere aan bande gelê het. Hoewel die beleidsinstrumente wat gebruik is verskil het in verskillende lande, het dit omtrent oral en altyd aanleiding gegee tot onbestendigheid van markpryse wat op sy beurt, volgens Williamson (2008), ekonomiese groeie negatief beinvloed het. Wat egter grootliks as 'n gegewe beskou kan word, is dat wanneer regerings in markte ingryp, ontwikkel pryswigte (*price wedges*) tussen die pryse wat agente in binnelandse markte teëkom en die pryse wat in 'n vryemark sou geheers het sonder staatsingryping. Hierdie pryswigte staan in die literatuur bekend as verwringings, aangesien hulle die aansporings van die markagente om sake te doen, verwring.

Dit is duidelik uit die literatuur dat die benadering van die regerings van ontwikkelende en van ontwikkelde lande teenoor hulle onderskeie landbousektore verskil. Verder word die kwantifisering van hierdie verdraaiings deur drie belangrike studies gedomineer. Twee van hierdie studies is deur die Wêreldbank aangepak, terwyl die Organisasie vir Ekonomiese Samewerking en Ontwikkeling (OESO) 'n deurlopende studie aan die gang hou.

Die studie deur die Wêreldbank onder Kym Anderson is in 2009 voltooi en het 'n volledige stel skattings van beleidsverwringings vir Suid-Afrikaanse primêre landbou en geselekteerde sekondêre landboubedrywe ingesluit vir die periode 1965 tot 2005,[2] en die langtermyn tendense is deur Kirsten, Edwards en Vink (2009) gedokumenteer. As gevolg van die intense datavereiste is hierdie beramings egter nooit gedisaggregeer per landboubedryf/kommoditeit gedoen nie, wat impliseer dat daar beperkte kennis is oor die omvang van die verwringings (of aansporings) waarmee die individuele markagente te doen kom te doen kry.

Kennis oor hierdie aansporings is noodsaaklik vir die formulering van doeltreffende landboubeleid. Net so belangrik as die omvang van die verdraaiings is egter die identifisering van die belangrikste drywers wat 'n invloed het op die omvang van die verwringings waarmee die totale bedrywe of spesifieke waardekettingagente binne die bedrywe te doen kom.

Die huidige studie volg op hierdie analise van die verwringings van landbouprodusente se aansporings in Suid-Afrika, en volg ook die empiriese raamwerk van Anderson *et al*. (2006), maar nou vir die tydperk vanaf 2005 tot 2014. Hier word die aggregaat sowel as die gedisaggregeerde verwringings in 'n vertikale waardeketting in die Suid-Afrikaanse konteks geskat. Die metodologie wat deur Briones

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[2] Ramings is gebaseer op werklike data vanaf 1965 tot 2004. Voorspelde data is gebruik om die ramings vir 2005 te bereken. Hierdie studie gebruik dus werklike data vanaf 2005 tot 2014, om dus 10 volledige jare te dek.

Alonso en Swinnen (2015) ontwikkel is, is op die Suid-Afrikaanse koring- waardeketting toegepas vir die bemarkingsjare wat in Oktober 2000 begin het en in September 2014 geëindig het.

Die resultate van die studie bring na vore die kontradiksies in aansporings (en dus in verwringings) waarmee primêre landbouprodusente te doen kom, grootliks as gevolg van die langtermyn depresiasie van die Suid-Afrikaanse Rand met produsente van verhandelbare kommoditeite wat positiewe aansporings het om te produseer (positiewe verwringings), teenoorprodusente van invoerbare produkte wat negatiewe aansporings het om te produseer (negatiewe verwringings). Verder bied die studie kritiese insigte oor die koring- waardeketting en spesifiek in die manier waarop markkonsentrasie op prosesseringsvlak beide produsent-aansporings sowel as die aansporings van verbruikers om koringmeel te verbruik, benadeel het. Die uitslag bring die behoefte aan doeltreffende markregulering binne die koringbedryf na vore, asook die kwessie van die kern mededingendheidsvermoëns van die onderskeidelike waardekettingagente.

Daar word aanbeveel dat beleidmakers en markreguleerders dus die implisiete impak van die langtermyn depresiasie van die Suid-Afrikaanse Rand op landbouprodusente se aansporings in ag neem, terwyl daar ook gefokus word op die uitfasering van die diskriminasie teen produsente om sodoende potensiële doeltreffendheidsvoordele te realiseer. Verder kan die skep van sterk skakels tussen die mededingendheid en markkrag van agente binne 'n waardeketting'n integrale rol speel in die uitpak van die drywers van inter- en intrabedryfsverskille. As die belangrikste drywers van die onderskeie ongelykhede eers geïdentifiseer is, sal 'n baie meer ingeligte benadering tot die uitskakeling van die verskille en doeltreffende hulpbrongebruik gevolg kan word.

Acknowledgements

I wish to express my sincere gratitude and appreciation to the following persons and institutions:

➢ My supportive and forever loving parents, brother and extended family. You gave me the gift of education and ensured that I never stop questioning the norm. Your unwavering support continues to drive my hunger for knowledge and motivates me to strive for excellence.

➢ Prof. Nick Vink - my lecturer, study supervisor and academic mentor. Thank you for sharing your tremendous volume of knowledge across all fields with me over the past six years. You remain an inspiration to many around you and I will endeavour to always maintain a sound academic foundation in all that I do in my future career.

➢ My girlfriend Jennin and the whole Kallis family. Thank you for understanding my challenges over the past two years and for opening up your home to me. It has allowed me to have a second family right on my doorstep; thank you for supporting me as one of your own!

➢ My great friends, Yves Tohermes, Jason Collett, Johann Boonzaaier, Laine Collett and Shepherd Mudavanhu, who have supported me throughout writing my thesis and ensured that I never forgot to have a beer and watch rugby on a Saturday!

➢ Dr Cecilia Punt, Jan Greyling, Dr Willem Hoffmann and Prof. Theo Kleynhans, who over the past six years have always had time to answer my hundreds of questions while studying Agricultural Economics. Had I not received the answers to those questions, this thesis would never even have been started, let alone completed.

➢ The institution that is Stellenbosch University, which has provided a conducive study environment in which I could thrive. The exemplary manner in which the management of the University have managed the turbulent times over the past six years is indeed commendable.

Dedication

Excellence is a Choice

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Chapter 1   Introduction

1.1   The Political Economy of Agriculture

The economic benefits of specialisation and trade are well known, yet governments persist in introducing measures that restrict international trade, including trade in agricultural products. While these restrictions differ from country to country, they contribute to volatility in global agricultural markets, consequently altering countries' terms of trade. As Williamson (2008) notes, this volatility in the long-run terms of trade has a growth-retarding effect.

In this regard, the governments of developed countries have tended to protect their farmers from import competition in order to counteract the competitive pressures to shed labour (Anderson, 2009). Not only have these protective measures had a negative impact on domestic consumers of agricultural products and exporters of other products, but they have also depressed international prices of agricultural products, thus hurting both foreign producers and traders of agricultural products. As a result, both national economic welfare as well as global economic welfare have been reduced.

On the other hand, governments of developing countries have tended to implement policies that directly or indirectly tax farmers, while at the same time pursuing import-substituting industrialisation (Anderson, 2009). As a result, producers face less of an incentive to produce – and this is compounded by the disincentive effect of subsidies for rich countries.

As economies industrialise and develop economically, their policy stances undergo gradual shifts, from negatively assisting agricultural producers to positively assisting them, as well as from subsidising food consumers to taxing them (Anderson, 2009). While the historical trends in policy stances between the two country groups have been documented extensively, empirical measurements of the extent to which policy shifts have succeeded in moving towards a least distorting policy environment have been limited to a handful of studies. These studies have been undertaken predominantly by the World Bank and by the Organisation for Economic Co-operation and Development (OECD).

Although the policy stances in developed and developing countries differ, both by their nature and the degree to which they distort agricultural incentives, the gradual policy developments within individual countries over time have had, and continue to have, a pronounced effect on the long-run growth and distribution of global welfare (Anderson, 2009). Furthermore, in addition to the economic growth implications, distortions to agricultural incentives have knock-on effects on consumers through the price of food. Consequently, policy stances not only influence economic growth, but also influence poverty and income inequality due to the importance of food prices in these parameters.

While policy intervention in agricultural markets has been reduced drastically over the past 25 to 30 years, the reduction of this intervention was only prioritised once agricultural commodities were duly included in the framework of international negotiations, specifically in the General Agreement on Tariffs and Trade (GATT). Prior to the inclusion of agricultural commodities in international negotiations during the Uruguay Round Agreement on Agriculture (URAA), signed in 1994, individual countries had been left free to determine their respective agricultural policies, even when these policies have had a disruptive effect on world markets (Butault, 2011). Preceding the URAA, the Haberler (1958) Report to the GATT highlighted the presence of these policy-induced distortions and cautioned that they could worsen, which they did, as shown by Anderson and Hayami (1986). The signing of the URAA agreement in 1994, together with the concurrent establishment of the World Trade Organization (WTO), paved the way for the majority of signatory countries to shift their policy stances towards reducing agricultural support and progressively decoupling this support from the level of production (Butault, 2011).

1.2   Background to the Study

Given the extent to which policy had distorted global agricultural markets, empirical studies were forthcoming that focused on measuring the government-imposed distortions that had created gaps between the domestic prices of agricultural products and the would-be free market prices. However, these studies were often limited to specific countries, with tailored methodologies aligned to the respective research objectives. This research stance made international comparisons of these country-specific studies near impossible and consequently failed to contribute meaningfully to the body of literature on policy-induced price distortions.

Since the late 1980s, three key inter-country studies have applied respective uniform methodologies to empirically measure the policy-imposed distortions on commodity level that arise due to the complex web of agricultural policies.

The seminal study conducted by Krueger, Schiff and Valdes (1988) covered a small range of developing countries (18 in total), excluding South Africa, which at the time remained sanctioned by the global community. The findings of this study proved ground-breaking in answering the age-old question about why agriculture had historically been supported in developed countries and taxed in developing countries, while also providing empirical estimates of the implicit taxation of agriculture in developing countries.

The OECD has provided estimates of policy support for its member countries and selected emerging economies, including South Africa, on an annual basis. The most notable and widely published measures from the OECD annual reports are the estimates of market price support (MPS), the nominal

protection co-efficient (NPC) and the producer support estimates (PSE). Furthermore, the OECD's estimates have empirically quantified the effects of specific policies within its focus countries. These empirical estimates are currently available for the past 30 years since 1986.

The most comprehensive study using a uniform methodology was conducted under the directorate of the World Bank and headed by Kym Anderson. Following on from the methodology derived by Anderson *et al*. (2006), a global study was conducted across 40 developing countries, together with the OECD countries and Europe's transition economies. At the time (2009), this group of countries accounted for around 90% of global agricultural production. The study was aggregated into key regions of the world where distortions to agricultural incentives were calculated from 1955 to 2007 and reviewed on a country basis. The initial study included a comprehensive investigation of the distortions to agricultural incentives in South Africa, conducted by Kirsten *et al*. (2009); however, the subsequent update of the empirical database to 2011 by Anderson and Nelgen (2013) did not incorporate updating the South African estimates.

Kirsten *et al*.'s (2009) empirical findings for South Africa were largely aligned with the political environment in which policies were made in South Africa during the Apartheid political regime, with high protection of the agricultural tradable sector throughout the 1960s and 1970s, peaking in the 1980s. Following the transition to democracy in the 1990s, distortions declined rapidly in the agricultural sector and, by the end of the period (2000 to 2004), the policy environment was such that resource allocation had shifted against the agricultural sector.

Since the Kirsten *et al*. (2009) distortion estimates up to and including the year 2005, no empirically aligned attempt has been undertaken to provide updated estimates for South African agriculture. Furthermore, with the exception of the Anderson and Nelgen (2013) empirical update, the application of the broad Anderson *et al*. (2006) methodology on country level has significantly dried up internationally. An update of these distortion estimates is therefore due for the South African agricultural sector, as well as for the countries not covered in the Anderson and Nelgen (2013) update.

A common thread throughout the estimates published by the OECD, as well as those published as a result of the Krueger *et al*. (1988) and Anderson (2009) studies, is that policy stances are either seen as assisting or hindering producers or consumers of agricultural products. Consequently, the distortion estimates in these studies are generally aggregated into their net effect on each of these two economic groups at various levels of aggregation, including individual commodity level, commodity group level, industry level as well as macro-economic level. Such aggregation enables the decomposition of results from the macro-economic level back down to the individual commodity level in order to analyse the contributions of the individual commodity or industry component to the

greater aggregated measure. However, all three of the above frameworks of estimates fail to allow decomposition from the individual commodity level down to individual agents in the value chain. For example, if South African wheat producers as a collective are seen to receive assistance under the policy environment using the aggregate measure, it could still mean that certain agents within the broader producer group are being taxed under the current policy setting. Such a situation would logically prevail if the magnitude of the support to agents within the broader producer category is larger than the magnitude of the taxation of agents within this category.

Consequently, and in essence, the distortion estimates published in their various forms in the documented studies hide how the policy assistance/hindrance incident on specific agricultural commodities or industries is distributed throughout the respective commodity value chains. Such an omission from inter-country studies is understandable due to the detailed value chain data required in order to decompose commodity/industry-level distortion estimates. Although not necessarily internationally comparable, such a decomposition – as has been undertaken by Briones Alonso and Swinnen (2015) for the Pakistani wheat flour value chain – is indeed possible when limited to a specific country and commodity or group of commodities.

An extension of the base nominal rate of assistance framework used by Anderson (2009) allows for policy welfare impacts to be disaggregated within producer and consumer groups. The results of this extension provides estimates of the welfare impacts of policies per agent in a vertical value chain operating under the producer and consumer "umbrellas". Welfare estimates on a per agent basis, rather than on an aggregate producer or consumer group basis, have important implications for the analysis of the economy and political economy. Furthermore, disaggregated estimates assist in the design of policies targeting the poorest groups along value chains (Briones Alonso & Swinnen, 2015).

To date, no such disaggregated empirical approach has been published within a South African agricultural context. The South African wheat industry is ideally poised for such an investigation, given the constant hype around the market concentration of the industry at processing level and the perceived declining ability of producers to competitively produce wheat.

1.3   Objectives of the Study

This study is the second comprehensive analysis of the distortions to agricultural incentives in the South African economy, the other being the study by Kirsten *et al*. (2009). The objectives of this study were five-fold. The first was to provide an overview of the theory of policy-induced price distortions in agriculture within the context of the political economy of agriculture. The second objective followed on the first and involved providing an overview of the major global studies that have attempted to comparably measure the distortion effects of countries' agricultural policies. The third objective was

to update the agricultural incentive distortions estimates for South Africa from the year 2005 until 2014 using the Anderson *et al*. (2006) methodology, as was applied by Kirsten *et al*. (2009) for South Africa for the period from 1955 to 2005. This update focused only on updating the empirical measures of distortions to agricultural producers' incentives and did not include any estimates of policy distortions facing consumers of agricultural products or non-agricultural sectors.

The results of the update will enable the latest 10-year trend of agricultural producer distortion estimates to be analysed for South Africa per agricultural commodity, in contrast to the trends available from the Kirsten *et al*. (2009) study. The fourth objective was to apply the disaggregated nominal rate of assistance approach of Briones Alonso and Swinnen (2015) to the South African wheat industry in order to determine the policy welfare impacts for three key individual agents along the value chain. The time period of this coverage included the marketing years from October 2000 to September 2014. The final objective was to incorporate the results from both the aggregate update as well as the disaggregated nominal rate of assistance extension into the recommendation of better-targeted agricultural policy – particularly trade policy.

1.4   Outline of Applied Study Method

The empirical methodology followed in this study is centred around the calculation of agricultural producer distortion estimates. These distortions are estimated through the calculation of nominal rates of assistance (NRA) for a representative range of agricultural commodities. The magnitude of the NRAs per commodity or agricultural industry provide an internationally comparable indication of the distortions facing producers within the respective industries.

In addition to the aggregate commodity/industry NRAs to be calculated, the base NRA methodology was further expanded and tailored in order to quantify the distortions facing various agents within a vertical value chain. This disaggregated empirical approach was applied to the South African wheat value chain in order to quantify the distortions facing wheat grain producers, wheat flour millers as well as wheat flour consumers.

1.5   Outline of the Study

In Chapter 2, an overview of the motives and patterns of government intervention in markets is provided, followed by a discussion of the structural transformation of the agricultural sector accompanying economic growth. Such an overview is important to contextualise the environment in which policy intervention in agricultural markets occurs, while also providing theoretical explanations for why intervention in agricultural markets is deemed necessary. This chapter also provides a review of the theory of policy-induced price distortions, before discussing and critiquing the three major

inter-country attempts to measure price distortions in agriculture and their applicability to the South African case.

Chapter 3 provides a detailed description of the methodology of Anderson *et al*. (2006) from which the analytical framework used in this study originates. In addition, the methodology extension by Briones Alonso and Swinnen (2015) is outlined, and its link to the base methodology of Anderson *et al*. (2006) is made explicit. While the review in the first part of Chapter 3 incorporates methods of measuring distortions to both agricultural producers and consumers, the empirical focus of this study remains producer focused.

The first part of Chapter 4 provides details on how the Anderson *et al*. (2006) methodology was applied to the South African agricultural sector, with an emphasis on the sources of the data used and adaptions that were made from the Kirsten *et al*. (2009) study. This is done on a commodity group level and ensures adequate clarity around the data used in the study, as well as the methodology applied in the study. Furthermore, it serves as a precursor to the second part of the chapter, which discusses how the extended methodology of Briones Alonso and Swinnen (2015) was applied to the South African wheat industry.

Chapter 5 presents and discusses the results and findings of the study and is structured in two parts. First, the results using the general commodity framework of Anderson *et al*. (2006) for all commodities covered in the study are presented together with the disaggregated results from the wheat value chain analysis. This is followed by a discussion of the key trends seen over the past decade in the distortion estimates of South African agricultural producers, and a comparison with prior time periods. Furthermore, the policy assistance estimates for the three selected agents in the wheat value chain are analysed and their trends are compared to the market conditions that have prevailed within the wheat industry.

Finally, Chapter 6 presents the conclusions drawn from the research findings of the study. The policy implications of these findings are highlighted, followed by recommendations for further research.

1.6   Delimitations of the Study

As alluded to in the study objectives, the focus of this study was purely on the calculation of distortion estimates for selected primary agricultural producers in South Africa, together with distortion estimates for three key agents in the wheat value chain. Although the literature review extends to motivations for and calculations of distortions to agricultural product consumers and non-agricultural products, distortion estimates for these two market groups are not estimated in this study. However,

an understanding of their empirical measurement relative to producer distortion estimates is critical, and thus is addressed adequately in both the literature review and the study methodology.

Chapter 2   Theoretical Motivation and Literature Review

2.1   Introduction

Understanding the political economy of agriculture and the rationale behind government intervention in agricultural is a fundamental starting point to conceptualising the theory of price distortions. Once we know why governments intervene in agricultural markets, we are better poised to evaluate the methods of measuring this intervention, as well as to design policies that ensure minimum distortions to the incentives of agricultural producers. The next section of this chapter will provide an overview of government intervention in agricultural markets, followed by a review of the theory of price distortions in Section 3. The final part of Section 3 will outline the applicability of this theory to agriculture in order to motivate the rationale behind empirical measurements of policy-induced price distortions in agriculture.

The motivation for this rationale is followed in Section 4 by a review of three key global inter-country studies that have measured policy-induced distortions in agricultural markets and shaped the empirical scene. The final part of Section 4 provides a discussion of the South African context in the light of the Anderson (2009) study. This is followed in Section 5 by a discussion of the value chain approach to measuring distortions and a brief outline of the South African wheat industry's transition through history. Section 6 concludes.

2.2   Government Intervention in Agricultural Markets – Motives and Patterns

Historically, the field of the political economy of agricultural protection and distortions has been dominated by the conceptual question of why agriculture is supported in rich, industrialised countries but taxed in poor, industrialising countries (Swinnen, 2009). Krueger *et al*. (1988, 1991) completed the answer to this puzzling question in the late 1980s/early 1990s through the first inter-country empirical study of its kind. However, an understanding of the theoretical motive for government intervention in markets remains an imperative starting point in the discussion on the evolution of the theory of agricultural protection (De Gorter & Swinnen, 2002).

As highlighted by De Gorter and Swinnen (2002), governments across countries are actively involved in the allocation of resources between agriculture and the rest of the economy. This is done in order to (1) increase social welfare, primarily through the correction of market failures, and (2) redistribute incomes, primarily through commodity policies (Rausser, 1982, 1992). However, in the context of agricultural protection and distortions it is not merely the motive for government intervention in agriculture that is of relevance, but more so the pattern that this intervention takes on across countries at differing stages of development and over time.

Schultz (1978) proposes a typology for incentive altering government intervention in agriculture based on the impact of this intervention on agricultural output. Firstly, there are government policies that take on a neutral stance with regard to the opportunity cost of agricultural production. Secondly, there are those policies which over-value agricultural production and tend to exhibit a strong agricultural bias. Schultz's final "policy category" is a policy setting in which agricultural production is inherently undervalued and where policies tend to exhibit a strong non-agricultural sector bias. Based on this typology, Schultz (1978) was able to expand on his previous proposition, presented in the first Elmhurst Memorial Lecture to the International Association of Agricultural Economists. This proposition was that the level of agricultural output within countries largely was not a technical consideration, but rather had to do with the manner in which governments view and treat agriculture (i.e. "what governments do to agriculture") (Bale & Lutz, 1981).

In striving to understand the "development paradox" (i.e. taxation of agriculture in low-income nations and support of agriculture in high-income nations), Anderson (1986) points to the starting point as being an examination of the structural changes that occur in an economy throughout its growth. In addition, he suggests that a further analysis is required to determine how these changes alter the incentives of interest groups with policy influence.

2.2.1   Structural Transformation Accompanying Economic Growth

Stark contrasts exist between a pre-industrial agricultural sector in a low-income nation and a highly industrialised agricultural sector in a developed nation. As outlined by Bonnen and Schweikhardt (1998), farmers in low-income countries are typically a large majority of the population, as well as of the labour force, making national policy intervention directed at subsidising farmers virtually impossible to finance. Furthermore, the low per capita income and price-inelastic demand for food in low-income nations hampers any attempts to subsidise or protect farmers, as such intervention has inflationary consequences through rising food costs. The upward pressure on food prices is followed by economywide wage increases, while the monetary cost to protect farmers exceeds the revenues of the state.

Engel's Law predicts that the income elasticity of demand for food will decline in countries that experience income and GDP growth. This is consistent with the early writings of JS Mill and TW Schultz in this field, as well as the empirical conclusions reached by Anderson (1987) and Krueger *et al*. (1988, 1991). Consequently, as nations transition towards an industrialised agricultural sector with higher productivity, agriculture's share in GDP and in employment decreases, since the pace at which total national output is growing exceeds the pace at which the farming sector's output grows. The outcome of this elasticity-GDP growth relationship is that, as nations proceed on their economic growth paths,

the price of food relative to non-food is likely to decline (i.e. deteriorating long-run terms of trade against the agricultural sector) (Anderson, 1987). Furthermore, in the case where an economy is not growing, the declining share of agriculture's contribution to national output as well as employment is compounded due to the induced domestic price effects of declining international food prices (Anderson, 1987).

The results of the above process are (1) downward pressure on agricultural product prices and (2) retarded growth in the demand for food. When combined, these two results initiate significant shifts in resource allocation. Firstly, within the agricultural sector, resources flow away from the low-productivity farming sector towards the commercial, productive farming sector. Secondly, as the non-agricultural sectors experience rapid growth rates compared to the agricultural sector, the opportunity cost of remaining in the agricultural sector in terms of the aforementioned rapidly growing non-agricultural income increases. This rise in opportunity cost effectively pulls resources out of the agricultural sector and into non-agricultural sectors within the economy (Schultz, 1945).

Furthermore, throughout the structural transition towards an industrialised agricultural sector, political pressures are created to minimise the effects on farmer welfare resulting from the downward pressure on farm income (Bonnen & Schweikhardt, 1998). Accompanying this structural transformation is the development of economic characteristics within agricultural sector markets. Through their interaction with one another, these characteristics lead to agricultural sector markets becoming far more economically vulnerable as opposed to the other, non-agricultural sectors of the economy. It is this interaction accompanying the development of agriculture that serves as the backdrop for the so called "farm problem".

Starting from after World War 1 (WW1) and the Great Depression, the early writing by Galbraith and Black (1938) and later additions by Schultz (1945) provided explanations for the economic vulnerability of agricultural markets and how this vulnerability accompanied development. Bonnen and Schweikhardt (1998:9) concisely summarise the "farm problem" in the form of three questions:

- Why are farm sector markets so unstable?
- Why is the farm sector plagued by low returns?
- If microeconomic theory is correct, why does the farm sector not rapidly adjust to low prices by shifting resources out of the sector?

The three prevailing characteristics accompanying the development of agriculture that are inherent in the "farm problem" are therefore instability, low returns and asset fixity. The mere prevalence of these characteristics distinguishes the industrialised farming sector in a high-income nation from that

of a pre-industrialised farming sector in a low-income nation. However, the presence of all three these characteristics in unison, as well as their interaction, renders the industrialised farming sector in a high-income nation unique compared to the other economic sectors. It is this uniqueness of the industrialised agriculture sector in high-income nations that warrants a distinctive policy prescription being tailored for the agricultural sector aimed at alleviating the farm problem.

According to Bonnen and Schweikhardt (1998:8), the switch from political intervention taxing farmers to political intervention supporting farmers only occurs once the economic structure of a nation is such that:

- The wealth of the nation has increased substantially as a result of the development process.
- The transmitted effects of increased food costs as a result of protective farm policies only have a minor effect on the cost of living and consequently on the nation's wage bill.
- The proportion of the nation's labour force being subsidised through government's protection of agriculture is within the taxing capacity of the state.
- There is intense interest in the public policies affecting the few commodities being produced by highly specialised farmers due to the resulting welfare implications of these policies.
- The number of farms has declined significantly, to the extent that the transaction costs of organising farmer interest groups mandated with influencing government policy towards agriculture are markedly reduced.

In summary, the "development paradox" of the taxation of agriculture in pre-industrialised agricultural sectors and the support of agriculture in industrialised agricultural sectors is best understood through understanding the structural transition of the agricultural sector throughout the economic development process. Pre-industrialised and industrialised agriculture sectors are inherently different in a multitude of ways and consequently require dissimilar policy prescriptions. Therefore, critical to analysing the impact of such policy interventions on agricultural incentives is first to conceptualise the context of the farm problem and to fully understand the intrinsic undercurrents of the "development paradox".

2.3   Origins and Overview of Policy Induced Price Distortions

2.3.1   Theoretical Base

The theory of price distortions is built around Samuelson's (1939) theory of trade and welfare, according to which, under perfect competition with no monopoly power in trade, a laissez-faire policy management stance is deemed Pareto optimal (Bhagwati, 1969). Theoretically, under the Pareto optimality of the laissez faire policy-management stance, an economy will operate with technical

efficiency. This is where the marginal rate of transformation in domestic production (DRT) is equal to the foreign rate of transformation (FRT), which is further equal to the marginal rate of substitution in consumption in the domestic market (DRS). This relationship is captured in Equation (2.1) (Bhagwati, 1969).

$$DRT = FRT = DRS \qquad\qquad (2.1)$$

Where Equation (2.1) does not hold, a market is observed to be distorted. However, as Bhagwati (1969) highlights, departures from full optimality (Equation (2.1)) characterise a market with imperfections, in which four broad variations (distorted situations) of Equation (2.1) manifest. The variations are as a result of either (1) endogenous distortions, (2) autonomous policy-imposed distortions, (3) instrumental policy-imposed distortions or, alternatively, (4) as a result of non-operation on the efficient production possibility frontier. Consequently, under Bhagwati's (1969) generalised framework, a total of 12 (4 x 3) distortionary situations shift the economic system away from Pareto optimality. The four broad variations of Equation (2.1) as described by Bhagwati (1969) are provided below:

1. $FRT \neq DRT = DRS$
2. $DRT \neq DRS = FRT$
3. $DRS \neq DRT = FRT$
4. $Non-operation\ on\ the\ efficient\ production\ possibility\ frontier.$

2.3.2 Welfare Aspects of Policy Distortions

From a practical standpoint, the theoretical underpinnings of a policy-induced price distortion are best understood by graphically analysing the contrasting impact of policy support for/taxation of imported commodity groups as opposed to exported commodity groups. As highlighted by the OECD (2016a), a key theoretical assumption when quantifying policy intervention in agricultural markets is that these markets are competitive and consequently exhibit the characteristics of competitive markets (perfect information, large number of firms, product homogeneity, and free entry and exit).

The implication of the presence of these characteristics is that price arbitrage will prevail, where market agents will continue to exploit price differentials across markets so that there is a stable tendency for the domestic prices of the traded goods to align with external prices for the same goods. Under this theoretical context, the persistence of a price differential between domestic and external markets is as a result of government intervention in the respective domestic markets. Therefore, intuitively, this price differential is a central aspect when quantifying the magnitude of government's

distortionary impacts in markets, either as a result of government measures imposed at the national border (tariffs, exports subsidies, quotas etc.) or otherwise as a result of direct market intervention in the domestic market (price controls, marketing boards etc.) (OECD, 2016a).

The use of a partial equilibrium framework concisely depicts the welfare consequences of policy-induced price transfers as a result of positive market price differentials (domestic price > border price) and negative price differentials (domestic price < border price) between imported and exported commodities. Such a framework enables both the direction of the welfare transfers as well as the benefiting market agents to be determined.

2.3.2.1   Price-increasing Policy Intervention

The theoretically prevailing market situations under positive market price differentials in the case of an imported commodity and an exported commodity are depicted in Figure 2.1 and Figure 2.2 respectively. In both figures, the lines DD and SS are representative of the domestic commodity demand and the domestic commodity supply respectively.
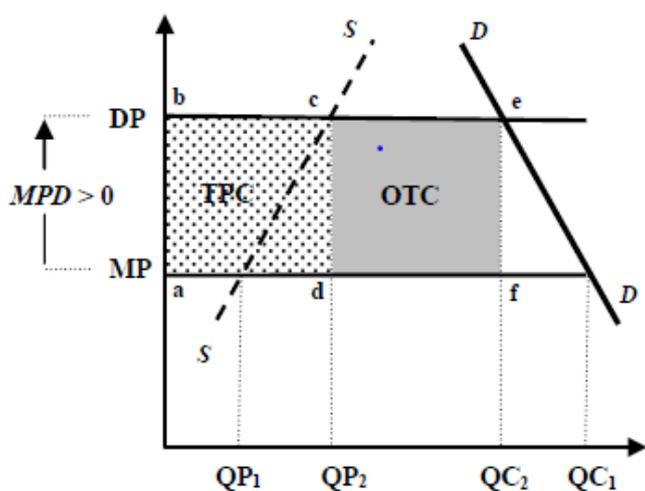
Figure 2.1. Price-increasing policy intervention in the case of an imported commodity.
Source: OECD (2016a)
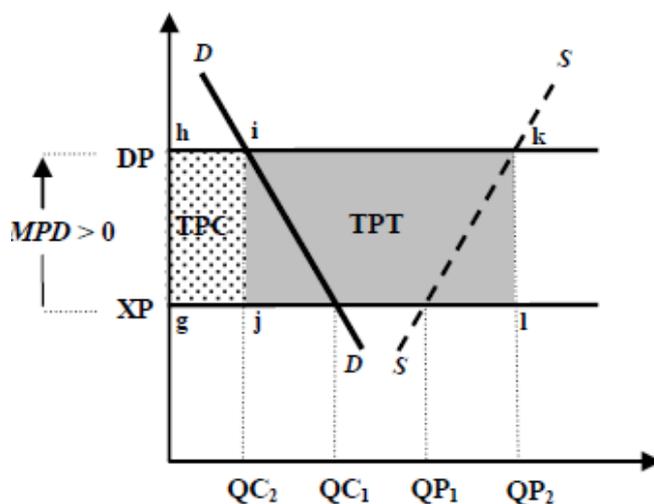
Figure 2.2. Price-increasing policy intervention in the case of an exported commodity.
Source: OECD (2016a)

In the case of an imported commodity (Figure 2.1), the domestic market will be in equilibrium when the domestic price is equal to the import price (MP). At this price (MP), QP_1 will be supplied by domestic suppliers and QC_1 will be demanded by domestic consumers. The supply shortfall ($QC_1 - QP_1$) will be met by imports of the commodity into the domestic market.

A policy environment in which the domestic price is raised to a higher level than the import price induces producers to respond by increasing supply while inducing decreased consumption by consumers. At the new policy raised the domestic price (DP), the supply shortfall is reduced on the domestic markets, with import volumes consequently falling to $QC_2 - QP_2$.

The market price differential (MPD = DP – MP) resulting from the policy intervention can thus be used in quantifying the welfare transfers that occur as a result of the intervention. In Figure 2.1, the area TPC is representative of the welfare transfer to commodity producers from consumers through the price mechanism, while the area OTC is representative of transfers from consumers to other market agents. The recipients of these other transfers are dependent on the specific policy tool being employed by governments in order to raise domestic prices to the higher domestic price level.

In the case of an exported commodity (Figure 2.2), the increased domestic price (DP) as a result of policy intervention shifts the equilibrium away from the would-be equilibrium in the absence of intervention (domestic price = export price (XP)). In doing so, the higher policy-induced equilibrium price reduces the domestic consumption of the commodity to quantity QC_2 (from QC_1), while increasing the domestic supply of the commodity to QP_2 (from QP_1). These polar quantity shifts increase the domestic market surplus, which consequently raises commodity exports to $QP_2 - QC_2$ (from $QP_1 - QC_1$).

As in the case of an imported commodity, the positive MPD also forms the basis when quantifying the welfare transfers that occur through the price mechanism as a result of the policy intervention. In the export case, the transfers to producers from consumers (TPC) is far smaller than in the import situation and is largely overshadowed by the transfers to producers from taxpayers (TPT). The TPT transfers represent the proportion of producer price support that is borne by tax payers through budgetary outlays.

As noted by the OECD (2016a), the critical distinction between the import and export situations under a positive MPD is that, under the import situation, only part (TPC) of the total transfers (TPC + OTC) are received exclusively by producers, whereas under the export situation, all transfers (TPC + TPT) are received exclusively by producers. Furthermore, under the import situation, the transfers received exclusively by producers are financed entirely by consumers, whereas under the export situation, the transfers received by producers are jointly financed by consumers and tax payers.

2.3.2.2   Price-decreasing Policy Intervention

In contrast to Figure 2.1 and Figure 2.2, Figure 2.3 and Figure 2.4 depict the prevailing market situations under negative market price differentials in the case of imported commodities and exported commodities. Such negative differentials could be brought about, for example, by government setting administrative limits on domestic food prices as well as subsidising imports (OECD, 2016a).
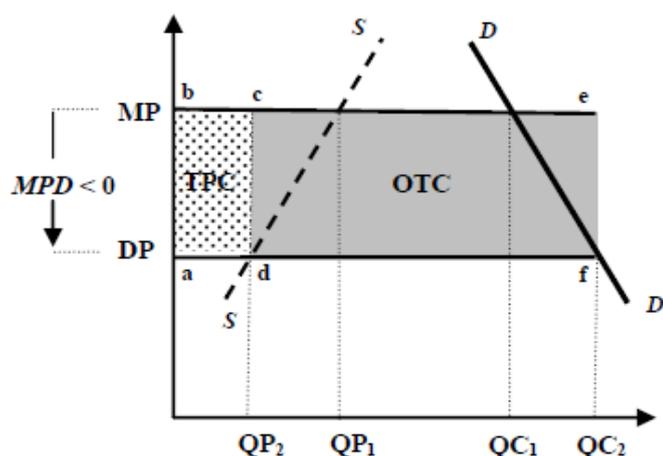

Figure 2.3. Price-decreasing policy intervention in the case of an imported commodity.
Source: OECD (2016a)
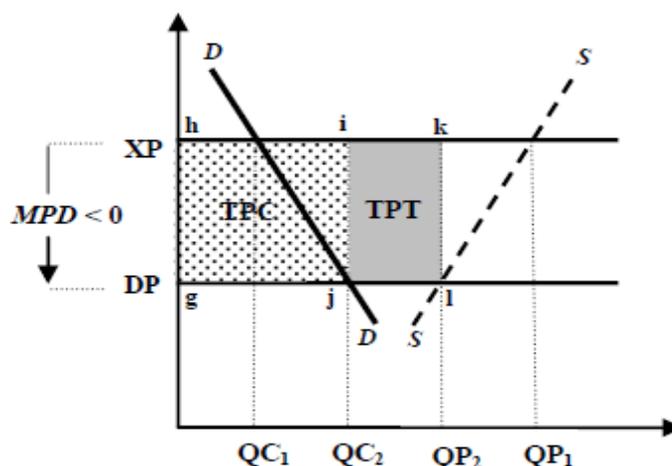
Figure 2.4. Price-decreasing policy intervention in the case of an exported commodity.
Source: OECD (2016a)

The case of an imported commodity (Figure 2.3) where the domestic price (DP) has been pushed below the import price (MP) due to policy intervention results in increased consumption of the importable commodity (QC_1 to QC_2), coupled with decreased production (QP_1 to QP_2) of the commodity. As a result, the supply shortfall on the domestic market worsens from its prior value of QC_1 - QP_1 to QC_2 - QP_2 as producers and consumers respond to price incentives. The import volume required to meet this shortfall consequently increases. This is in contrast to the positive MPD policy setting. Furthermore, under a negative MPD policy setting, welfare transfers flow towards consumers rather than towards producers. These welfare flows come from taxpayers (area OTC in Figure 2.3) as well as from producers (area TCP in Figure 2.3).

Where policies that decrease the domestic market price are introduced for an exported commodity, the decreased domestic market price lowers the incentives of producers to produce the exported commodity while raising the incentives of consumers to consume the exported commodity. Consequently, the supplied quantity of the commodity on the domestic market drops to QP_2 (from QP_1), while the demanded quantity increases to QC_2 (from QC_1). These shifts have a domestic surplus-reducing result and subsequently lower the quantity exported to QP_2 - QC_2 (from QP_1 - QC_1). The welfare transfers are in contrast to the positive MPD policy setting, where it is observed how welfare

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transfers rather flow to consumers from agricultural producers through the price mechanism (area TPC in Figure 2.4) as well as from budgetary transfers (area TPT in Figure 2.4), which are also financed by agricultural producers. Therefore, where the policy environment is supressing the domestic prices of exported commodities, consumers welfare is being increased solely at the expense of the welfare of producers (OECD, 2016a).

2.3.3   Applicability to Agriculture

A market price distortion is something that governments impose through intervention that creates a gap or wedge between the marginal social return to the sellers and the marginal social cost to the buyer in a specific transaction (i.e. the gap between the price paid and the price received) (Bhagwati, 1971). In essence, the market mechanism becomes distorted, as not all agents in the economy are faced with the same price ratios (Kawamata, 1974). The resulting price wedge that develops represents an economic cost to society, which is able to be quantified using welfare measurement techniques such as those pioneered by Harberger (1971), in which changes in volumes directly affected by such price distortions are evaluated. The discussion in Section 2.3.2 graphically depicted the theoretical base of these measurement techniques in a partial equilibrium context.

Lerner's (1936) symmetry theorem shows that, in a two-sector model, an import tax and export tax have the same impact on the export sector. Vousden (1990:46) proves the applicability of the theorem in a multisector model by showing that a multisector model is unaffected, regardless of whether the model is under imperfect competition domestically or internationally, or whether some of the sectors only produce non-tradables (Anderson *et al*., 2008). In the light of Vousden's (1990) multisector finding, Anderson *et al*. (2008) highlight the relevance of the symmetry theorem within the agricultural sector. The scenario of the identical impact on the incentives to produce exportables of an import tariff-protecting import-competing farm industries and an export tax taxing agricultural exporters is used by Anderson *et al*. (2008) to emphasise the applicability of the symmetry theorem.

For this reason, as Anderson *et al*. (2008) note, it is relative prices and relative rates of assistance between the agricultural and non-agricultural sectors that affect agricultural producers' incentives. Consequently, the total effect of distortions within the agricultural sector will not depend only on agricultural policy measures, but also on the magnitude of distortions generated by policy measures that alter incentives in non-agricultural sectors. In addition to the direct incentive effects of distortions, there are a range of other developments affecting producer and consumer incentives that are flow-on consequences of the distortion. Examples include the large-country trade argument, whereby domestic distortions in terms of a specific traded commodity within a large country

contribute to altering the world (distortion-free) price, which consequently reduces/increases the negative impact of the distortion within the specific country.

2.4   Price Distortions in Agriculture: Review of Past Studies

2.4.1   Historical Perspective

The disarray in world agriculture, as once described by Johnson (1973), encapsulates the practical implications for global agriculture of the opposing governmental policy stances towards agriculture in developing and developed nations. While the taxation of the agricultural sector in developing nations has been motivated by objectives such as those discussed in Section 2.2.1, the depression of developing nations' agricultural price incentives has historically been compounded, and continues (albeit to a lesser extent) to be compounded, through depressed international prices for farm products. This international price depression is as a result of the supportive agricultural protectionist policy stances of countries in the developed world towards their respective agricultural sectors (Anderson, 2010). In addition to this, the industrialisation strategies adopted by numerous developing countries over the past 50 to 60 years have been characterised by purposefully over-valued domestic currencies, together with the pursuance of import-substituting industrialisation strategies through restrictions on imports of manufactured goods. This import substitution, as highlighted by Krueger *et al*. (1988, 1991), indirectly taxes producers of other tradable products in these countries, the majority of these producers being farmers (Anderson, 2010).

Consequently, Johnson's (1973) state of disarray in global agriculture is still of relevance today, albeit to a lesser extent, and is induced through the overproduction of agricultural products in high-income nations together, with the underproduction of these products in low-income nations. Furthermore, as outlined by Anderson (2010), the markets for agricultural products have been thinned and consequently have been made volatile due to the fact that less international trade of agricultural products has occurred than would otherwise have been the case under free trade. The past 20 to 25 years have witnessed widespread agricultural price and trade policy reform globally, in line with the broader policy reform agenda. Such reform has contributed to the reversal of the "disarray" in agriculture and the drive towards free trade.

Empirically, the measurement of the changing agricultural policy environment of global agriculture is underpinned by the measurement of distortions to agricultural incentives over time (price distortions). The analysis hereof yields the extent to which policy reforms have been successful or unsuccessful in reversing the "disarray" in global agriculture. Most early studies (see FAO, 1973, 1975; OECD, 1987; USDA, 1987, 1988) focused on developed countries and predominantly had a "trade distortion" focus. A three-part focus was implied by this policy focus, in which (1) specific commodities

were focused upon, (2) price as opposed to non-price policies were analysed and (3) a short- and medium-term policy horizon were considered, rather than a long-term structural and technological policy horizon (Josling & Valdes, 2004). Consequently, Josling and Valdes (2004) highlight how these early studies considered policies that directly impacted on prices, while ignoring factor markets as well as exchange rate misalignments. Furthermore, the partial nature of these early policy studies ignored the impact of non-agricultural policies on the agricultural sector, which was revealed through the work of Krueger *et al*. (1988) in developing countries to have been a significant omission.

While many country-specific studies have been conducted throughout the developing world, three key cross-country studies/projects since the late 1980s have been pivotal in shaping the agricultural price distortions analysis landscape in developing countries. These include, firstly, the seminal multi-country study by Krueger *et al*. (1988, 1991) under the direction of the World Bank, covering the period 1960 to 1984 for a range of 17 developing countries. Secondly, estimates of consumer and producer support levels have been (since 1986), and continue to be, provided annually by the Secretariat of the OECD, predominantly for its member countries (OECD, 2015). Lastly, complementing the previous two studies is the most recent empirical quantification of the extent of policy intervention, conducted by Anderson (2009) under the direction of the World Bank for the years 1950 to 2007, with a subsequent update to the year 2011 by Anderson and Nelgen (2013).

For comparative reasons, each of the three studies is reviewed in the rest of Section 2.4, using a three-point structure. The premise and coverage of each project is first highlighted, followed by a summary of the methodology applied before the key findings are presented and discussed.

2.4.2   World Bank Study by Krueger, Schiff and Valdes

2.4.2.1   *Premise and Coverage of the Project*

Four stylised facts about agricultural policies in developing countries served as the theoretical motivation for this project. At the time, the view of Krueger *et al*. (1988) was that the interaction among these stylised facts had not been appreciated sufficiently.

The first of these facts was the observation that the majority of developing countries had adopted growth strategies characterised by policies directed at import substitution and the protection of domestic producers against competing imports. The second stylised fact concerned overvalued exchange rates that had been maintained throughout the developing world as a result of country-specific exchange control mechanisms in combination with import-licencing mechanisms. The third fact highlighted the previously documented trend in the literature that agricultural marketing boards, export taxation as well as export quotas had been used by developing countries to suppress the prices

of agricultural commodities. The last of these stylised facts was the observation that input subsidisation had been used as an attempt by developing countries' governments in order to offset part of the disincentives facing producers (Krueger *et al.*, 1988).

With the recognition that agriculture is taxed in most developing countries, the premise of the World Bank-endorsed project (see Krueger, 1992; Krueger *et al.*, 1988, 1991; Schiff & Valdes, 1992) evaluating the political economy of agricultural pricing policy was to determine the magnitude of this taxation within countries. Using a uniform methodology, comparative studies were conducted in 18 developing countries for the time period from 1960 to 1985, which for most developing countries was the first 25 years after colonial rule (Anderson, 2010). Furthermore, this period in the international economic environment was one of significant volatility in the prices of major global agricultural goods (Krueger *et al.*, 1991). This seminal project covered on average 4.3 agricultural products for each of the countries for the time period studied, which altogether accounted for 6% of global agricultural output at the time (Anderson, 2010:198). Importantly, the project was not only undertaken to determine the effects of distortionary policy on agricultural commodity prices, but also to explain how political factors and market forces affected government intervention in the agricultural sector (Krueger *et al.*, 1991).

2.4.2.2   Methodology

Under the notion that most agricultural commodities are tradable, and that the majority of countries' shares in world trade are too insignificant to influence world prices, the price at which countries are able to trade agricultural commodities globally is exogenously determined. Consequently, Krueger *et al.* (1991:261) state that, in the case such as the above:

> … the border prices of the commodities examined can be used as reference prices to measure the impact of sector specific or direct price interventions on agricultural prices.

Furthermore, a significant underpinning in the determination of comparable undistorted commodity prices was that international commodity prices first needed to be adjusted for transport costs in order to make these prices comparable to domestic producer prices. Given this, Krueger *et al.* (1991) highlighted that, in unregulated markets, the reasonable assumption would entail that, once adjusted for transport, handling and storage costs as well as for quality differences, domestic producer prices would be closely linked to the border price for agricultural commodities.

The essence of the Krueger *et al.* (1988) distortion estimates was thus underpinned by the theoretical premise aligned with that in the price distortion literature discussed in Section 2.3.1, where, in its simplest form, a market distortion was shown to be a situation where Equation (2.1) no longer holds.

Empirical estimates were consequently constructed as part of this study in order to quantify the magnitude of both direct and indirect policy impacts on agricultural commodity prices.

Direct impacts included policy intervention that was focused directly on either the inputs into the agricultural sector or, alternatively, the outputs from the sector. Contrastingly, the indirect impacts were far more complex to estimate and were deconstructed by Krueger *et al*. (1988) into three main components: (1) the real exchange rate depreciation required in order to eliminate the non-sustainable portion of the current account deficit; (2) the size of the real exchange rate depreciation as a result of the removal of trade policy interventions; and (3) the increase in relative prices between agricultural and non-agricultural tradable products, as a result of trade policy interventions mainly protecting non-agricultural industry.

The total intervention affecting the agricultural sector was consequently taken to be the sum of the direct and indirect policy impacts, with the exception of some adjustments in country-specific cases. The intervention estimates were measured using nominal protection rates for the commodities covered. These were computed as the proportional difference between the domestic producer price (relative to non-agricultural prices) and the border price (after transport, handling, quality and storage adjustments) measured at the official exchange rate (Krueger *et al*., 1988).

2.4.2.3   Key Findings

The study by Krueger *et al*. (1988) reasserted the a priori literature conclusions in terms of policy discrimination against agriculture in developing nations. However, the most notable finding from this seminal study was the magnitude of this discrimination and the manner in which it had remained constant over the study period.

The study found that, on average, direct government intervention in the agricultural sector had resulted in agricultural prices being depressed by around 8%, while indirect intervention had resulted in a depression of prices for the period covered of around 23% (Krueger, 1992:61). Furthermore, in addition to the sheer magnitude of the discrimination, the study's findings emphasised the importance of exchange rate policy and the protection of non-agricultural industry in the discrimination against agriculture. What arose from this was the general notion that the impact of economywide direct interventions in agriculture by far outweighed the direct policy effects on agriculture, regardless of whether the direct effects were positive or negative (Krueger *et al*. 1988). In terms of the policy stances between agricultural importables and agricultural exportables, Krueger *et al.* (1988:264) summed up the general trend for the two time periods of their study (1975 to 1979 and 1980 to 1984) using Malaysian rice and rubber producers as an example, as follows:

> Indeed, the degree of discrimination against exportables in favour of import competing crops is remarkable: contrast Malaysian rice, receiving the equivalent of 38 and 68 percent nominal protection over the two time periods, with Malaysian rubber, taxed at the equivalent of 25 and 18 percent. Direct pricing policy led to an increase in the relative price of rice of 84 percent in 1975-79 and 105 percent in 1980-84 (relative to rubber).

Although extreme, the Malaysian rice/rubber case highlights one of two significant findings of the study with regard to sector-specific agricultural interventions. Firstly, there was a stark contrast between the direct policy stances towards imported food products and exported crops, as it was observed that food imports on average were subsidised, while exports were taxed. Secondly, the study's findings indicate that, in around 70% of the studied countries, food production had been protected through direct policies. Such findings were labelled as ironic by the authors of the study, as for the study period, most of the covered countries had foreign exchange shortages, therefore it was puzzling that agricultural policies were in effect compounding this foreign exchange shortage by reducing the amount of foreign exchange earned (Krueger, 1992). Considering the country-specific studies and the ensuing analysis, Krueger (1992) outlines several key conclusions that can be extracted.

Firstly, from the data evidence for the period, it was revealed how greater discrimination against agriculture was directly related to slower economywide economic growth (see Table 3-1 in (Schiff & Valdes, 1992)). As a result, this evidence largely helped refute the argument once present in the literature, namely that discrimination against agriculture leads to more resources being available for industrial development and spurs economic growth.

Secondly, the revenue gain for governments from the discriminative policies was short lived and consequently does not hold water as a motive for such policy stances. Furthermore, Krueger (1992) points to evidence that, under the situation where government revenue was the motive, pricing policies would have taken a different stance from that which prevailed. This stance would have been characterised, firstly, by the efficient allocation of resources amongst agricultural commodities and, secondly, the uniform taxation of all commodities. Such a stance would have ensured maximum tax revenue gain for governments.

Thirdly, as discussed by Schiff and Valdes (1992), the only goal of agricultural pricing policy that was shown by the evidence to be realised was the stabilisation of domestic commodity prices within the studied countries relative to international commodity prices. However, Krueger *et al*. (1988) question the relative cost of this stability, while Krueger (1992) emphasises how such an objective of price stability is able to be achieved independently of efforts to raise or lower average prices paid to

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farmers. Consequently, the pursuance of such an objective is insufficient in explaining why domestic prices received by farmers were so much lower than international prices of the equivalent commodity over the studied time period.

Fourthly, as the Malaysian rice/rubber example portrayed for Malaysia, foreign exchange shortages were experienced by most of the project countries. However, discriminative agricultural policy stances persisted across the studied countries, in which the average reduction in export earnings as a proportion of actual earnings within countries was 29%. Krueger (1992) consequently questions the willingness of policy makers over the time period to self-constrain their respective country's abilities to import essential goods and services into their countries.

The last of the key conclusions from the study concerned the relatively small magnitude of the income-distribution effects as a result of the policy discrimination. Schiff and Valdes (1992a), through their analysis of income distribution, refuted the proposition that agricultural pricing policies had been undertaken in order to ensure improved access to food for lower-income consumers. This refutation is aligned with the assertion of Krueger (1992) that, as a result of the majority of the poor coming from rural areas in the countries studied, discrimination against agricultural commodities produced by this proportion of the population would naturally have an adverse impact on income distribution. For selected countries within the project for which the necessary data was available, the above assertion was reinforced by the data.

In summary, the findings of this seminal study uncovered the various mechanisms through which the economic policy environment affects the agricultural sector and successfully quantified these impacts. In addition to the stark contrasts that prevailed in the policy stances towards imported food products and exported crops in developing countries, a notable finding was the manner in which indirect, economywide policies generally dominated the effects of direct agricultural policies in the developing countries studied (Krueger *et al*. 1988). This was reinforced through the policy bias towards the protection of industry, as well as the currency overvaluations characteristic of the developing world during the period.

2.4.3   Ongoing Project by The Secretariat of the OECD

2.4.3.1   *Premise and Coverage of the Project*

The early 1970s were characterised by a sharp rise in agricultural commodity demand and prices, which was followed by accelerated inflation and a worldwide recession towards the late 1970s/early 1980s (Huff & Moreddu, 1989). This economic environment, together with the macroeconomic policies at the time, contributed to the depression of agricultural incomes (Huff & Moreddu, 1989). In

response to depressed agricultural incomes, many OECD member governments introduced a variety of policy measures targeted at assisting agricultural producers. As a result of these policy measures, the OECD agricultural economy became isolated from world markets while its member countries' agricultural expenditures skyrocketed. In addition to this, consumers faced higher food prices (Huff & Moreddu, 1989).

In 1982, the OECD ministerial council committed to reforming agricultural policies in order to more fully integrate agricultural trade within the open, multilateral trading system. In the light of this commitment, OECD countries were advised to pursue a gradual reduction in protection and a liberalisation of trade, while continuing to maintain a balance between countries as well as between commodities (OECD, 2016a). In order to monitor the progress of this, the ministerial council requested the OECD to develop a framework that would be able to measure the progress of the reduction in protection and liberalisation of trade.

The resulting study (mandated in 1987 by OECD ministers) has since (from 1986) calculated annual quantitative measures of assistance to producers and consumers for OECD member states, as well as for selected non-OECD countries in recent times. The utility of quantitative support indicators that are comparable across time and between countries is indicated by the OECD (2016b) to be three-fold.

Firstly, the indicators can be used in order to monitor and evaluate the levels and composition of agricultural support with respect to the policy reform agenda. Such monitoring includes measuring the extent of reform between countries and individual commodities over time. Furthermore, the relative success or failure of specific policy reform efforts, such as various CAP reforms as well as progress in relation to the 1982 OECD Ministerial Council agreement, can be established.

Secondly, through using a consistent and comparable method to calculate the nature and extent of support, the OECD indicators ensure a common base for policy dialogue. In 2016 the indicators were calculated and published for 47 countries (27 EU members were treated as a single entry), which enhanced their international comparability and their use as a tool for policy dialogue amongst a broad range of institutions and organisations, both within the OECD member states as well as outside of the OECD member states.

The final utility aspect of the quantitative support indicators is the purpose that the data serves as an input into modelling. This aspect ensures research usability of the indicators and enables empirical modelling to assess the effectiveness and efficiency of specific policies in delivering their targeted outcomes. As cautioned by the OECD (2016b), the support indicators alone are unable to quantify the relative success or failure of specific policies against their stated objectives; however, the economic

information from which the indicators are constructed serves as a critical building block in this type of analysis.

Although initially being established in order to measure the reduction of agricultural protection within OECD member states, the OECD's annual Agricultural Policy Monitoring and Evaluation reports have continued to increase both in scope as well as country coverage. By 2008, the OECD reports covered 30 countries in total, which at the time accounted for just more than 25% of the global agricultural output when valued at undistorted prices (Anderson, 2010). By 2016, the country coverage had reached 50 countries, including 34 OECD countries, seven non-OECD EU member states and nine emerging economies, including South Africa.

2.4.3.2   Methodology

A common element identified by the OECD regarding agricultural policies is that these policies generate transfers to agriculture. Under the methodology applied by the OECD, agriculture is seen as a supported sector and is deemed to be the main beneficiary of policy transfers (OECD, 2016b). As graphically depicted in Figure 2.1 to Figure 2.4 , the main sources of these policy transfers and the consequent economic groups bearing the cost are consumers of agricultural products and taxpayers in the respective economies. Furthermore, underlying the key measurement aspects of agricultural support is the perspective from which agricultural producers are viewed – either as individual entrepreneurs or, alternatively, as a collective sector (OECD, 2016b).

Preceding the calculation of the agricultural support indicators is the definition of the policy measures that are to be included in the measurement of support. Policies are differentiated according to which of the three economic groups (agricultural producers individually, agricultural consumers, agricultural producers collectively) receive the policy transfer concerned. As stated by the OECD (2016b:25), a specific policy measure will only be included in the measurement of support if the policy "provides a transfer whose incidence is at farm level" and "is directed specifically to agricultural producers or treats agricultural producers differently from other economic agents in the economy".

Based on the above policy differentiation, policies are grouped into three broad economic groups, namely producer support estimates (PSE), general services support estimates (GSSE) and consumer support estimates (CSE). Each of these broad groups contain sub-indicator measures that are used in calculating the broader indicator. The total support estimate (TSE) is the sum of these three economic groups and provides an estimate of the annual value of transfers from policy measures that support agriculture. All four of the above indicators are published as monetary indicators as well as percentage indicators, with varying interpretations. However, a detailed discussion of these does not fall within the scope of this review of the methodology and is discussed extensively in OECD (2016c).

2.4.3.3   Key Findings

The overall burden of one country's economy as a result of its support of agriculture is measured by the TSE as a percentage of GDP (%TSE). According to the OECD's 2016 Agricultural Policy Monitoring and Evaluation report, most of the covered countries have persisted with positive %TSEs (with some exceptions), although steady decreases in the %TSEs have been a common trend since the mid-1990s. This is in line with the declining share of the agricultural sector within countries' economies as they undergo economic development (OECD, 2016b).

The composition of the aggregate TSE remains dominated by the PSE, which for the majority of countries represents more than 80% of the TSE (2013 to 2015 period) (OECD, 2016b:42). On average, the GSSE represented 12% of the TSE calculated for the period from 2013 to 2015. However, this somewhat lower average compared to the mid-1990s is largely due to a relative decline in GSSE of TSE as a result of China's extraordinary increase in PSE for the period. The CSE represents the final component of the TSE and, in most countries in the study, has maintained a negative value over time, which is indicative of the implicit tax placed on consumers as a result of agricultural policies (OECD, 2016b).

The PSE – the largest component of the TSE, has tended to follow a declining trend over the past twenty years, with market price support (MPS) remaining the driving component of the PSE. MPS does not burden the state budget directly; rather, this type of support for agricultural producers is as a result of transfers from consumers of agricultural commodities to the producers thereof. From a policy distortions perspective, the OECD (2001) highlights how MPS are one of three forms of support that are deemed to have significant potential to induce distortions in production and trade. Analysis of the average %PSE between OECD countries and emerging countries aligns itself with the historical trends of agricultural policy in the literature, as well as with the broader OECD policy reform agenda initiated in 1982.

During the mid-1990s, OECD countries were generally providing significant support to agricultural producers, whereas emerging countries were generally taxing their agricultural producers or providing extremely low levels of support to them (OECD, 2016b). Such a situation is aligned with the explanation in Section 2.2.1, where the historical observation was shown to be that pre-industrialised agricultural sectors in the developing world are generally taxed, whereas industrialised agricultural sectors in the developed world are supported.

Since the mid-1990s, the support provided to farmers in the emerging countries as opposed to the OECD countries included in the study exhibited opposite trends. In line with the OECD ministerial agreement reached in 1982, OECD countries' average support levels for agriculture have continued to

decline and have roughly halved in the period from the mid-1990s to 2015. In contrast, and aligned with the relationship between agricultural support levels and economic development, emerging countries' support for agriculture has increased from the low and negative levels observed in the mid-1990s to average levels. These average levels in 2015 were surprisingly higher than the average of the OECD countries, although this was largely due to the massive levels of support provided to agricultural producers in China and Indonesia.

2.4.4 Anderson-led World Bank Project

2.4.4.1 Premise and Coverage of the Project

The World Bank's project on "Poverty alleviation through reducing distortions to agricultural incentives" was grounded on five premises (Anderson *et al*., 2006). Firstly, it was observed that more than two-thirds of the world's poor people were from developing countries and, furthermore, that they depended directly or indirectly on agriculture for their livelihoods. Secondly, as shown by Dollar and Kraay (2002, 2004), poverty can be alleviated by economic growth. Their findings show that, on average, growth benefits the poor as much as anyone else in society. Thirdly, price and trade policy interventions by governments have been shown by Bhagwati (1969) to have comparative static welfare costs, while also being shown to be growth inhibiting, amongst others by Winters (2002, 2004). Furthermore, Reardon and Timmer (2006) show how these interventions by government were and still are becoming increasingly costly through their blunting effect on producers' responsiveness to consumers' shifting preferences towards the quality, variety and safety attributes of food. The fourth premise of the project was the theme consistently present in the literature that, in most developing countries, farming incomes have been supressed by policies, while in most developed countries, farming incomes have been raised. This has had a knock-on effect in developing nations of further supressing the earnings of farming households. Lastly, as Anderson *et al*. (2006) state, the apparent objective of the government interventions in both the developed and developing world could be achieved more efficiently and effectively using alternate instruments to the ones currently chosen.

With the backdrop of the five premises discussed above, Anderson *et al*.'s (2006) empirical framework was constructed in order to evaluate the degree to which the last two premises still hold. In line with the broader policy agenda of moving towards free trade, the empirical framework was designed in order to measure the progress of individual economies towards a low-distorting policy environment. Where large distortions still remained, the framework allowed for the nature of these distortions to be determined, while also being able to predict what the relative contributions would be of policy reform by developing countries, developed countries as well as own policy reforms to a specific

country's agricultural distortions. Furthermore, the potential contributions to reducing these distortions by agricultural policy reform relative to non-agricultural reform were also a product of the empirical framework. Theoretical explanations could then be constructed on a country-specific level in order to account for the historical patterns of distortions throughout various stages of development.

The study initially covered a total of 70 products across 75 countries, which were representative of 90% to 96% of global GDP and global agricultural GDP for the time period 1955 to 2007. A subsequent update of the developed countries in the sample and a select few developing countries was undertaken by Anderson and Nelgen (2013), covering the period 1955 to 2011. This update also expanded the coverage to 82 countries using the data provided on an annual basis by the OECD (methodology outlined in Section 2.4.3.2), as well as FAO data and the World Bank's pink sheets.

2.4.4.2   Methodology

The methodology constructed by Anderson *et al*. (2006) draws inspiration from and builds on the OECD measurement methods, as well as the methodology employed by Krueger *et al*. (1988). Aligned to the theoretical base of price distortions, this methodology is centred on the measurement of government-imposed distortions that create a wedge between the domestic price (distorted price) of the specific commodity and the like tradable commodity's border price (undistorted price) (Anderson, 2010). In the case of a non-traded product, the undistorted price is seen as the farm commodity price that would have prevailed in the absence of domestic subsidies and taxes.

Nominal rates of assistance (NRAs) and consumer tax equivalents (CTEs) characterise the empirical indicators representing the policy assistance or taxation experienced of producers and consumers of agricultural products respectively. A series of ratios are then applicable in order to extract the dynamics of the policy impact from the calculated indicators and to analyse the consequent trends over time.

2.4.4.2.1   Nominal Rates of Assistance (NRA)

The NRA for each farm commodity is representative of the percentage by which government policies have directly raised gross farm incomes above what these incomes would have been in the absence of intervention. Using the value of production at undistorted prices as weights, the weighted average NRA for all covered agricultural commodities is calculated across countries. This is done by using an estimate of the NRA for the 30% of non-covered products, in conjunction with the empirical estimates of the covered products. Within the covered commodities, a further distinction is made between exportable commodities, import-competing commodities and non-tradable commodities. This

distinction enables the NRAs to be calculated according to the trade status of commodity groups and thus assists in identifying trade or anti-trade policy biases.

On the intuition that government policy intervention in non-agricultural sectors also alters the incentives of agricultural producers – predominantly through factor markets, NRAs are also estimated for the non-agricultural economic sectors of the respective country economies. With these estimates, the impact of all government policies on agricultural producers, both directly and indirectly, is able to be estimated and presented as the total rate of assistance to agriculture (Anderson *et al*., 2008). Similar to the policy biases that can be identified between agricultural commodities based on trade status, comparisons between the NRAs of agricultural commodities and non-agricultural commodities allow policy biases between the agricultural sector and the non-agricultural sector to be identified and quantified.

2.4.4.2.2 Consumer Tax Equivalent (CTE)

Although the predominant focus of this methodology is on the policy implications for agricultural producers, consumers may concurrently be either taxed or subsidised under the existing policy environment. Therefore, CTE measures are calculated to encompass the deviation between the price paid by consumers for food products (adjusted to farmgate level) and the international price at the country's border for the food products.

In the absence of any policy-induced distortions in the domestic economy, the adjusted farmgate consumer price for a specific agricultural product will be equal to the price received by the producer of the product. However, distortions – typically as a result of transfer policies and various forms of taxes and subsidies – result in price differences between what consumers pay and what producers receive (Anderson, 2010). By using the value of production as weights, the weighted average of CTEs across commodities and countries is able to be determined and used to reflect the extent to which the policy environment is affecting consumers.

2.4.4.3 *Key Findings*

The findings by Anderson (2009) on policy-induced distortions in the developed and developing world are characteristic of the contrasting policy stances towards agriculture accompanying the various stages in economic development (Section 2.2.1). However, in line with the broader global policy-reform agenda, the study noted a convergent trend between developed and developing countries' policies during the years subsequent to 1985. Key to conceptualising this convergence is understanding the contrasting policy environment that had developed in the developed and developing world from the late 1950s until 1985, as opposed to that which prevailed post-1985.

As stated by Anderson (2010), the nominal rates of assistance, as well as the relative rates of assistance to the covered countries arising from the study, highlight several points of interest masked by the two contrasting time periods.

2.4.4.3.1   Time Period 1950 to 1984

Firstly, the agricultural sectors throughout the developed world were already heavily assisted in the late 1950s, for which agricultural NRAs in excess of 20% were calculated by Anderson (2009). These rates of assistance to agriculture doubled over the period up to 1984, with the only slight dip in this upward trend occurring in the mid-1970s as a result of food price spikes (Anderson, 2010). In contrast, the developing world was heavily taxing agriculture, which was reflected in the calculated average NRA of around -20% for the period prior to 1985.

In addition to the aggregate NRA trend prior to 1985, the intra-sectoral trends uncovered in the study highlighted how both export-producing farmers as well as import-competing farmers in developed nations were assisted under the prevailing policy environment. This finding was consistent with the prior findings of Krueger *et al*. (1988) for the same time period, although suggesting far greater levels of support and taxation by including policy intervention in the non-agricultural sector in the empirical measurement.

A comparison of the NRAs between import-competing farmers in developed countries and their developing country counterparts shows how developed farmers producing import-competing products experienced NRAs that on average were three times those experienced by their developing-country equivalents. Furthermore, export-producing farmers in developed nations also received policy assistance during this period, albeit significantly less than their import-competing countrymen. On the other hand, during the same time period, export-producing farmers in developing nations were heavily taxed, while import-competing producers in these nations were increasingly assisted. The above trends are reflected in the negative trade bias index values corresponding to the same time period (see Table 4 in Anderson, 2010).

Lastly, as alluded to by Anderson (2010), the pro-agricultural policy strengthening in the developed world was enhanced by the decline in manufacturing protection in the developed nations in the study, starting from 1955. This policy enhancement was reflected in the relative rates of assistance (RRA) measures calculated in the study, where the RRA on average rose more for the developed world than the agricultural NRA average. The strengthening of this pro-agricultural policy stance in the developed world consequently increased competition in world agricultural markets, which implied that farmers in developing countries were harmed by both their own countries' agricultural policies as well as the non-agricultural policies of developed countries (Anderson, 2010).

2.4.4.3.2   Time Period Post-1984

Characterising the policy shift in the developing world post-1984 is a reversal of the net taxation of agriculture (negative NRA) to positive support for agriculture (positive NRA). This reversal was driven by the substantial reduction in the taxation of export agriculture and the increased protection of import-competing agricultural producers in developing countries (Anderson, 2010). Consequently, the aggregate trade bias index for developing countries for the quarter of a century from 1985 steadily became less negative in the face of agricultural export protection declining at a faster rate than agricultural import protection was growing. Similarly, the anti-trade bias decreased somewhat in developed nations. Anderson (2009), however, alludes to the fact that, due to the anti-trade biases that still exist in developed and developing countries, non-uniform rates of assistance are prevalent across commodities. This non-uniformity points to resources not being put to their best use within the global farming sector.

Contrasting the rates of assistance to the agricultural sectors with those of the non-agricultural sectors in developing countries culminates in the relative rate of assistance (RRA) measure. As depicted in the results of Anderson (2009), the weighted average RRA for developed nations improved from a level worse than -50% in the late 1970s to just above zero in the later years of the period (2000 to 2004). However, the explanation for this reversal hinges on the degree to which non-agricultural NRAs have declined, which has consequently driven a more significant improvement in the RRA than the disappearance of negative NRAs for agricultural products.

Although not as extreme as in developing countries, developed countries also saw an improvement in their weighted average RRA. However, this improvement came from the opposite direction to that of developing countries and was deemed an improvement, as RRAs started to move downwards and closer to a zero value, which characterises an economy with no pro- or anti-agricultural bias. Consequently, it can be concluded that it was rather global trade liberalisation that drove the improvement in the RRAs across all of the studied countries as opposed to agriculture-specific policy (Anderson, 2010).

2.4.4.3.3   Global Summary

In summary, the findings of Anderson (2009) are aligned with the theoretical trends in the way agriculture is treated throughout the various stages of economic development. Through a more inclusive empirical method, the study particularly reinforces the findings for the developing countries covered by Krueger *et al.* (1988) for the equivalent period leading up to 1984. These findings are consistent with the broader trend in the developing economy observed throughout the study period. Furthermore, the trade liberalisation trend – also displayed in the findings of the OECD (2016b) for

post-1985 until more recently – is also pivotal to the findings of Anderson (2009), particularly in the developing world, where a complete reversal of taxation was found in the agricultural sector. The trends for these two country groups in the empirical results of Anderson (2009) for the period from 1955 until 2007 (also applicable up until 2011 for the selected updated countries) generally converge on a minimal policy-distorting environment. This convergence has occurred with developed nations being seen to have reduced agricultural sector support and developing nations seen to have reduced taxation.

2.4.4.4   *The South African Context*

It is imperative to interpret the historical changes in distortions to South African agricultural producer incentives in the context of the significant structural changes that were initiated by key policy drivers during the time period 1955 to 2005. According to Kirsten *et al*. (2009), these structural changes were initiated sequentially, first by the initial voting power of white farmers who were able to use this power to attract favourable policy treatment from the government. This was followed by the impact of sanctions on the South African economy and increased isolation from the global sphere, which meant that the deregulation and liberalisation steps taken throughout the 1980s were aimed at the domestic market. The third major initiator of structural change was that of the effect of democratisation on the South African economy, ushering in a new political leadership structure and wider macroeconomic policy reform. Most recently, the impact of multilateral trade liberalisation has been and continues to be a key driver of the evolving economic structure.

The nominal rate of assistance (NRA) indicators for South African agriculture in the period of the study by Kirsten *et al*. (2009) on average reflect the change in policy that accompanied the structural changes seen in the South African economy during the half a decade leading up to 2005. Kirsten *et al*.'s (2009) NRA estimates reflect the trend towards trade liberalisation and portray a change in policy stance from one with a strong anti-trade bias in the 1970s and 1980s to a more liberal stance in the 1990s and early 2000s. Furthermore, when comparing importable and exportable product groups, the quantitative import controls in place for most of the period between 1960 and 1994 are reflected in the positive NRA estimates for importables. However, as noted by Kirsten *et al*. (2009), the NRAs for importable products were significantly reduced to close to zero percent in the period 1995 to 2005, in line with South Africa's obligations under the Marrakech Agreement on Agriculture. On the other hand, as liberalisation measures were introduced after 1995, the South African export portfolio experienced a shift away from a yellow maize- and fresh fruit-dominated portfolio. All measures to support exports and shield against export losses were abolished, yielding a decline in the average NRA for exportable agricultural products.

The trade liberalisation trend initiated in the mid-1990s was reflected in low levels of aggregate distortions in agriculture up to the end of the studied time period. While indicating that economic policies on average had a neutral impact on aggregate agricultural production, Kirsten *et al.* (2009) highlight the significant variation between agricultural industries. This variation between the mid-1990s and 2005, during which some agricultural industries were being taxed and others protected, suggests that there was scope for efficiency gains to be realised within the agricultural sector through the phasing out of inter-industry NRA differences (Kirsten *et al*., 2009).

The results estimated by Kirsten *et al*. (2009) on the nominal rate of assistance and relative rate of assistance reaffirmed the general perception of the time, namely that, since the mid-1990s, South African agriculture had on average been operating in an undistorted environment. However, the general update of the agricultural distortions database by Anderson and Nelgen (2013) failed to incorporate a South African component. Consequently, no empirical indicators of the incentives facing agricultural producers for the most recent 10 years post-2005, besides those published by the OECD, are available for South Africa. Therefore, when wanting to contrast the recent decades of South African agricultural producer-incentive trends with those faced by producers for the previous five decades, an update of the distortion estimates using the globally comparable methodology of Anderson *et al*. (2006) is the empirically wise choice.

2.5   Value Chain Approach to Measuring Distortions to Agricultural Incentives

2.5.1   Motivation for a Disaggregated Model

The methodology developed by Anderson *et al*. (2006) is able to indicate the degree to which agricultural producers (NRA) and product consumers (CTE) are taxed or subsidised under various policy environments. These measures are able to be calculated for specific commodities, as well as for aggregated groups such as exportable commodities or import-competing commodities. Furthermore, as will be empirically highlighted in Chapter 3, these indicators are able to be aggregated into sectoral indicators, where the split between the agricultural sector and the non-agricultural sector culminates in the relative rate of assistance (Equation (3.11)), which indicates the anti- or pro-agricultural bias of the current policy environment.

However, Briones Alonso and Swinnen (2015) dissect the NRA measure of Anderson *et al*. (2006), which represents the distortions to producers, and CTE, which represents the distortions faced by consumers and emphasises the fundamental point that, within each of the "producer" and "consumer" groups, there are a large number of agents throughout the value chain. Using the example of the NRA measured at the level of processed sugar, Briones Alonso and Swinnen (2015) highlight that there are both farmers of raw sugar cane as well as sugar-processing companies within the

"producers" category. Consequently, it is not clear from the broad NRA indicator developed by Anderson *et al*. (2006) how the specific policy environment affects specific groups, such as farmers, throughout the value chain. A similar intuition holds in the case of the "consumers" category, for which the CTE indicates the distortions being faced. In the case of sugar, consumers include both households and the general food industry. Each of these groups is part of the CTE indicator, although the aggregated measure fails to provide specific information on the distorting effect of the current policy environment on each group's welfare.

The difficulty of determining the policy impact of groups within the "producers" and "consumers" categories gives rise to the need for an indicator of the disaggregated nominal rate of assistance in order to disentangle the aggregate distortions faced by various groups throughout the value chain.

2.5.2   The South African Wheat Industry

Wheat cultivation and wheat milling are two of the oldest agricultural activities and industries in South Africa, and can be traced back to the first European settlers in the Western Cape (Mncube, 2013). After maize, wheat represents one of the most important grain crops in South Africa, with the wheat industry contributing significantly to agricultural GDP (Meyer & Kirsten, 2005). Furthermore, milled wheat flour as an input for bread continues to grow in importance, with bread firmly poised as one of the main staple foods in South Africa.

The wheat value chain in South Africa was extensively regulated between 1937 and 1996, with the Wheat Board in place as the main intermediary between wheat grain producers and wheat grain processors. The centralised Wheat Board operated a single marketing channel for wheat, fixing wheat prices while also controlling imports and exports (Van der Merwe *et al*., 2016). This control enabled the manipulation of import and export prices by the Board, thus protecting the local supply chain from market forces.

Shortly after the institution of the first democratic government in South Africa, the marketing of agricultural products changed dramatically with the introduction of the Marketing of Agricultural Products Act, No. 47 of 1996. These changes included the closure of multiple industry control boards, including the Wheat Board, together with commodity tariffication (Mncube, 2013). Allowing international market forces to prevail enabled international competitors to enter the domestic market and to play a significant role in the wheat industry supply chain (Van der Merwe *et al*., 2016).

One of the unintended consequences of the abolition of the Wheat Board is highlighted by Cock (2009) as being the concentration of ownership and regulation across the entire wheat-to-bread value chain. This concentration was driven primarily by the necessity for higher efficiency in an open market, as is

evident from the decline in wheat buyers – from 137 mills in 1997 to 65 mills in 2011 (Van der Merwe et al., 2016). This market concentration is reflected in the four biggest milling companies accounting for more than 95% of all flour sales in the domestic market (Mncube, 2013).

Although it has a competitive advantage in the wheat milling industry, wheat production in South Africa remains internationally uncompetitive (Van der Merwe *et al*., 2016). However, Van der Merwe *et al*. (2016) show how the increased market concentration following the abolition of the Wheat Board coincided with the decreased competitiveness of wheat producers. Their findings conclude that the decline in competitiveness of wheat farmers is due to farmers' inability to adapt to the free market system without the significant protection as was provided during the Wheat Board era. They furthermore raise concerns about the policy environment in which wheat producers have to operate.

Given the high level of concentration in the wheat milling industry, and the consequent regulatory and market control that this concentration yields, collusion between firms was inevitable. Mncube (2013) methodically evaluates these conditions that are conducive to collusive, while documenting the details of the wheat flour cartel that was active from 1999 to 2007. However, neither Van der Merwe *et al*. (2016) nor Mncube (2013) seek explanations for possible policy drivers of the competitiveness of agents within the wheat value chain.

The motivation for the current study was primarily concerned with updating the aggregate distortion estimates for primary agricultural production in South Africa, and then disaggregating these estimates per agent in the wheat value chain. However, with the recent history of the wheat industry being characterised by cartels at the processing level, together with declining competitiveness in wheat production, disaggregated policy distortion estimates will provide key insights into the policy environment under which the collusion and decline in competitiveness have been occurring.

2.6   Conclusion

Given the reasons why governments intervene in agriculture in the context of the political economy of agriculture, the empirical theory of price distortions proves critical in quantifying this intervention. While multiple studies that have attempted to quantify these intervention-driven price distortions have been reviewed, the superior coverage of the Anderson-led World Bank study positions it ideally to be applied in a study updating policy-induced price distortions in South African agriculture. Furthermore, the clearly defined vertical structure of the South African wheat value chain enables a disaggregation of the aggregate commodity-distortion estimates per agent in the wheat value chain, using the Briones Alonso and Swinnen (2015) framework.

Therefore, from the review of the literature, three aspects with regard to the available distortion estimates for primary agriculture in South Africa are important. Firstly, an update of the distortion estimates database – initially constructed by Kirsten *et al*. (2009) under the Anderson-led World Bank project – is due for South Africa for the years post-2005. Secondly, there is a need to assess the reasons for the variation in the updated commodity distortion estimates for primary agricultural producers post-2005. Lastly, due to the omission of a commodity-specific value chain distortion estimate study in the South African literature, the South African wheat value chain is ideally positioned for the pioneering of such a disaggregated approach. Thus, the basis of the current study is a combination of a distortion estimates update on the basis of the Anderson *et al*. (2006) methodology, as used by Kirsten *et al*. (2009), together with the application of the disaggregated distortion estimate methodology of Briones Alonso and Swinnen (2015) in the wheat value chain.

Chapter 3   Study Methodology

3.1   Introduction

The theoretical discussion and review of past attempts at measuring policy-induced distortions in agriculture have highlighted the relevance of the Anderson *et al*. (2006) methodology for the South African agricultural context. As concluded in Chapter 2, and considering that the period of the Kirsten *et al*. (2009) study ended in 2005, an update of the agricultural distortion estimates is due for South Africa, using the Anderson *et al*. (2006) methodology. Furthermore, Chapter 2 highlighted how a disaggregated approach to this measurement per commodity would uncover key insights into the manner in which individual agents within a specific commodity value chain are affected by the policy environment. The first part of this chapter outlines the methodology designed by Anderson *et al*. (2006) that was applied by Kirsten *et al.* (2009) and was applied selectively in this study. This is followed by an explanation of the methodology of the disaggregated approach as applied by Briones Alonso and Swinnen (2015), which was applied as an extension to the Anderson *et al*. (2006) framework for the South African wheat industry. The final part of the chapter highlights the key indicators from the two methodologies and concludes.

3.2   General Commodity Framework

3.2.1   Direct Agricultural Distortions

In the situation of many firms producing a homogenous product using just primary factors while operating in a small, open, perfectly competitive market, economic welfare would be maximised if the following relationship holds (Anderson *et al*., 2008):

$$DFP = CPP = (E \times P) \tag{3.1}$$

In Equation (3.1), DFP represents the domestic farmgate price for a product, CPP represents the consumer product price for the product, and E × P is the domestic currency price for foreign exchange multiplied by the foreign currency price for the specific product in the international market. Furthermore, the relationship in Equation (3.1) only holds in the absence of externalities, product processing, marketing margins, exchange rate distortions and domestic and international trading costs. The result of any government-imposed diversion from the above equality in the absence of market failures or externalities would have a welfare-reducing impact on the small economy described. Consequently, the analytical framework developed by Anderson *et al*. (2006) sets out to measure any government-imposed diversion from the equality in Equation (3.1).

3.2.1.1 *Nominal Rate of Assistance & Consumer Tax Equivalent (NRA & CTE)*

3.2.1.1.1 Distortions Imposed at the National Border.

Considering a situation where an ad valorem import tariff (t_m) is the only distortion, its distorting effect on producer incentives is able to be determined by the nominal rate of assistance to farm output as a result of border price support (NRA_{BS}). The NRA_{BS} is the unit value of production at the distorted price less the unit value of production at the undistorted price expressed as a fraction of the undistorted price. This relationship is depicted mathematically in Equation (3.2).

$$NRA_{BS} = \frac{E \times P(1 + t_m) - E \times P}{E \times P} = t_m \qquad (3.2)$$

The NRA as depicted in Equation (3.2) differs from the PSE as calculated by the OECD in that the PSE is expressed as a fraction of the distorted value, whereas the NRA is expressed as a fraction of the undistorted value ($E \times P$).

The parallel impact of an ad valorem import tariff (t_m) on consumer incentives is represented by a consumer tax equivalent (CTE) for the specific agricultural product in question for final consumers. The CTE relationship is contained in Equation (3.3).

$$CTE = t_m \qquad (3.3)$$

Had the border price intervention been an import subsidy rather than a tariff, t_m in Equation (3.2) and Equation (3.3) would have a negative value, reflecting the decreased price faced by importers and consumers. The opposite intuition to that in Equation (3.2) and Equation (3.3) holds in the case of an export subsidy (s_x) or export tax ($-s_x$).

3.2.1.1.2 Domestic Producer and Consumer Price-distorting Measures

While border price intervention is one source of incentive distortions, direct interventions for farmers by government in the form of a production subsidy (s_f) or tax ($-s_f$) also distort producer incentives. Similarly, on the consumption front, a consumption subsidy (c_c) or tax ($-c_c$) distorts the incentives of consumers. In the presence of such interventions, and in the absence of any other distortions, the nominal rate of assistance to farming output conferred by the domestic price intervention (NRA_{DS}) can be determined as in Equation (3.2), except that s_f replaces t_m. However, in the case of a direct production intervention (s_f or $-s_f$), the CTE is zero. Similarly, in the case of a direct consumption intervention (c_c or $-c_c$), the NRA_{DS} is zero. Combining the distortions imposed at the national border

and those as a result of direct production or consumption intervention yields a total rate of assistance to output and the total consumer tax equivalent, as depicted in Equation (3.4) and Equation (3.5).

$$NRA_o = NRA_{BS} + NRA_{DS} \tag{3.4}$$

$$CTE = NRA_{BS} + c_t \tag{3.5}$$

3.2.1.1.3   Exchange rate-driven price distortions

In a multi-tier exchange rate system, the cost of foreign currency for importers is typically higher than the price at which exporters are forced to surrender their foreign exchange earnings at (Anderson *et al.*, 2008). Consequently, according to Bhagwati (1978), a wedge is created that changes the equilibrium exchange rate ("E" in Equation (3.1) and Equation (3.2)) from the level that otherwise would have prevailed in the market for foreign exchange without the government-induced distortion.

The surrendering of foreign exchange by exports represents an implicit tax on exporters that consequently reduces their incentive to export and hence reduces the available foreign currency flowing into the country. This reduction in foreign currency supply results in a higher price being paid for it by the demanders of foreign currency – typically importers. This higher demanded price creates an opportunity for rent extraction by governments, who are able to auction off their stock of foreign currency at a higher price than the surrendered price (Anderson *et al.*, 2008).

In addition to a simple dual exchange rate system in which importers and exporters are charged different rates, government is also able to incentivise/disincentivise exporters from different industries by raising/lowering the price at which these exporters are made to surrender their foreign exchange earnings. Similarly, government is able to incentivise certain groups of importers by charging a lower price for the foreign exchange that the government releases to them. When determining the magnitude at which importers and exporters are taxed via a dual foreign exchange rate system, Anderson *et al.* (2008) point to the gap between the surrender price of exporters and the purchase price of importers as being a robust indication.

Therefore, in line with the methodology being discussed, the relevant exchange rate, "E", for calculating the NRA and CTE for a specific tradable product is dependent on the specific rate applying to the specific product after taking into consideration a dual or multiple exchange rate policy.

3.2.1.1.4   Nature of Trading Costs and Input

3.2.1.1.4.1   Trading Costs

In the case where a product is unable to be traded internationally due to excessive trade costs, the domestic price fluctuates between the CIF import price and the FOB export price. As a result, any trade policy measure such as a tariff or subsidy or exchange rate-induced distortion does not distort incentives (NRA = 0 and CTE = 0). However, direct producer and consumer taxes and subsidies affect the domestic prices faced by producers and consumers and consequently distort incentives (Anderson *et al.*, 2006). In this case, the extent of the influence on incentives is dependent on the price elasticity of demand (η) and supply (Ɛ), and the NRA and CTE calculations are adapted as in Equation (3.6) and Equation (3.7).

$$NRA_{DS} = \frac{s_f}{1 + \frac{\varepsilon}{\eta}} \tag{3.6}$$

$$CTE = \frac{-s_f}{1 + \frac{\eta}{\varepsilon}} \tag{3.7}$$

3.2.1.1.4.2   Intermediate Input Use

Where intermediate inputs are used in production in conjunction with primary inputs, any intervention in the production, consumption or trade of these intermediate inputs influences the incentives of producers. In some instances, distortions for outputs and inputs are offset (Rausser, 1982) through additional intervention elsewhere in the value chain, such as in a situation that could prevail in which farm inputs are subsidised but final products are taxed at export. As Anderson *et al.* (2006) highlight, all the offsetting measures by government could theoretically be brought together in an effective rate of direct assistance to the farm value-added measure, of which the NRA_o as well as the sum of nominal rates of direct assistance to farm inputs (NRA_i) are components. In terms of measuring distortions to input costs, on the basis of knowledge of input–output coefficients of inputs, the NRA for each input can be summed in order to obtain a combined measure for all inputs (NRA_I). Considering that the NRA_o is obtained from Equation (3.4), the NRA_i can be added to it in order to obtain a measure for the total nominal rate of assistance to farm production (NRA). This relationship is depicted in Equation (3.8).

$$NRA = NRA_o + NRA_i \tag{3.8}$$

3.2.1.2   Aggregating Direct NRAs for the Agricultural Sector

At this point, the empirical framework being reviewed has provided a step-wise approach to determining the total nominal rate of assistance to farm production (NRA) of a specific commodity (Equation (3.8)). In conjunction with this, the computation of consumer tax equivalents has been reviewed. However, from a macroeconomic policy perspective, an aggregate measure of distortions faced by the agricultural sector is needed.

Following from the results of the commodity-specific calculations, an aggregate measure is able to be calculated for the total agricultural sector of tradable covered products (NRAag^t), as well as the exportables (NRAag^x) and import-competing (NRAag^m) sub-sectors, using weighted averages (Anderson *et al.*, 2008). This firstly requires the classification of each farming industry into either import-competing or export-producing categories. Furthermore, the value share of production for each commodity of the total primary agricultural production value (valued at farmgate undistorted prices) is required in order to calculate the relative weights. Once this has been done for all covered products, the NRA$_{ag}$ can be obtained by summing the weighted average calculation of covered products to the NRA assumed for non-covered products.

3.2.1.3   The Trade Bias Indicator

Once the NRAag^x and NRAag^m have been calculated, the degree to which the policy regime has an anti-trade bias within the agricultural sector can be determined. From a resource-competing perspective, the agricultural subsector with the highest nominal rate of assistance will be incentivised to bid mobile resources up that would otherwise have been employed in the alternate subsector. Consequently, the relative degree to which the exportables and import-competing subsectors are incentivised/ disincentivised under the current policy regime can be determined via the trade bias index (TBI) contained in Equation (3.9).

$$TBI = \left[\frac{1 + NRAag^x}{1 + NRAag^m} - 1 \right] \tag{3.9}$$

Intuitively, the TBI takes on a value of zero when there is equal assistance for the import-competing and exportables subsectors. In the extreme case of an anti-trade policy bias, the lower bound of Equation (3.9) approaches -1 (Anderson *et al.*, 2008).

3.2.2 Non-Agricultural Distortions

The Lerner (1936) Symmetry Theorem furthermore highlights how farmers' incentives are also influenced, albeit indirectly, by government assistance to/taxation of non-agricultural production within the economy. From a mobile resources perspective, the higher the nominal rate of assistance to non-agricultural production (NRAnonag), the higher the incentive is for producers in non-agricultural sectors to bid up the value of mobile resources that would otherwise have flowed to agriculture (Anderson *et al*., 2008). Consequently, if NRAag is less than NRAnonag, it is likely that fewer resources would be employed in agriculture than would otherwise have been employed under free market conditions.

Anderson *et al*. (2008) highlight the protection of industrialists from import competition via tariff and non-tariff barriers as having one of the most pronounced negative effects on farmers. Apart from the agricultural and manufacturing sectors, other primary sectors, such as forestry, fisheries and mining, are less prone to distortions, although certain exceptions do exist. However, in the services sector of the economy, which typically is the largest sector and is often characterised by non-tradable, public sector-provided services, distortions are near impossible to measure (Anderson *et al*., 2008). Consequently, the methodology of Anderson *et al*. (2006) in its calculation of a NRAnonag assumes all services to be non-tradable along with the non-tradable commodities from non-agricultural sectors, and furthermore assumes no distortions to be present in this aggregated group.

The tradable portion of non-agricultural sectors' production can be divided into the production of commodities that are import competing and those that are exportables. Individual nominal rates of assistance to import competing (NRAnonag^m) and exportables (NRAnonag^x) can be calculated for each product and then aggregated into subsector measures. Furthermore, using the same approach to the weighted average calculation as was used when calculating the NRAag, the nominal rate of assistance for all tradable non-agricultural products (NRAnonag^t) can be calculated, with production value shares at border prices being used as weights in the calculation.

3.2.3 Agricultural Assistance vs Non-Agricultural Assistance

In addition to the comparison of NRAs between agricultural and non-agricultural sectors, Anderson *et al*. (2006) compute a total rate of assistance to agricultural output (TRAag) by subtracting the direct rate of assistance to non-agricultural sectors (DRAnonag) from the direct rate of assistance to agriculture (DRAag). The DRAnonag and DRAag are simply the aggregates of the nominal rates of assistance for both tradable and non-tradable non-agricultural and agricultural products respectively. The direct rate of assistance to agriculture is contained in Equation (3.10).

$$TRAag = DRAag - DRAnonag \qquad (3.10)$$

From Equation (3.10), it follows that agriculture could be assisted or harmed by the existing policy regime even if DRAag is greater than zero, because DRAnonag could be greater than DRAag. Consequently, the need arises for a measure of agricultural assistance relative to non-agricultural assistance. Anderson *et al*. (2008) propose the relative rate of assistance (RRA) measure depicted in Equation (3.11).

$$RRA = \left[\frac{1 + NRAag^t}{1 + NRAnonag^t} - 1 \right] \qquad (3.11)$$

The RRA indicates the extent to which the current policy environment within a country has an anti- or pro-agricultural bias. A value of zero indicates a neutral bias, whereas a strong anti-agricultural trade bias is indicated as the RRA approaches the lower bound of -1. As the RRA approaches its upper bound of +1, a pro-agricultural trade bias is depicted.

3.3   Disaggregated Value Chain Extension

3.3.1.1   *Adaptation of NRA and CTE*

Briones Alonso and Swinnen (2015) present Equation (3.12) as a means for calculating the nominal rate of assistance to a specific agent[i] in a vertical value chain.

$$NRA^i = \frac{p_o^i - p_o^{i^*}}{p_o^{i^*}} + \frac{\sum_j \left(p_j^{i^*} - p_j^i \right) \times {Q_j^i}\Big/{Q_o^i}}{p_o^{i^*}} \qquad (3.12)$$

$$= NRA_o^i + NRA_I^i$$

In Equation (3.*12)*, P_o^i represents the actual domestic price of output "o", $P_o^{i^*}$ is the undistorted domestic price, Q_o^i is the quantity of output sold, P_j^i is the actual domestic input price of input "j", $P_j^{i^*}$ represents the undistorted price of input "j" and Q_j^i is the quantity of input "j" that is needed to produce output "o". The conversion rate from input "j" to output "o" is represented by Q_j^i / Q_o^i. In the case of an agent such as a wheat miller, this conversion rate will be less than 1, whereas in the case of an agent such as a commodity trader it will be equal to 1.

In Equation (3.12), the NRA^i_o indicates the extent of distortions to output prices expressed as a percentage of the undistorted output price, in line with the base methodology of Anderson *et al*. (2006) (E × P in Equation (3.2)). Similarly, the NRA_i^i is representative of the extent of the total

distortions to input prices for all inputs "j" used to produce output "o". Consequently, the total nominal rate of assistance to agent[i] (NRA[i]) is the sum of NRA[i]$_o$ and NRA$_I$[i]. Considering this, aggregating the NRAs of all agents under the "producers" category yields the total nominal rate of assistance to commodity producers (NRA[P]).

In terms of measuring the distortions that consumers face, Anderson *et al.* (2006) propose the use of CTEs (Equation (3.3) and Equation (3.5)). Briones Alonso and Swinnen (2015) draw on this methodology, but utilise an NRA equivalent measure in which the nominal rate of assistance to commodity consumers (NRA[c]) is obtained through Equation (3.13).

$$NRA^C = \frac{p_I^{c^*} - p_I^c}{p_I^{c^*}} \tag{3.13}$$

In Equation (3.13), p_I^c is the domestic price paid by consumers for the commodity, whereas $p_I^{c^*}$ represents the undistorted price that would have been paid by consumers of the specific commodity in a free market.

The relationship of the NRA^C to Anderson *et al*'s. (2006) CTE measure is contained in Equation (3.14).

$$CTE = -NRA^c = -NRA_I^c \tag{3.14}$$

3.3.1.2   *Value Chain Price Linkages*

In a vertical value chain with multiple agents operating, the logical assumption is made in the methodology of Briones Alonso and Swinnen (2015) that the price paid by the subsequent agent (agent "j") handling the traded commodity is equal to the price received by the previous agent (agent "I") who handled and sold the commodity. Consequently, the market price of the output received by agent "I" ($p_o^i \ in \ Equation \ (3.12)$) is equivalent to the price of the input paid by agent "j" (p_I^j).

A wheat value chain example assists in understanding the above relationship. Consider the two primary agents in a simple wheat value chain, namely farmers and traders. The farmgate price that farmers receive for their wheat (p_o^f) is equivalent to the price that wheat traders pay for their input of wheat (p_I^t). A similar intuition holds throughout the value chain when linking market prices, although, when the commodity is transformed via processing, for example, the conversion rate of the inputs to outputs ($Q_j^i/Q_o^i \ in \ Equation \ (3.12)$) has to be considered.

3.4   Conclusion

Although comprehensive and in some instances conceptually challenging, the review of the Anderson *et al*. (2006) general framework is characterised by its output of nominal rates of assistance indicators.

While many considerations need to be acknowledged during the empirical application of this methodology, the presence of the Kirsten *et al*. (2009) application to South Africa aids in acting as a coherent base from which to extend the empirical analysis. Furthermore, the presentation and linking of the Briones Alonso and Swinnen (2015) disaggregated extension to the Anderson *et al*. (2006) base framework enable adequate integration of the two methodologies into a single study to achieve the stipulated objectives. Chapter 4 provides an in-depth explanation and discussion of how the respective theoretical frameworks were applied and integrated in the current study. In addition, Chapter 4 highlights the intense data collection that preceded the application of the integrated framework, with a strong focus on the challenges involved.

Chapter 4   Data and Methods

4.1   Introduction

Chapter 2 provided a theoretical motivation for government intervention in agricultural markets and highlighted how this intervention distorts these markets. From the review of the three major international studies concerned with measuring these distortions, the empirical method (Anderson *et al*., 2006) used in the study by Anderson (2009) was identified as a suitable framework to be used in updating the agricultural distortion estimates for South African agricultural producers. In addition to this update, the disaggregated value chain methodology of Briones Alonso and Swinnen (2015) was identified as being a relevant method when wanting to analyse how the aggregate distortion estimates of the Anderson *et al*. (2006) methodology are distributed amongst agents within the broader producer and consumer groups. A case was subsequently made for the need for such a disaggregated analysis for the South African wheat flour value chain.

Following from the theoretical motivation and framework selection in Chapter 2, Chapter 3 provided a detailed discussion of the key indicators of the Anderson *et al*. (2006) methodology, with a strong focus on their empirical calculation. The nominal rate of assistance (NRA) and consumer tax equivalent (CTE) formed the fundamental base of this framework, from which other empirical indicators, such as the trade bias indicator (TBI) and relative rate of assistance (RRA), could be derived. Linked to the Anderson *et al*. (2006) methodology, and central to the uniqueness of this thesis going forward, was the proposition of the Briones Alonso and Swinnen (2015) value chain approach in disaggregating the broad distortion estimates characteristic of the Anderson *et al*. (2006) approach.

The rest of this chapter is structurally split into two broad sections. Section 4.2 provides a detailed discussion on how the Anderson *et al*. (2006) methodology was selectively applied in this project. A key precursor to this discussion is to highlight the sources of the data used and the general trend exhibited by this data. Furthermore, due to the nature of the first phase of this study being an update of the aggregate distortion estimates for South Africa originally estimated by Kirsten *et al*. (2009) under the larger Anderson (2009) study, contrasts are constantly made between the data and trends of the current study and those of the study by Kirsten *et al*. (2009).

Section 4.3 outlines the step-wise application of the methodology of Briones Alonso and Swinnen (2015) in empirically estimating the nominal rates of assistance of market agents within the South African wheat flour value chain. Due to this disaggregated application being the first of its kind for a South African agricultural commodity, no contrasts can be drawn to previous studies. Consequently, the disaggregated method is contrasted with the aggregated method of the wheat industry reported

in Section 4.2. In addition, comparisons are drawn between the current application of this framework and its seminal application by Briones Alonso and Swinnen (2015) in the Pakistani wheat flour value chain.

4.2   Aggregated Distortion Estimates

4.2.1   Agricultural Product Selection

The primary step in empirically estimating agricultural distortions is to identify the individual agricultural commodities for which these estimates are to be constructed. Aligned with the framework of Anderson *et al*. (2006), which prescribed global coverage of all major food items together with key country-specific farm products, the Kirsten *et al*. (2009) study covered all major livestock, field crop and horticultural products contained in the first column of Table 4.1. On average, this product coverage accounted for 69% of total primary agricultural production value at distorted prices for the years 1955 to 2005, which was acceptable given the Anderson *et al*. (2006) stipulated target of 70%.

Table 4.1. Summary of agricultural product selection in the current study vs the previous study.

Products covered by Kirsten *et al*. (2009) for 1955–2005	Trade status 1955–2005	Included in update	Trade status 2005–2014
Livestock products			
• Beef	Imported	✔	Imported
• Mutton	Imported	✔	Imported
• Poultry	Imported	✔	Imported
Field crops			
• Wheat grain	Mainly imported	✔	Imported
• Yellow maize grain	Exported & imported	✔	Exported & imported
• White maize grain	Exported & imported	✔	Exported
• Sunflower seed	Non-tradable	✔	Mainly non-tradable
Field crop products			
• Wheat flour	Exported	✔	Mainly exported
• White maize flour	Exported	✔	Exported
• Sunflower oil	Mainly imported	✔	Mainly imported
Fruit & sugar products (exportables)			
• Apples export	Exported	✔	Exported
• Table grapes export	Exported	✔	Exported
• Oranges export	Exported	✔	Exported
• Raw sugar	Exported	✘	
• Refined sugar	Exported	✘	
Fruit & sugar (non-tradables)			
• Apples non-trade, processing	Non-tradable	✔	Non-tradable
• Apples non-trade, domestic sales	Non-tradable	✔	Non-tradable
• Table grapes non-trade	Non-tradable	✔	Non-tradable
• Oranges non-trade	Non-tradable	✔	Non-tradable

For comparative purposes, the product selection of the current update is strongly governed by its predecessor's selection. All agricultural products covered by Kirsten *et al*. (2009) are included in the current update, with the only product omissions being raw and refined sugar which were omitted due to the unavailability of reliable import tariff data. The significant manner in which border protection measures affect distortion estimates, including products for which border protection measures are unreliable, hampers the credibility of the combined distortion trends being evaluated. Consequently, the current update calculates distortion estimates for approximately 80% of field crops and animal products and approximately 65% of horticultural products. In addition to this primary product coverage, distortion estimates are also calculated for selected directly related lightly processed products. The current study's product coverage is summarised and correlated with the Kirsten *et al*. (2009) selection in the third column of Table 4.1.

4.2.1   Time Period Covered

The time period of the broader Anderson (2009) project had a targeted start date of 1955 and a targeted finish date of 2005. However, Kirsten *et al*.'s (2009) South African dataset was only consistently available from 1965 until 2004. As a result, comparable distortion estimates could only be computed for this period, while some data extrapolation allowed for the end period to be extended to 2005.

Due to the 2005 data extrapolation issue in Kirsten *et al*. (2009), the current update covers the 10-year period from and including the year 2005 up to and including the year 2014. Where extrapolated 2005 data was used by Kirsten *et al*. (2009), this was replaced with actual data in the current update. The main restricting factor governing the end period of the update was the availability of data from the Food and Agriculture Organization of the United Nations (FAO) post-2014 at the time of writing. While other data sources can be used, this will considerably jeopardise the consistency of a large number of datasets that were obtained from the FAO for the Kirsten *et al*. (2009) study.

4.2.2   Determination of Trade Status

It is vital to clearly identify the trade status of each covered product. This identification directly affects the composition of the aggregate distortion measures, which have a direct link to indexes such as the trade bias index presented in Equation (3.9). An evaluation of a product's annual import volumes as opposed to its export volumes yields one of three trade status results.

Firstly, a domestically produced product is classified as import competing if its annual import volume exceeds its annual export volume. The opposite classification of exportable holds when a domestically produced product's export volumes exceed its import volumes. Lastly, in the case where a

domestically produced product's annual import and export volumes are negligible, the product is classified as a non-tradable.

For most products, this classification will have changed over time and could have moved through each of the three classification categories. Such variation results in the product mix composing the trade-based aggregate distortion indicators changing over time. However, such compositional changes are strictly as a result of the definition of the aggregate indicators. Practically speaking, the composition of the two components ($NRAag^x \ and \ NRAag^m$) of the trade bias indicator represented in Equation (3.9) could be constructed from different product distortion estimates on a year-to-year basis.

The second column of Table 4.1 contains the trade status classification of each product as contained in the Kirsten *et al*. (2009) study. As can be seen, some commodities such as apples were explicitly split into two separate products according to the market for which they were produced. This split was warranted by the inherent differences in the product produced for export as opposed to the product that was consumed domestically. These intra-commodity product splits were maintained as product groups in the current update, while the trade status of all covered products in the update were determined using the above method. These trade status descriptions are contained in the fourth column of Table 4.1.

4.2.3   Key Data Sources

4.2.3.1   *Food and Agriculture Organization Statistics (FAOSTAT)*

The Food and Agriculture Organization of the United Nations (FAO), through its FAOSTAT database, provides agricultural statistics covering a wide range of indicators – from commodity-production statistics to land-use patterns and trade data. The database's coverage includes nearly 400 agriculture-related products traded from 245 countries in a time series form from 1961 until 2014 (FAO, 2017). Due to its extensive coverage, the FAOSTAT data was utilised to obtain multiple time-series datasets required for the update of the distortion estimates, especially in cases where industry-provided data was not available or where Kirsten *et al*. (2009) had prioritised the use of FAO data.

A further benefit from using the FAO (2017) time-series data is the provision of the meta-data, which describes the exact harmonised system (HS) codes of the individual products that make up the broader product groups available from the FAOSTAT database. This proved critical in the current study, as some of the time-series data was only available from FAOSTAT up to 2013. The provision of the meta-data enabled 2014 values to be calculated where required by making use of TRADEMAP data from the International Trade Centre (ITC), which is available up to HS six-digit level from the year 2001 until 2016.

4.2.3.2   *International Trade Centre (TRADEMAP and Market Map)*

The International Trade Centre (ITC) has a number of individual, open-access databases that provide trade statistics for international business development. Throughout this study, both the Trade Map (TRADEMAP) and Market Access Map (MACMAP) platforms provided by the ITC were used to obtain trade data, as well as data on border protection rates. Trade Map provides indicators on export performance, international demand, alternative markets and competitive markets for more than 5 300 products of the Harmonised System (HS) covering 220 countries and territories (ITC, 2017a). On the other hand, Market Access Map provides information on border protection rates applied by more than 200 countries and faced by 239 countries and territories per HS product code (ITC, 2017b).

4.2.3.3   *South African Abstract of Agricultural Statistics*

The South African Department of Agriculture, Forestry and Fisheries (DAFF) annually publishes the Abstract of Agricultural Statistics. The publication contains important agricultural indicators, as well as meaningful information on, amongst others, livestock, horticulture and field crops (DAFF, 2016). The source of the information is predominantly the Directorate of Statistics and Economic Analysis (DSE) of the Department of Agriculture, Forestry and Fisheries, with some industry organisations' statistics being used in conjunction with the DSE.

Due to its time period coverage of 1955 to 2016, a large number of the data time series used in this update were sourced from the abstract. This was aligned with the data collection approach by Kirsten *et al*. (2009), which implied consistency of the update with the previous distortion estimates.

4.2.4   Data Collection Part 1: Quantities

Production and consumption quantities, as well as trade quantities, were employed in the measurement of commodity-specific distortion estimates. Aligned with the data sources used by Kirsten *et al*. (2009), the two primary sources of this secondary data for the updated 10-year period were FAOSTAT and the 2016 Abstract of Agricultural Statistics. In the instances where FAO data was only available up until 2013, TRADEMAP data was matched to the FAO data using the metadata provided for each data category by the FAO. Similarly, where the 2016 Abstract did not contain the required trade data, TRADEMAP was used as the source of this data.

In specific commodity cases where none of the key data sources were sufficient, industry organisations were contacted and the necessary data was obtained directly from them. This was also done in cases where Kirsten *et al*. (2009) had utilised industry-specific data in order to maintain consistency and comparability between the current update and its predecessor. These "special" cases are highlighted per broad commodity group in Table 4.2. As can be noted from Table 4.2, all wheat and maize quantity

data, as well as the majority of the sunflower data, was obtained from the South African Grain Information Service (SAGIS). The Department of Agriculture, Forestry and Fisheries (DAFF) provided import and export quantities for mutton as well as production and consumption data for poultry, as this was only available in an aggregated white meat form in the 2016 Abstract.

Table 4.2. Data sources of quantity data for the respective covered products.

	Data Source					
	FAO - STAT	**TRADE - MAP**	**Abstract**	**Industry**	**Other**	**Comment**
Livestock products						
• Beef		✓	✓			
• Mutton			✓		✓	Imp & Exp – DAFF*
• Poultry		✓	✓		✓	Prod & Cons -DAFF
Field crops						
• Wheat grain				✓		All Quantities – SAGIS**
• Yellow maize grain				✓		All Quantities - SAGIS
• White maize grain				✓		All Quantities - SAGIS
• Sunflower seed			✓	✓		Prod, Imp, ΔStock - SAGIS
Field crop products						
• Wheat flour	✓					
• White maize flour						n/a
• Sunflower oil	✓					
Fruit & sugar products (exportables)						
• Apples export			✓			
• Table grapes export			✓			
• Oranges export			✓			
Fruit & sugar (non-tradables)						
• Apples non-trade, processing			✓			
• Apples non-trade, dom. sales			✓			
• Table grapes non-trade			✓			
• Oranges non-trade			✓			

South African Department of Agriculture, Forestry and Fisheries
**South African Grain Information Service*

4.2.5   Data Collection Part 2: Domestic Variables

Once the physical quantities had been obtained in the first part of the data collection, the domestic financial variables per individual product were collected. The key domestic variables included, firstly, the respective wholesale prices for the primary and processed goods, together with a transmission factor from each product's primary form into the processed form. With the exception of field crops and field crop products, the predominant source of the required domestic financial variables was the 2016 Abstract of Agricultural Statistics. In the cases where the required data was unavailable or published in an aggregate form in the Abstract, Statistics South Africa (SSA), the South African Futures

Exchange (SAFEX) and the Bureau for Food and Agricultural Policy (BFAP) were contacted directly in order to obtain the data.

In addition to the wholesale prices per product, the consumer tax on primary and processed products was obtained as a proportion of the base selling price. As was included in the calculations by Kirsten *et al*. (2009), value added tax (VAT), which was introduced in 1991, was included as the primary consumer tax. For the period, the VAT percentage remained consistent at 14%, with staple foods and unprocessed vegetables and fruits being excluded from the tax.

Direct subsidies for individual agricultural products were unavailable for use in the study. However, as was consistent with the previous model of Kirsten *et al*. (2009), non-product-specific subsidies net of abnormal taxes for primary agriculture were obtained.

Table 4.3 concisely summarises the sources of part 2 of the study's data collection. As can be seen, BFAP-supplied data was only used for the wholesale price of poultry and sunflower oil, as these values were unavailable in the abstract of agricultural statistics. SAFEX and SSA were jointly used for field crops and field crop products, as this was consistent with the data sources used by Kirsten *et al*. (2009) and proved to be a more reliable source than the aggregated data available in the abstract.

Table 4.3. Data sources of domestic variables for the respective covered products.

	Data source					
	STATS SA	SAFEX	Abstract	Industry	Other	Comment
Livestock products						
• Beef			✔			
• Mutton			✔			
• Poultry					✔	W/S Price – BFAP*
Field crops						
• Wheat grain		✔				
• Yellow maize grain		✔				
• White maize grain		✔				
• Sunflower seed		✔				
Field crop products						
• Wheat flour	✔					
• White maize flour	✔					
• Sunflower oil					✔	W/S Price - BFAP
Fruit (exportables)						
• Apples export			✔			
• Table grapes export			✔			
• Oranges export			✔			
Fruit (non-tradables)						
• Apples non-trade, processing			✔			
• Apples non-trade, dom. sales			✔			
• Table grapes non-trade			✔			
• Oranges non-trade			✔			

Wholesale prices sourced from the Bureau for Food and Agricultural Policy.

4.2.6   Data Collection Part 3: International Variables

4.2.6.1   CIF Import and FOB Export Prices

The final phase of data collection firstly involved obtaining the cost insurance freight (CIF) import prices, as well as the free on board (FOB) export prices, of each covered primary product and the covered processed products. Critical for identifying the correct price in relation to the covered product was the explicit identification in the study of the Harmonised System (HS) code of each product. This international system of product classification ensures that the same products for which Kirsten *et al*. (2009) calculated distortion estimates were used consistently during the current study's update of these estimates.

In some instances, the primary product classification of the model incorporated two traded products. In these instances, the HS codes of each of the defined primary products were used to obtain average per unit trade prices and average trade volumes. This enabled trade-weighted average prices to be calculated for each of the covered primary agricultural products based on trade volumes. The same

methodology was applied in the case of processed agricultural products, where the term "processed" in most instances incorporated multiple HS-classified product groups.

The identification of the individual HS product codes and the collection and calculation of trade-weighted average prices proved to be the tedious part of the data analysis. The presence of the FAOSTAT database somewhat alleviated the task, although multiple Excel spreadsheets still had to be utilised to process the raw data into the desired format required for the model. Furthermore, the previously mentioned issue of the FAO database only providing values up to and including the year 2013 meant that a further step was required in order to ensure the 10-year coverage of the study was maintained. This final step involved using the metadata supplied by the FAO for each published product group in order to match the HS codes of the products grouped in the FAO product classification with individual product data available in the ITC Trade Map database. The individual product ITC data was then combined using trade-weighted averages in order to correlate it with the published FAO data. A five-year overlap was calculated using ITC data to ensure that the medium-term trend in the data matched that of the FAO data, which had been used for the previous nine years of the model's coverage.

4.2.6.2   International Reference Price

For internationally traded products, the international reference price per product was of vital importance, as it served as the base from which the free market price was calculated. This free market price served as a major input into the ultimate calculation of the distortion estimates central to this study. With the exception of products such as traded maize, which have a fixed-point reference price that is internationally quoted, the majority of products' international prices were obtained from the FAOSTAT database. These international reference unit prices were derived by the FAO by dividing the global value of trade of a specific product by the global volume of trade in the product. In the case of fixed-point international reference prices, industry organisations such as SAGIS and SAFEX (in the case of maize) were used as the source of the data in the study.

As was the case with the import/export prices obtained from the FAO, the unavailability of data post-2013 proved challenging. For consistency, the FAO metadata consequently was used in the same manner as it was used in the import/export price determination in order to determine a global reference price from the ITC Trade Map database that correlated with the utilised FAO data.

In order to convert the international reference price per product to a value that could be compared to the domestic market price, the reference point of the international price needed to be the same as that of the domestic price. For products such as maize, which have an international reference point (Gulf of Mexico) as well as a domestic reference point (Randfontein), a more precise comparison could

be made. In this case, the international trading costs separating the two reference points could be calculated and added (subtracted) to (from) the domestic (international) price in order to accurately compare the two prices. The international trading costs were assumed to be the sum of the freight costs between the two reference points together with the processing and handling costs per traded unit.

However, the majority of products covered in the study did not have fixed-point reference prices, which consequently prescribed the use of average values throughout. Consequently, average CIF import and FOB export prices were used, together with average trading cost values. By their nature, the FAO international reference prices without fixed reference points are already average values, thus enabling direct comparisons to be made between them and the trade cost-adjusted domestic prices.[3]

4.2.6.3   *Adjustments in Product Quality*

Throughout the study, international product comparability was maintained as far as was possible through ensuring product homogeneity. In doing this, dealing with the different product quality levels between domestically produced products and internationally traded products was the major challenge. These different quality levels hampered equal price comparisons, as was described in Section 4.2.6.2. For example, over the study period's years, the poultry industry was characterised by cheap imports and several cases of dumping. This put the domestic industry under tremendous pressure and caused a clear division between the quality of the domestically produced product and the imported product.

Consequently, the data on the imported product needed to be adjusted in order to accurately reflect its inferior quality. While exceptionally difficult to quantify, in the case of poultry, Kirsten *et al*. (2009) estimated the imported product to be inferior by a proportion of 15% from 1998 to 2005. Therefore, a negative adjustment of the same magnitude was included in the current study in order to reflect the continued inflow of lower quality poultry products over the period.

Quality adjustments were also made for imported and exported processed products. However, all adjustments made were aligned with those made by Kirsten *et al*. (2009), as there was no major motive driving a change in these quantified adjustments.

4.2.6.4   *Trade Subsidies and Taxes*

As discussed in the theoretical Section 2.3.2 and methodology Section 3.2.1, governments impose measures at the national border that distort agricultural incentives. These measures typically take on

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[3] In cases where average price values were used, trade-weighted averages of freight rates to South Africa's top five trading partners were calculated and utilised as inputs into the model.

the form of trade subsidies and taxes. Therefore, accurate measurement of the magnitude of these subsidies and taxes on each of the covered primary and processed products in the study was a critical aspect in calculating the eventual distortion estimates.

The HS code classification of each of the covered products enabled accurate subsidy and tariff values to be obtained. These values were primarily sourced from the ITC Market Access Map database per individual HS product code, and where possible were verified against industry published data. The AVE methodology was applied in the calculation of the subsidy and tariff values.

A similar case to that of the import/export price calculations arose where the primary product classification in the model (based on FAO product groups) included multiple HS product code classifications. In this case, however, the issue was compounded by the fact that, at times, each HS-classified product had a different pool of trading partners as well as being governed by dissimilar tariffs or subsidies. Consequently, a trade-weighted average based on volume was firstly calculated in order to determine the average tariff or subsidy per product according to HS code. Thereafter, where multiple HS-classified products made up a single product group in the model, the trade-weighted averages of the individual HS-classified products needed to be combined. This was also done using a trade-weighted average based on volume.

The two-step weighted average calculation proved to be an exceptionally tedious task, as it was conducted for the primary product groups as well as for the processed product groups. In some cases, the processed product groups in the model included FAO product data and classifications that incorporated up to five HS product groups.

4.2.6.5   Exchange Rate

South Africa has adopted a floating exchange rate system, implying that the exchange rate is determined by market forces. Although the South African Reserve Bank (SARB) possesses the power to participate in the market, this is seldom done. As a result of the floating nature of the South African exchange rate, the exchange rate-driven price distortions as discussed in Section 3.2.1.1.3 are not applicable to the time period covered by the study.

Due to international commodity prices being included in the model, with US dollars as the monetary unit, as opposed to domestic market prices in South African rand as the monetary unit, the exchange rate between the two currencies was consequently needed. The annual average exchange rate expressed in rand per US dollars was obtained from the South African Reserve Bank (SARB, 2017a). This average exchange rate series was used consistently throughout the study across all covered agricultural products.

4.2.7   Noteworthy Data Trends

4.2.8   Calculation of Primary Distortion Indicators

Using the methodological framework discussed in Section 3.2.1.1, the nominal rate of assistance (NRA) of each covered agricultural product in the primary and processed form could be calculated. Critical to this phase of the calculations was to correctly identify the trade status of the product in each year, as the NRA formula varied subtly depending on whether the product was classified as an importable or exportable in the specific year. In order to minimise the possibility for error, both the importable trade scenario NRA as well as the exportable trade scenario NRA were calculated for each product. Using the prior identified trade status as discussed in Section 4.2.2, an automatic selection formula was used in the Excel spreadsheet to select the correct NRA value for each product based on the product's trade status for the specific year.

The above calculation procedure was carried out for bsoth the primary and processed form of each product covered in the study, thus yielding two NRA estimates per product. This enabled NRAs between individual products and broader product groups to be compared with one another. However, in order to obtain an estimate of the total distortions present in the agricultural sector, further refinement of these individual indicators was needed in order to obtain a sector-wide representative indicator.

4.2.9   Calculation of Combined Indicators

The individual product distortion indicators discussed in Section 4.2.8 were able to provide an indication of the policy support provided to the respective primary agricultural industries. However, given that the primary objective of the study was to evaluate the policy-induced price distortions at an aggregate sector level, the individual product indicators had to be combined into representative aggregate indicators.

From the output of the model, individual product estimates of NRAs for on average 71% of the total value of primary agricultural production (valued at distorted prices) were available. Thus, the remaining 29% of non-covered primary agricultural production needed to have distortion estimates assumed in order to generate a representative aggregate indicator of the entire agricultural sector. These NRA "guesstimates" for the non-covered products were obtained through a continuation of the series "guesstimated" by Kirsten *et al*. (2009), which was generated by utilising the preceding 10 years' average value as an indicator of the current year's NRA value.

Consequently, the non-covered products could be treated as a single entry into the calculation of the sector-wide NRA indicator. As briefly discussed in Section 3.2.1.2, the sector-wide NRA to agriculture

(NRA$_{ag}$) is generated through a weighted average of all covered products and non-covered products. The weights used in this calculation are each product's value share of total agricultural production valued at farmgate-equivalent undistorted prices. The value shares per agricultural industry were obtained from the 2016 Abstract of Agricultural Statistics. The value of non-covered products was calculated by subtracting the sum of the covered products' production value from the total agricultural production value.

The NRA indicators for the importable, exportable and non-tradeable subsectors within the agricultural sector were further calculated using the same weighted average method used in the NRA$_{ag}$ calculation. These results enabled the trade bias indicator for each year of the period to be computed. This was done using Equation (3.9), as was discussed theoretically in Section 3.2.1.3.

4.3   Disaggregated NRAs for SA Wheat Industry

4.3.1   Value Chain Identification

In order to disaggregate the NRA indicators throughout a value chain, the vertical structure of the value chain first had to be identified explicitly. This implied the identification of each agent within the value chain, together with its respective function. Three key agent levels within the South African wheat flour value chain were identified for empirical measurements. These were, firstly, wheat grain farmers, secondly wheat grain millers and lastly wheat flour consumers. Although sub-agents such as wheat grain traders and wheat flour retailers are also an integral part of the vertical value chain, the availability of data, especially market price data, enabled only the three core value chain agent's NRA estimates to be calculated.

Furthermore, as broadly discussed in Section 4.2, the nature of the measurement of the aggregate wheat NRA estimate encapsulates the combined assistance to primary wheat production. This includes the assistance to both wheat farmers as well as wheat traders, as the point of measurement is wheat grain supplied to the market for miller to purchase.

4.3.2   Determination of Domestic Reference Point

Given that the nature of the distortion estimates is characterised by the difference between the would-be free market price (assumed to be the world price) and the prevailing domestic market price, the border price measurement reference point is of great importance. Clear identification of the reference point ensures that equal price comparisons can be made. Consequently, all producer prices for wheat were first converted to a Randfontein mill door price by adding average marketing costs from farm to Randfontein to the producer price series obtained from the South African Grain Information Service (SAGIS) price database (SAGIS, 2017). In the case where the published data on the

SAGIS website was insufficient due to its time-period limitation, SAGIS was contacted directly in order to obtain the archived historical data.

Similarly, import parity prices for wheat also had to be comparable at a Randfontein mill door-quoted price. Grain SA, via its website database, publishes daily import and export parity prices for both Randfontein and Durban as reference points (Grain SA, 2017). Using the published Randfontein parity price series for Hard Red Winter number 2 (HRW 2) wheat obtained from Grain SA, monthly averages could be calculated and compared to the domestic producer prices at the Randfontein mill door point. Thus, through the clear identification of the refence point, the price-series inputs into the disaggregated model for farmer output and miller input were made comparable. This enabled marketing year (October to September) average estimates to be constructed per agent in the wheat value chain, which formed the core of the disaggregated model's output.

4.3.3   Value Chain Price Adjustments & Linkages

As discussed in Section 3.3.1.2, the disaggregated NRA methodology assumes that the price linkages in the vertical value chain are such that the price paid by the subsequent agent handling the traded commodity is equal to the price received by the previous agent who sold the commodity (Briones Alonso & Swinnen, 2015). In the case of the farmer–miller agent linkage, this intuition is plausible. However, in the case of the wheat flour miller–wheat flour consumer linkage, this intuition is somewhat debatable given the presence of retailers linking these final two market agents. Due to the coverage of this study not including direct distortion estimates for retailers, mainly due to the lack of market information, due adjustments had to be made to the retail price of flour obtained from Stats SA (2017).

However, preceding the retail price adjustment was the transformation of farmer-supplied wheat grain into wheat flour by the wheat miller. As highlighted in Equation (3.12) and in the discussion in Section 3.3.1.1, the conversion rate of the wheat millers' inputs into outputs needed due consideration. Due to no distinction being made in the bread flour consumer price data between white bread flour and brown bread flour, the average extraction rate between the two respective flour types was utilised. This approach was aligned with that applied by Kirsten *et al*. (2009) and resulted in an average extraction rate from wheat grain to wheat flour of 0.79 (white 0.76; brown 0.81) being used as the conversion factor for millers in this study.

In addition to the conversion rate of grain to flour, the milling costs involved also needed due consideration in order to convert the wheat grain input price (reference point Randfontein mill door) to a wheat flour output comparable price. While these costs would naturally tend to vary between millers, largely dependent on economies of scale, an average was obtained from the published FAO

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(2009) international standard and the domestically published NAMC (2004) standard. This yielded a value of 18% (FAO 19%; NAMC 17%) of the wholesale wheat flour price per ton of flour.

Obtaining the output prices necessary for the calculation of Equation (3.12) required knowledge of the wholesale price of wheat flour for both the distorted and undistorted situations. Obtaining the undistorted wholesale price for wheat flour was done using the average import price per ton of wheat flour landed in Durban harbour from the FAOSTAT database. As was the case with wheat grain parity prices, the wheat flour wholesale price was then converted to a Randfontein reference price by adding the transport differential between Durban and Randfontein obtained from Grain SA (2017) to the Durban import price.

However, the domestic wholesale price for wheat flour was incredibly difficult to obtain, largely because of non-co-operation from the National Chamber of Milling with regard to sharing price information. This is somewhat understandable, given the structure of the South African wheat milling industry, which is conducive to collusion[4], and the outcomes of the 2007/2008 Competition Commission's investigation into the wheat flour cartel that was active from 1999 to 2007 (Mncube, 2013). Given the industry's unwillingness to share wholesale wheat flour price information required certain assumptions to be made in order to work back to a wholesale price for wheat flour from a known retail price series of wheat flour obtained from Stats SA (2017). s

In their empirical calculations of base distortion estimates, Kirsten *et al*. (2009) encountered the same challenge in terms of the availability of wholesale flour price data as was encountered in the current study. In overcoming this challenge, the VAT percentage of 14% and a retail margin of 14% were deducted from the retail price of the price series for 2.5 kg of bread flour published by Stats SA. This method was similarly applied in the current study in order to obtain an estimate of the wholesale price of bread flour that would be comparable to the wholesale import parity price of bread flour calculated from the FAOSTAT data. All comparisons were carried out on a rand price per ton basis, with the necessary exchange rate adjustments being done using the SARB (2017) exchange rate series.

The final value chain agent group included in the study was the consumers of wheat flour. Given that no distortion estimates were attempted for retailers of wheat flour, the price linkage between wheat flour output from millers and the price paid for wheat flour by flour consumers differed. However, as was highlighted above, this break in the price linkage was of minimal concern due to the fact that actual retail price data for wheat flour was available from Stats SA (2017). This ensured that, given the assumptions on retail percentage and VAT percentage removal, there was a coherent link between

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[4] Few large firms with concentrated market power create an enabling environment for collusion to occur.

the price series used as the domestic distorted miller output price and the domestic distorted retail price of flour. As highlighted earlier in this section, this retail price was taken as being the price of a 2.5 kg package of bread flour converted to a price per ton basis.

4.3.4   Calculation of Distortion Estimates

Following from the value chain identification, as well as the sourcing of historical price data, the final stage of the disaggregated empirical procedure was to utilise the disaggregated methodology (Section 3.3, specifically Equation (3.12) and Equation (3.13)) to combine the respective time series into distortion estimates per value chain agent. As with the aggregate distortion estimates discussed in Section 4.2, multiple Excel spreadsheets were utilised to generate the empirical results.

Due to the majority of the input data series being on a per month basis, NRA estimates per value chain agent were first computed for each month from the beginning of the year 2000 until the end of 2014. The major limiting factor of the time series coverage was the availability of price data from the FAO. At the time of writing, complete data series were only available up to and including the year 2014. Furthermore, some of the data series used, such as the retail price of flour, were only available as calendar year averages. In such instances, the calendar year average was used consistently for each month within the specific year.

The computation of the per month NRA estimates was an important precursor to the calculation of annual averages, as it was not calendar year annual averages that were calculated, but rather wheat marketing-year averages. Thus, monthly estimates were averaged for the respective 12-month period, starting at the beginning of October and ending at the end of September in the following year. For example, the NRA estimate for the 2000/2001 marketing year was calculated for the 12 months starting in October 2000 and ending in September 2001. Consequently, it is the marketing year starting in October 2000 and the marketing year ending in September 2014 that form the lower and upper bounds of the disaggregated NRA estimates for the time period covered in this study.

4.4   Conclusion

The highly data-intensive nature of this study warranted an adequate explanation of the intrinsic elements of the empirical application of both the aggregated and disaggregated distortion estimate frameworks applied in this study. Section 4.2 highlighted the mammoth task of collecting multiple datasets for all 10 of the broadly covered agricultural commodity groups in order to calculate the commodity-specific distortion estimates. As alluded to throughout Section 4.2, this task was not without its challenges, which were characterised firstly by the lack of data in the public domain, and secondly by the need for extensive data refinement before being able to calculate reliable and

accurate distortion indicators. Such challenges led to the complete exclusion of sugar as a covered commodity, while the data availability from the FAO governed the end date of the studied period to be 2014.

The challenges experienced during the calculation of the aggregate distortion indicators increased in intensity when calculating the disaggregated distortion estimates for the wheat industry. An understandably data-hesitant wheat milling industry forced the use of assumptions when calculating domestic flour wholesale prices, while data availability from the FAO once again determined the end date of the period. Nonetheless, as discussed extensively throughout Section 4.3, each data and methodological challenge was strategically overcome so as to ensure that the most comprehensive and accurate distortion estimates were calculated.

Chapter 5   Presentation & Discussion of Results

5.1   Introduction

The motivation behind the measurement of distortion estimates in agriculture, and the methodology and application of the empirical framework, have been covered systematically in Chapters 2, 3 and 4 respectively. The products of this in-depth process make a two-fold contribution to the existing empirical literature. The primary contributions of this study are the nominal rate of assistance (NRA) estimates for primary agricultural production in South Africa at an aggregated commodity-production level for the 10-year period leading up to and including 2014. Arising from this primary contribution are a range of disaggregated NRAs for three key levels of value chain agents in the South African wheat value chain. While the aggregated estimates are an update of those estimated by Kirsten *et al*. (2009), the disaggregated estimates for the wheat value chain are an advancement in the South African empirical field of distortion estimates.

The rest of this chapter is divided into three sections. Section 5.2 presents the results of both the aggregated distortion estimates to primary agriculture and the disaggregated estimates for the three agents in the wheat value chain. In addition to the distortion estimates, the trade bias index values for the time period preceding the studied period, as well as for the studied period, are presented. Section 5.3 provides an in-depth discussion of the results of the study, with a focus on the trends over the most recent 10- (aggregated) and 14- (disaggregated) year period. This discussion is in two parts and includes separate but related discussions on the aggregate and disaggregated results. Section 5.4 concludes.

5.2   Presentation of Results

5.2.1   Aggregate NRA to Primary Agriculture

Figure 5.1 presents the aggregate distortion estimates calculated in this study for the 10-year period leading up to and including 2014 in the context of the long-term trend from 1962 calculated by Kirsten *et al*. (2009).
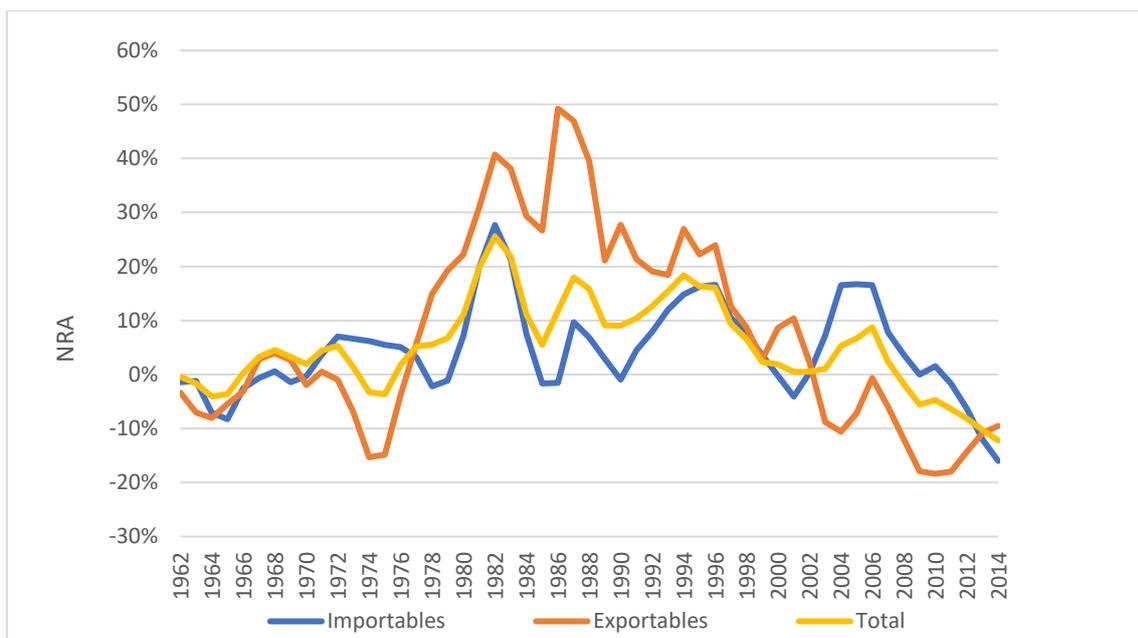
Figure 5.1. Aggregate NRAs for primary agricultural production – three-year moving average, South Africa, 1962 to 2014.
Source: 1962–2004: Kirsten et al. *(2009); 2005–2014: author's calculations*

Following an initial increase in the total NRA to primary agricultural commodities in the beginning of the period, Figure 5.1 depicts a steady decline in NRA to primary agriculture over the most recent 10-year period. This decline reflects a complete reversal of the NRA to primary agriculture, from a positive average of close to 10% to a negative average value in 2014 in excess of 10%. Furthermore, with the exception of the negative NRA values experienced for a couple of years in the mid-1960s and 1970s, the years post-2008 mark the first sustained period of negative NRA values for aggregate primary agricultural production in over 50 years.

The NRA to exportable agricultural commodities continues to exhibit a volatile but declining trend from 2005 to 2014, in line with that observed from the mid-1980s. Over the studied 10-year period, the NRA to exportables remained consistently negative, with a trough in 2010 of -18.4%. However, subsequent to 2010, a marked improvement in the NRA to exportables is seen, corresponding to an almost halving of the NRA from 2010 to a value of -9.5% in 2014.

Although breaching the zero NRA barrier sporadically since the early 1960s, the NRA to importable agricultural commodities has been negative and declining since 2011. Furthermore, with respect to the magnitude of the NRA reversals over the studied 10-year period, importables lead the way with a decline in NRA values from 16,8% in 2005 to -16% in 2014.

5.2.1   Aggregate NRA to Covered Agricultural Commodities

Table 5.1 contains the three-year moving average NRA values for each covered agricultural commodity for the 10-year study period. The mixed trade status commodity group contains commodities that were included in both the importables and exportables groups at various times throughout the period starting in 1961, depending on their trade status within the specific year.

Table 5.1. Three-year moving average NRAs per covered agricultural commodity.

Agricultural commodity	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014*
Importables										
Beef	63,5	70,1	53,8	49,2	28,5	19,3	8,4	-1,5	-6,0	-12,2
Mutton	11,3	17,5	14,4	2,7	-1,5	-0,9	-0,8	-4,5	-1,8	-0,5
Poultry	15,0	8,8	-3,8	-9,5	-11,8	-3,4	-5,4	-10,1	-22,0	-27,9
Exportables										
Apples	5,0	14,2	15,2	12,9	7,0	6,6	16,4	19,8	20,9	14,2
Oranges	6,8	7,9	10,5	11,2	9,5	14,1	18,2	19,9	19,8	20,8
Table grapes	2,4	11,2	24,2	16,3	8,9	6,6	9,1	14,7	12,1	11,0
Mixed trade status										
Wheat	-3,3	-9,6	-9,9	-8,2	-6,5	-5,4	-7,7	-9,3	-14,4	-14,6
Yellow maize	17,9	27,2	2,8	10,8	23,1	18,2	13,8	9,0	18,8	21,6
White maize	-29,2	-20,8	-23,9	-33,7	-42,9	-44,6	-44,1	-40,0	-35,7	-35,4
Sunflower	-12,5	-13,0	-13,3	-14,0	-13,8	-12,6	-11,2	-11,4	-12,2	-12,8
NRA importables	16,8	16,6	7,8	3,6	0,0	1,5	-1,7	-6,3	-12,1	-16,0
NRA exportables	-7,2	-0,6	-6,0	-12,0	-17,9	-18,4	-18,0	-14,3	-10,8	-9,5
Total NRA**	9,7	11,0	5,5	-9,3	-1,5	-5,9	-6,8	-6,5	-11,2	-13,3

Source: Data compiled by the author.
*Average based on 2013 and 2014 values only due to time period limitation.
**Value of production per agricultural commodity used as weights in the total NRA calculation.

5.2.1.1   NRA to Field Crops

Figure 5.2 presents the aggregate NRAs for the covered field crops in the study. As was the case with the sector-wide NRA presentation in Figure 5.1, the field crop NRAs are presented within the context of the long-term trend.
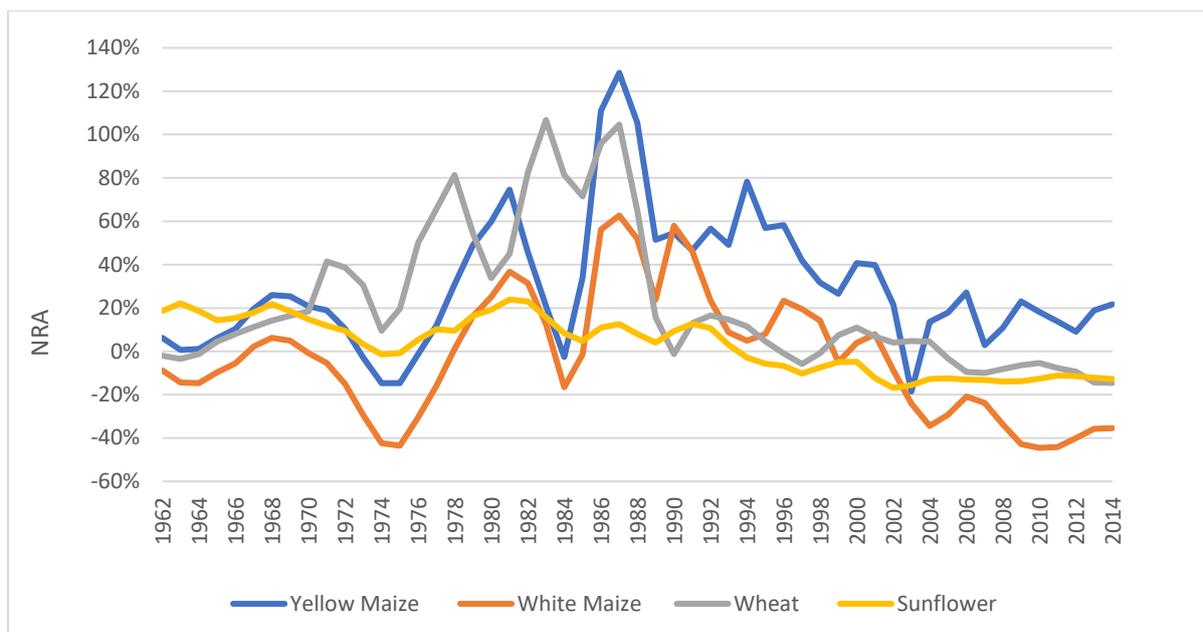
Figure 5.2. Aggregate NRAs for covered field crops – three-year moving average, South Africa, 1962 to 2014. Source: 1962–2004: Kirsten et al. *(2009); 2005–2014: author's calculations*

Although exhibiting a sharp trough in 2003, two years before the start of the studied period, the average NRA to yellow maize remained positive throughout the 10-year period. The recent trend from 2005 to 2014 has been a sideways movement, with NRAs oscillating between the zero and twenty percent bounds. Although more volatile, this recent trend of sideways movement in the case of yellow maize is similar to that seen from the early 1960s to early 1970s. Notably, the most recent 10-year NRA average values indicate a shift away from the previous long-run trend of steady decline in NRA values from the mid-1980s to 2003. By the end of 2014, the NRA average to yellow maize stood at 21,6%, slightly higher than its 2005 value of 17,9%.

In contrast to yellow maize, the NRA to white maize remained strongly negative throughout the 10-year period. While the NRAs up until 2009 were aligned with the long-term declining trend initiated in the mid-1980s, the white maize NRA for the latter years of the study exhibit a sideways movement at around the -40% mark, characterized by a 50-year low of -44,6% in 2010.

The NRA for both wheat and sunflower seed remained remarkably consistent between 2005 and 2014. This is in line with the general trend for all field crops observed in Figure 5.2, namely that of a sideways-moving trend. The NRAs for both wheat and sunflower converged in the latter years of the period, with the three-year average NRA values in 2014 being -14,6% and -12,8% respectively.

5.2.1.2   NRA to Livestock

Figure 5.3 contains the NRAs for the three covered livestock products included in the study, namely beef, mutton and poultry.
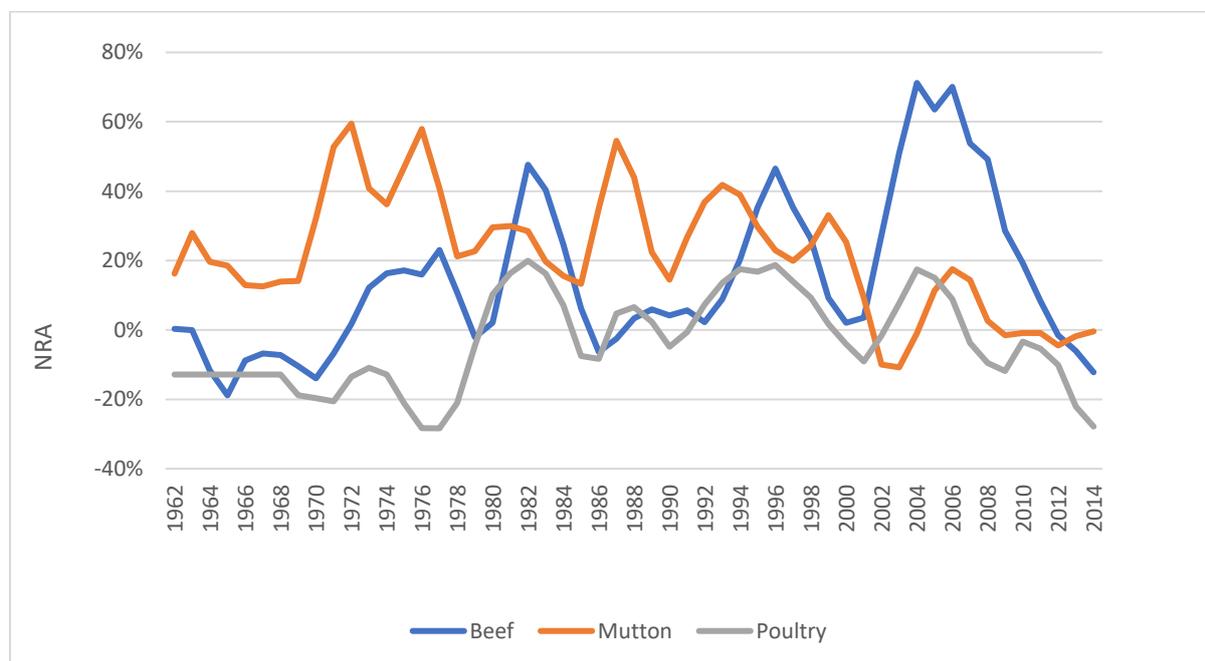

Figure 5.3. Aggregate NRAs for covered livestock – three-year moving average, South Africa, 1962 to 2014. Source: 1962–2004: Kirsten et al. *(2009); 2005–2014: author's calculations*

Although exhibiting a slight increase in the NRA to beef production from 2005 to 2006, Figure 5.3 most notably reveals a rapid decline in the NRA average values to beef from 2006 until 2014. The immense rate of this decline in NRA is comparable (via its slope) to both the decline seen in the mid-1980s as well as that seen in the five years leading up to the year 2000. By the end of the studied period, the average NRA to beef stood at -12,2%, a staggering 82,3% lower than the NRA value from where the declining trend started in 2006.

The NRA average estimates for poultry producers declined from 15% in 2005 to -27,9% in 2014. This was characterised by an acceleration of the declining trend from 2010, seen throughout the 10-year period. In the final four years of the study, the average NRA declined from -3,4% in 2010 to its 2014 value. This 2014 NRA low of -27,6% is the second lowest experienced by the poultry industry in over 50 years, with only the 1977 trough of -28,3% yielding a greater negative NRA average value.

The NRA for mutton producers showed a significant decline in its own right throughout the earlier years of the study. However, since 2008, the average NRA has consistently been negative and has exhibited a lateral movement very close to zero. This lateral trend very close to zero is unlike any seen in the discussed commodity NRAs for the 10-year period studied. In terms of the long-run trend

observed in the NRA for mutton, Figure 5.3 is suggestive of the fact that the long-term steady declining trend initiated in the early 1970s has perhaps changed to a more lateral trend since the early 2000s.

5.2.1.3   NRA to Exportable Fruit

The NRAs for South Africa's three largest fruit export commodity groups are displayed in Figure 5.4 in the context of the long-term trend. However, the spike in the NRA to table grapes in the early 1980s compresses the scale of the graph, resulting in the legibility of the most recent 10-year period being distorted. Figure 5.5 is therefore included in order to clearly depict the NRA trend in fruit exports for the period.
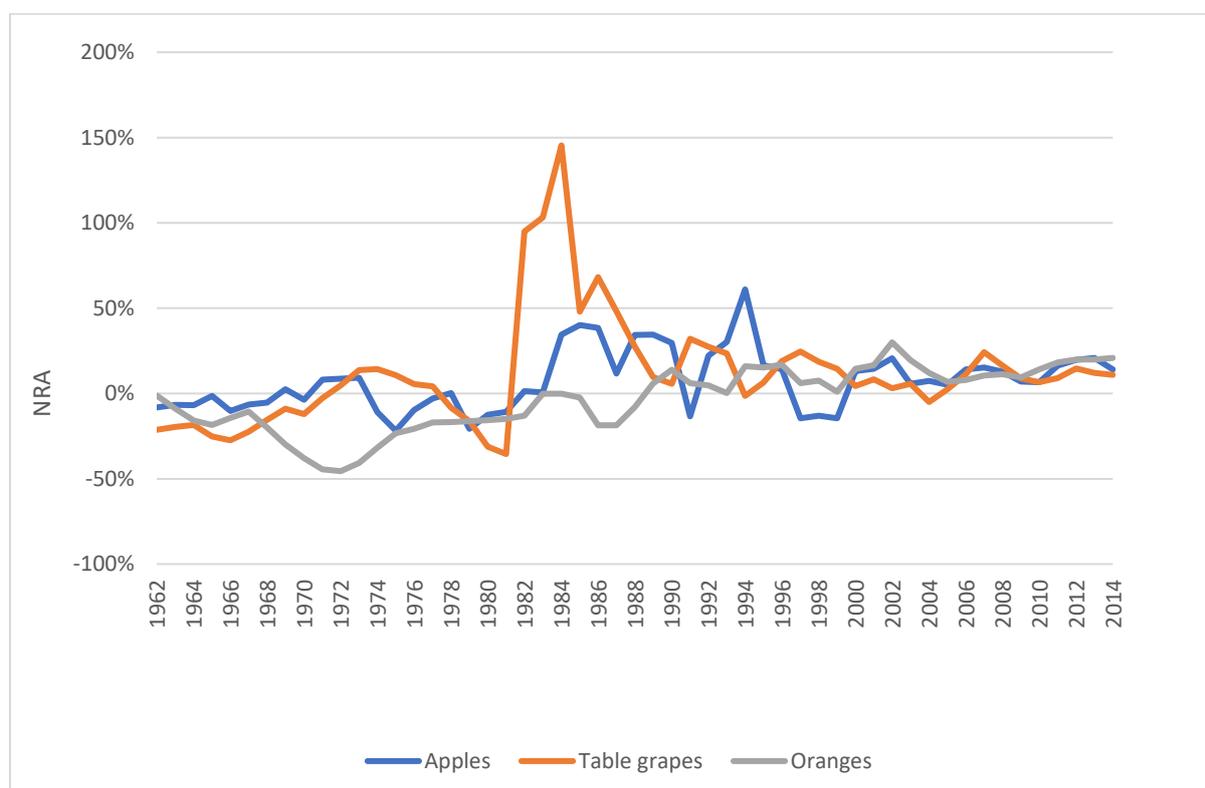

Figure 5.4. Aggregate NRAs for covered fruit exports – three-year moving average, South Africa, 1962 to 2014. Source: 1962–2004: Kirsten et al. (2009); 2005–2014: author's calculations
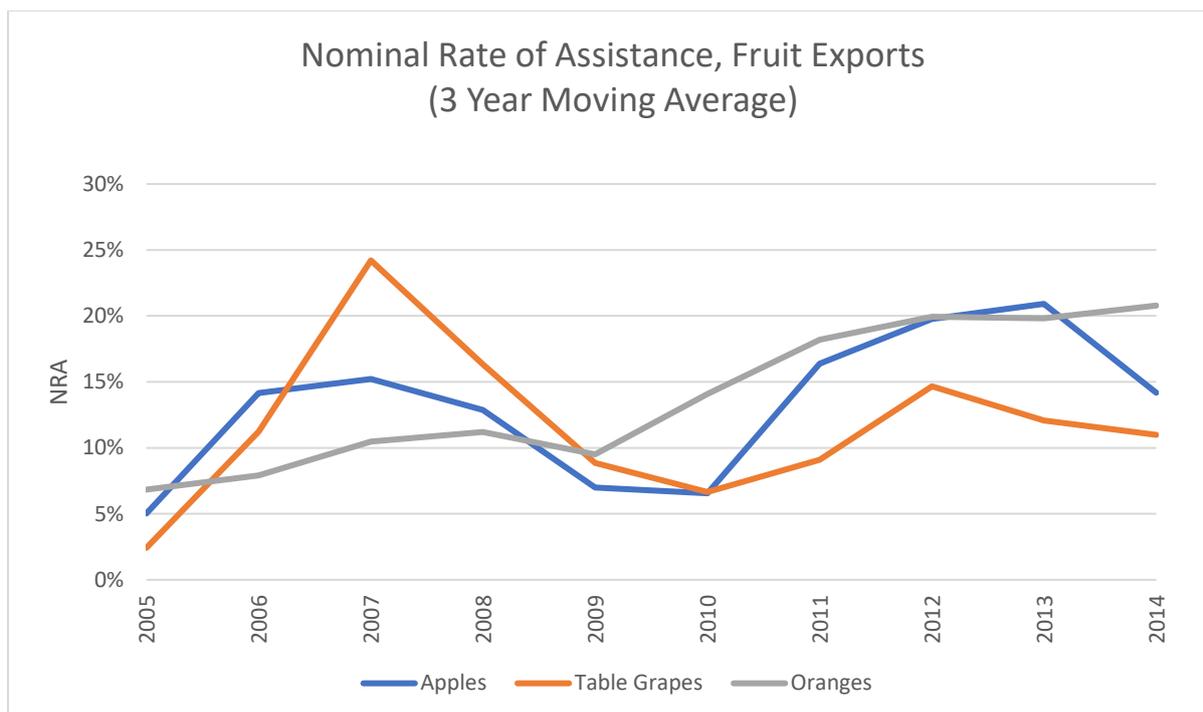
Figure 5.5. Aggregate NRAs for covered fruit exports – three-year moving average, South Africa, 2005 to 2014. Source: Author's calculations

The NRA to export apples experienced a gradual upward yet volatile trend between 2005 and 2014, starting from a NRA value of 5,0% and reaching a value of 14,2% by the end of the period. This contributed to a continuation of the positive NRA trend for apples initiated in the year 2000. However, a notable dip in the NRA to apples can be seen in 2009 and 2010, with rapid improvement in the three years thereafter.

For the years 2005 to 2014, table grape NRA values exhibited a strong sideways trend at around the 10% NRA mark. The peak of 24,2% in 2007 was the highest since 1997, but it declined rapidly to the 2010 trough of 6,6%. This decline in NRA values was significantly more rapid than that observed in the NRA to apples and was followed by a more sluggish recovery in the years after the trough than that seen in apples.

From all three of the covered export fruit commodities, oranges produced for export exhibited the least volatile and strongest upward trend in estimated NRA values. Over the studied 10-year period, the NRA increased from 6,8% in 2005 to 20,8% in 2014, with the only period showing a decrease being that from 2008 (11,2%) to 2009 (9,5%). In terms of the long-term trend observed in Figure 5.4, the NRA to export oranges turned positive in 1989 and has remained positive ever since, including in the most recent period.

5.2.1.4   Trade Bias Indicator

The trade bias indicator (TBI), discussed in Section 3.2.1.3, measures the extent to which the policy environment has an anti (-'ve) or pro (+'ve) trade bias. Figure 5.6 contains the five-year average trade bias values for the period studied by Kirsten *et al*. (2009), as well as for the 10-year period covered in this study.
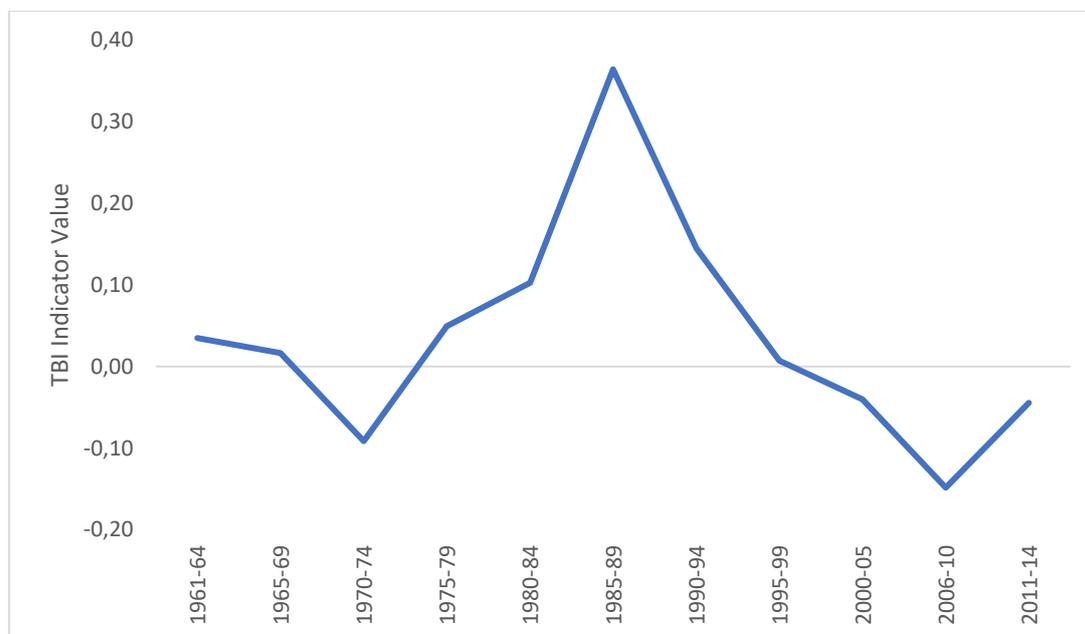

Figure 5.6. Trade bias indicator: Primary agriculture – five-year moving average, South Africa, 1961 to 2014. Source: Author's own calculations (1961 to 2004 data for calculation obtained from Kirsten et al. *(2009); 2005-2014 data obtained from this study)*

The trade bias indicator remained negative for both five-year sub-periods of the study, although it demonstrated a possible reversal in the declining trend which started in the time period from 1985 to 1989. This trend reversal occurred from the 2006–2010 value of -0,15, the lowest level of the five-year average in over 50 years. The 2011–2014 sub-period's value of -0,04 is exactly the same as the 2000–205 TBI value, although moving upward as opposed to downward.

This upward movement is driven by the improvement in the NRA to exportable products, together with the increased rate at which the NRA to importable commodities decreased (Figure 5.1). Therefore, although still negative and anti-trade, the severity of the anti-trade bias over the 2011–14 sub-period was significantly less due to the NRA to exportables and NRA to importables moving in opposite directions. This was comparable to the value in the 2006–2010 sub-period, when the NRAs to both the importable and exportable sectors were declining. As will be highlighted in Section 5.3, the primary driver behind the improvement in the TBI is the implicit impact of the long-term depreciation of the South African exchange rate. What is clear from Figure 5.6, however, is that for

the 19 years since 1995, primary agricultural production has persisted, albeit in an anti-trade policy environment within the sector.

5.2.2   Disaggregated NRA for Wheat Value Chain

The disaggregated NRAs for each of the three covered agents in the South African wheat value chain are presented in Figure 5.7.
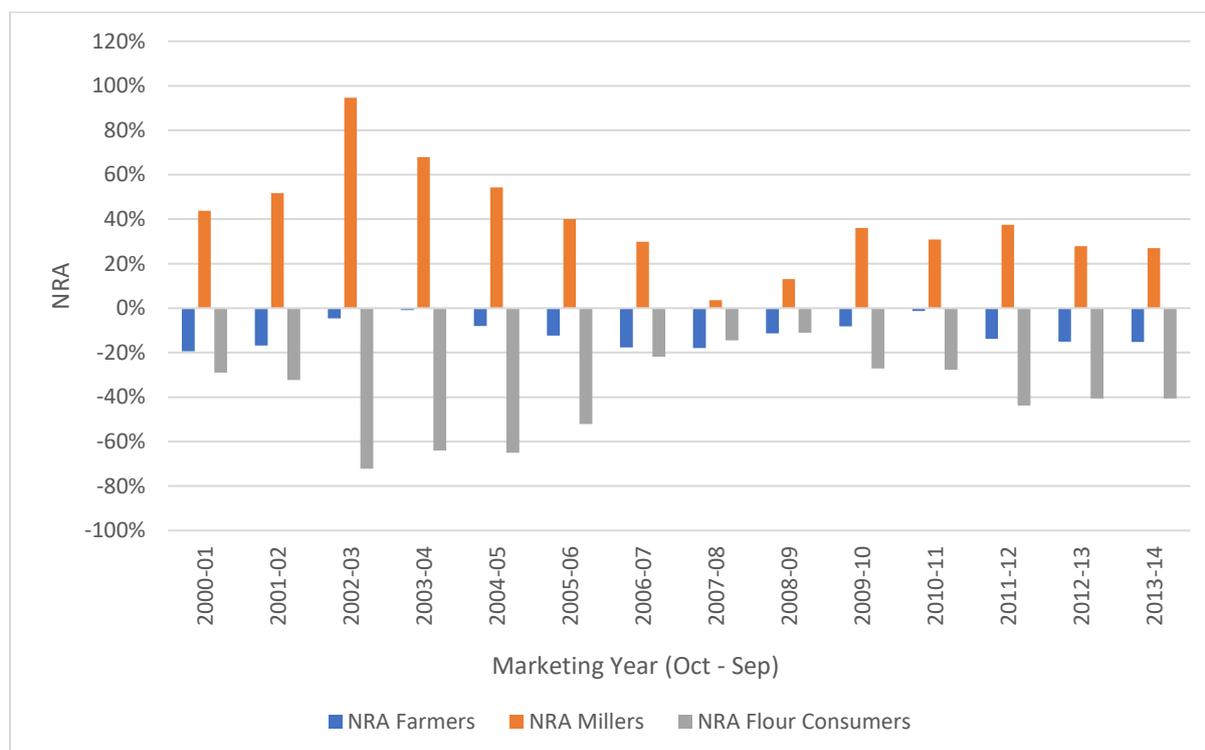

Figure 5.7. Disaggregated NRA per agent in the wheat value chain – marketing years, South Africa, 2000 to 2014. Source: Author's own calculations.

The NRA to wheat farmers remained negative for all 14 marketing years, although it came extremely close to zero (-1%) in both the 2003/2004 and 2010/2011 marketing years While this trend is similar to that observed for wheat in Figure 5.2, the estimates are not directly comparable, as the aggregate NRA for wheat includes NRAs for both wheat traders and wheat farmers as opposed to the disaggregated NRA measure just for wheat farmers.

In stark contrast to farmers, the NRA to wheat millers remained highly positive throughout the period, while only coming close to zero (4%) in the 2007/2008 marketing year. In addition, the 14-year peak of and extraordinary high 95% in 2002/2003 was followed by a five-year rapid decline to the period low of 4%. For the last five years of the studied period, the NRA to millers remained significantly positive at above 20%, although not coming close to the highs observed in the earlier years of the study.

As with wheat farmers, the NRA to wheat flour consumers remained negative throughout the 14 studied marketing years. However, the magnitude of the NRAs for flour consumers were significantly more negative than those of farmers, reaching a negative high of -72% in the 2002/2003 marketing year. Furthermore, the analysis of the NRA miller trend in relation to the NRA flour consumer trend reveals how these estimates moved in opposite directions throughout the period, with NRAs to consumers becoming less negative as NRAs to millers became less positive. In the last marketing year covered, the NRAs to farmers, millers and consumers were -15%, 27% and -41% respectively.

5.3   Discussion of Results

5.3.1   Aggregate Distortion Estimates

5.3.1.1   South African Rand Exchange Rate

Of importance in the interpretation and understanding of the aggregated results presented in Section 5.2 is to have an adequate understanding of the rapid depreciation of the South African rand against major international currencies from January 2005 until December 2014. Over this 10-year period, the nominal USD/R exchange rate depreciated by 48%, from $0.17/R to $0.09/R (SARB, 2017a). When viewed in R/USD, the depreciation over the period is far more extreme, having depreciated 92% from R5.97/USD to R11.46/USD. The USD/R depreciation is highlighted by the orange and red arrows in Figure 5.8.

Figure 5.8. Nominal monthly average exchange rate, United States dollar per South African rand, January 2000 to July 2017.
Data source: SARB (2017a)

However, evaluating the strength of the rand purely against the US dollar needs to be done with extreme caution. The depreciation of the USD/R seen in Figure 5.8 could in actual fact have been as a result of an appreciation of the US dollar's value, while the value of the rand could have remained constant when compared to other currencies besides the US dollar. In order to confidently evaluate the nominal value of the rand, the nominal effective exchange rate (NEER) of the rand published by the South African Reserve Bank (SARB) is typically used. The NEER contained in Figure 5.9 is a weighted average exchange rate of the South African rand measured against a basket of currencies comprising South Africa's 20 most important trading partners (SARB, 2017b). If the value of the rand falls against the basket of currencies, the indexed rate declines, as opposed to increasing when the value of the rand improves against the basket of currencies.
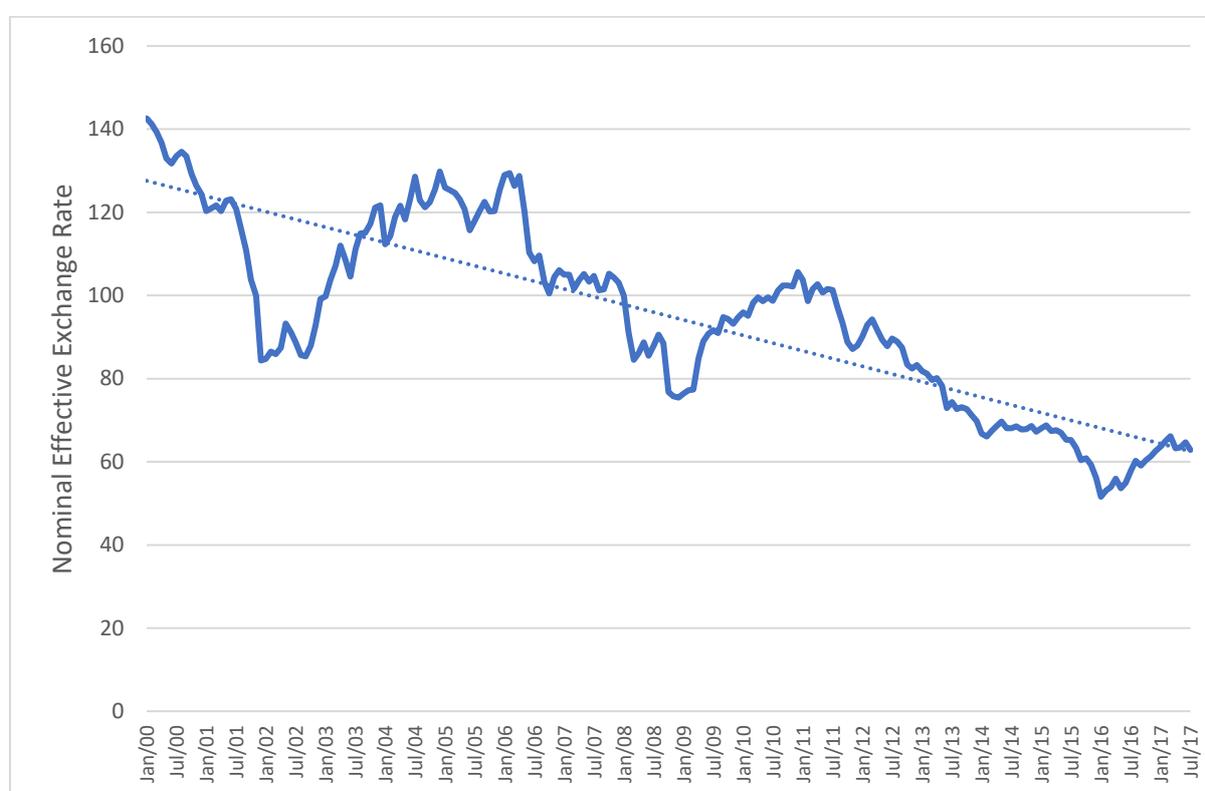
Figure 5.9. Nominal monthly average effective exchange rate, South African rand against 20 most important trading partners, January 2000 to July 2017.
Data source: SARB (2017b)

Evident from Figure 5.9 is the persistent weakening of the rand compared to South Africa's major trading partners throughout the 10-year study period. This consequently implies that the weakening trend of the rand observed from the USD/R exchange rate is far more widespread. It therefore is likely that it is the rand weakening, rather than the other currencies strengthening while the rand maintains its value.

Given that both data series depicted in Figure 5.8 and Figure 5.9 are in nominal terms, the inflation differential between South Africa and its major trading partners needs to be considered when analysing how the external value of the rand affects South Africa's trading competitiveness. Although primarily an indicator of South Africa's price and cost competitiveness in international trade in manufactured goods, the real effective exchange rate of the rand (REER) adjusts the NEER for the inflation differential between South Africa and its major trading partners (Motsumi *et al*., 2014). Figure 5.10 depicts the REER as calculated by the SARB (2017c).
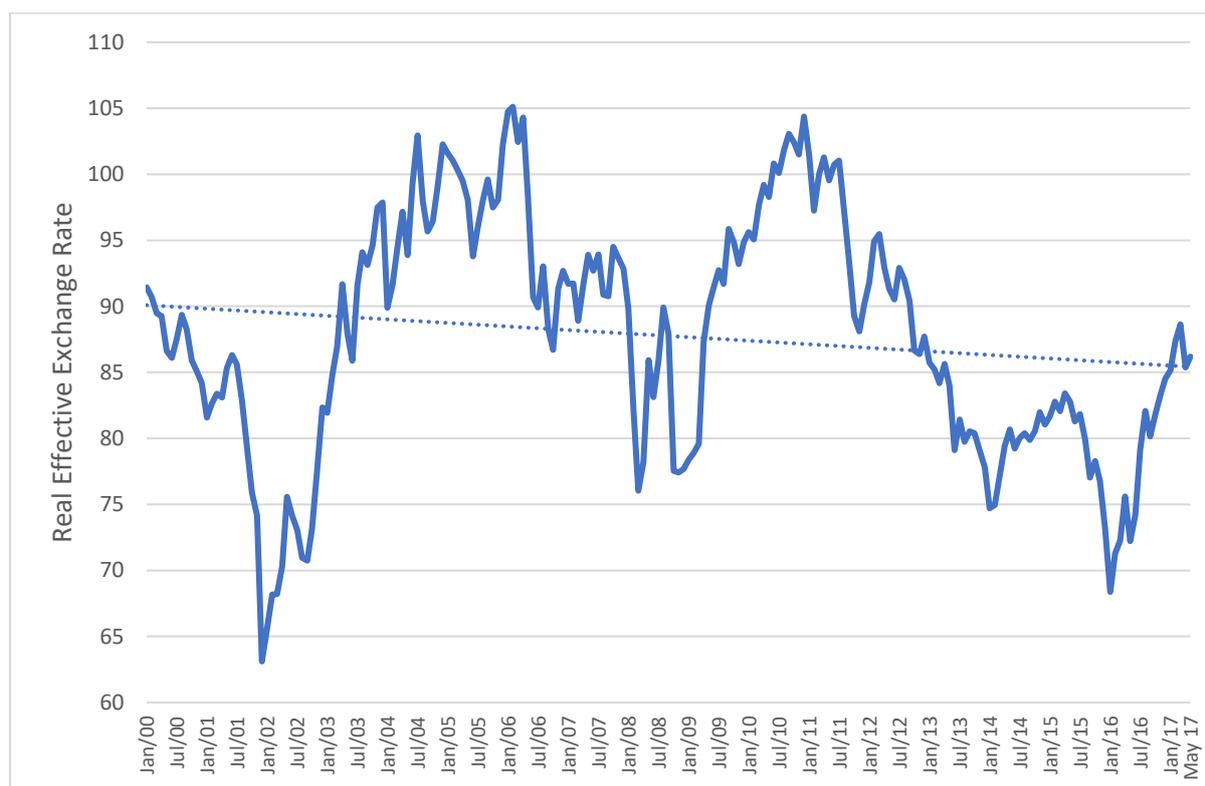
Figure 5.10. Real monthly average effective exchange rate, South African rand against 20 most important trading partners, January 2000 to July 2017.
Data source: SARB (2017c)

An increase in the REER leads to exports becoming more expensive for South Africa's trading partners and imports becoming cheaper for South African importers (IMF, 2017). Consequently, an increase in the REER indicates a loss in trade competitiveness, while a decrease indicates a gain.

Over the 10-year period, the REER index moved from a value of just greater than 100 to a value just greater than 80, which is indicative of a 20% gain in international competitiveness. However, over the same period the nominal USD/R (Figure 5.8) exchange rate depreciated by 48% while the NEER index (Figure 5.9) declined by around 47%. The differential between the REER and NEER implies that potential competitiveness gains to be realised via the depreciation of the rand were largely reduced due to price levels in South Africa increasing at a faster rate than those of its 20 major trading partners.

Moving forward in the discussion of the distortion estimate results for primary agricultural production, the linkages of the three key exchange rate indicators and their respective interpretations are vital in understanding the trends exhibited in this study's results. This, together with commodity-specific trade policies and trends, provide key insight into the trends exhibited in the NRA.

5.3.1.2   NRA to Primary Agriculture

On average, the NRA for South African primary agriculture between 2005 and 2014 reflect a change in policy environment from one that incentivised primary agricultural production to one that disincentivised primary agricultural production. This shift coincided with the rapid depreciation of the rand against major trading partners' currencies, which in theory would have increased South Africa's competitiveness in the global market, as is evident from Figure 5.10.

Throughout this period, South Africa's real agricultural export value more than doubled, with this occurring at an increasing rate after 2012 (DAFF, 2016). However, agricultural net exports remained extremely volatile throughout the period, reflecting erratic year-on-year agricultural imports. The acceleration of agricultural exports after 2012 reflected a positive shift in the policy environment in which agricultural exporters were operating. This shift is evident in Figure 5.1 where, post-2011, the NRA to primary agricultural exportables has been on an upward trend towards a zero-distorting environment.

Ironically, the policy environment shift facing the exportable sector has predominantly been a passive shift driven by the floating exchange rate depreciation and the consequent international competitiveness gain. This is in stark contrast to the active policies of the government that were in place until 1995 to support exporters and shield against losses, as highlighted by Kirsten *et al.* (2009). Since the removal of these active direct policies, the NRA to exportables has remained in a downward trend as markets liberalised. What the NRAs from this study reveal for the primary agricultural exportable sector is that this downward NRA trend has possibly been reversed, with the "saviour" being the widely negatively perceived depreciation of the rand.

While the NRA to exportables remained negative throughout the period, the NRA to importables only turned negative post-2010, although it had been exhibiting a declining trend for all 10 years of the study. However, while a depreciation of the rand would intuitively lead to implicit support for import-competing commodities on the output side due to the increased rand costs of imported commodities, the NRAs fail to reflect this implicit protection. Instead, the NRAs in the last four years exhibit a shift from a neutral policy-distorting environment to an environment strongly disincentivising the production of import-competing commodities.

While the removal of tariff protection seems the logical explanation for such a decline in NRAs, the manner in which the depreciating exchange rate has affected the import-competing sector needs dual consideration. As highlighted, an exchange rate depreciation on the output side would lead to implicit support for the import-competing sector. However, on the input side, the same depreciation would increase the costs of imported inputs, thus raising the cost of production. Given this, and without sufficient productivity gains, if the relative rise in output prices is lower than the relative rate at which input costs are rising, the onset of a cost price squeeze is inevitable (Tweeten & Griffin, 1976).

Consequently, while attempting to fulfil international trade agreement obligations in terms of the movement towards free trade, the removal of import-protection policies is justified from a welfare perspective (Anderson & Van Wincoop, 2001). However, the results of the NRA to the importables sector in Figure 5.1 amplify an important aspect. Given the global trend of import tariff removal, the transformation of an import-competing sector from one that is protected by tariffs to a more open, zero-distorted sector needs to be conducted with caution. What the overshooting of the study's NRA to importables below zero is suggestive of is an import-competing agricultural sector having lost import protection on the one hand, while concurrently being faced with a cost price squeeze through the depreciation of the South African rand. This results in a sector fighting for survival, rather than being able to attempt productivity gains.

An analysis of the NRA trends regarding individual commodities covered in this study aids in understanding the aggregated estimates in Figure 5.1. While intense industry knowledge is required in order to adequately justify the commodity-specific NRA trends, an analysis of individual commodity trends according to border protection measures, as well as in the context of the exchange rate trends, aids substantially in the understanding.

5.3.1.3   *Commodity Trend Drivers*

5.3.1.3.1   Field Crops

Of the four major field crops for which NRAs were estimated in the study, white maize was the only commodity classified as exportable. Both wheat grain and sunflower seed remained import-competing commodities for the entire period, while yellow maize was classified as exportable throughout the period except in the years 2006 and 2007, when domestic crop failures drove the need for increased imports (SAGIS, 2017).

The NRA to white maize continued its declining trend, which had started in the mid-1980s, throughout the study period. While remaining consistently negative and fluctuating between the -20% and -40% bands, the three-year NRA average to white maize rose only slightly during the first three years of the

study, reflecting the two-year dip in production in 2006 and 2007. From 2005 (± 6.1 million tons) to 2006 (± 4.4 million tons), the production of maize in South Africa declined by around 30%, forcing surplus stock reserves to be utilised (SAGIS, 2017). Production volumes were even lower in 2007 (± 4.3 million tons) than in 2006, requiring stock reserves to be supplemented with a small volume of imported white maize.

The decreased domestic production in 2006 and 2007, coupled with increased domestic demand for white maize, resulted in an almost doubling of producer prices for white maize between 2005 and 2007. This, in turn, led to the domestic price moving closer to import parity, which resulted in an increase in the NRA average over this period, as depicted in Figure 5.2. Although not as extreme as in the earlier years of the study, the decreased production in 2011 and 2013 also raised domestic prices through the same price mechanism as in 2006 and 2007. This translated into a slight improvement in the NRA average in the latter years of the study, as can be seen in Figure 5.2 by the slight upward trend from 2011.

In stark contrast to the NRA for white maize, the NRA for yellow maize remained positive throughout the period. While classified as import competing in 2006 and 2007, the import tariff was only 1,72% in 2006 and 0% in 2007 (SAGIS, 2017). Furthermore, domestic production was substantially lower in these two years than in the period surrounding 2006 and 2007. However, the domestic producer price remained substantially above the referenced world price in 2006, while the domestic price was strongly aligned with the world price in 2007. This caused a dip in the estimated NRA average in 2007 to close to zero, as the theoretical "price wedge" between the domestic and free market price (world price) was negligible.

However, the broad motivation for maintaining support for yellow maize production needs to be considered in the light of the final primary use of the commodity being animal feed. Although not exhibiting as large support estimates as can be seen in the mid-1980s (see Figure 5.2), the declining trend in estimated NRAs to yellow maize production seen up to the early 2000s has evidently been halted. The constant support over the past more than 10 years is suggestive of the need to locally secure yellow maize supply as an input into the animal feed-processing sector. This ensures an in sorts insulation from global yellow maize supply shocks and limits animal protein price inflation being driven by global grain shortages.

Given the constant growth in disposable income of South Africans, and the accompanying shift from plant to animal proteins, the security of the primary input into the production of animal proteins will naturally grow in prominence. Esterhuizen (2015), for example, points out how the per capita consumption of poultry meat (mainly broiler meat) increased by almost 80% between 2000 (21,5 kg)

and 2014 (38,5 kg). The reliance of animal protein producers on yellow maize together with soya thus implies that it is in the best interests of policies and market conditions to ensure adequate support for the production of yellow maize. This plausibly supports the positive NRA for yellow maize estimated in this study.

NRAs for both wheat grain and sunflower seed displayed no drastic trends or sudden reversals in the period. However, both of these import-competing crops' NRAs remained negative, with wheat grain turning negative in 2005 and sunflower seed having turned negative in 1994. While sunflower seed displayed a slight improvement in NRA over the study period, wheat grain experienced a deterioration in NRA, with the NRA at its lowest in 2014 – at -14,6%.

Although import competing, the implicit protection on the output side of wheat grain production via the deterioration of the rand does not seem to have been passed on to primary producers. Furthermore, contributing to the decrease in NRA measures is the considerable decline in the import tariff of wheat during the period leading up to the studied 10 years. This is evident in the halving of the annual average wheat tariff from 16% in 2001 to 8% in 2002, followed by a decrease to 2% in 2005. Subsequent to the studied period, however, the wheat tariff was re-instated at a level of 17% in 2015 and 38% in 2016 (SAGIS, 2017).

Therefore, a considerable and rapid shift in the market and policy environment in which wheat producers were operating prior to and throughout the studied period contributed significantly to the steady decline in NRA. All output price protection of wheat producers was removed rapidly, leaving them with little time to adapt. Compounding this was the rapid depreciation of the rand, which was evidently not passed down to producers on the output side while. on the input side, it was likely to have caused considerable inflation in production input prices.

In addition to this, the gradual decline of the estimated NRA in the study (Figure 5.2) has a tendency to underestimate the extent to which wheat producers were being "taxed" by the policy environment that they faced. This when considering the higher quality standards of local wheat as opposed to imported wheat. As highlighted by Van der Merwe *et al*. (2016), wheat prices in the local market are dictated by the lowest quality import parity price in the global markets. Therefore, a comparison of domestically produced, higher quality wheat to inferior quality global wheat would yield a smaller price wedge as a comparison between an equivalently high-quality global alternative. This quality mismatch results in the distortion estimate of the study being representative of a smaller price wedge between the domestic and international market than should be the case.

Sunflower seed NRAs showed the most consistent values among all covered commodities throughout the period, remaining within the -11% and -14% bound for all the years of the study. In contrast to other import-competing commodities, the implicit exchange rate-driven cost price squeeze did not drive a decline in NRA values in sunflower production. Furthermore, the import tariff on sunflower seed imports remained constant throughout the period, at 9.4% (ITC, 2017b). The consistent tariff protection of sunflower producers, together with the industry's evident resilience against the depreciation of the rand, together contributed to the lateral trend of NRAs for sunflower seed, as seen in Figure 5.2.

5.3.1.3.2   Livestock Products

Although the three covered livestock products were classified as import competing for the period, the degree to which producers of the individual livestock commodities competed with imports varied significantly. For both beef and mutton, South Africa approached self-sufficiency, with imported volumes of beef falling to below 20 000 tons in 2014 and mutton to less than 3 000 tons (ITC, 2017a). This occurred while the domestic consumption of beef increased significantly, from 825 000 tons in 2005 to 1 023 000 tons in 2014, and the consumption of mutton plateaued to a value of 186 733 tons in 2014 (DAFF, 2016).

On the other hand, poultry producers were forced to compete rigorously with imports, while domestic consumption grew by in excess of 30% from 2005 until 2014 (DAFF, 2016). This consumption growth was accompanied by a growth in imports of 83.5% over the same time period, leading to domestic producers losing in excess of 5% market share to imports (ITC, 2017a). The consequent picture for the poultry industry over the time period was an industry that moved in the opposite direction to self-sufficiency, while being faced with increased import competition.

The large peak and subsequent decline in the estimated NRA to beef production over the period stands out clearly in Figure 5.3. However, the extreme NRA highs from 2005 to 2008 need to be interpreted with caution, given that the protection for producers was against a small volume of imports. These imports were of South American origin and originated from three countries with excessively high ad valorem-equivalent tariff[5] levels to South Africa with respect to beef. The decline in the NRA from 2006 to 2014 corresponds with a trade substitution of the highly tariffed South American beef imports with imports from Namibia and Botswana – both with zero import tariffs into South Africa.

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[5] Weighted average tariff (volume) of products HS 0201 and HS 0202, as is consistent with Kirsten *et al*. (2009).

By the end of the period, more than 85% of the small volume of beef imports into South Africa were from Namibia and Botswana. This is compared to 0% of imports coming from Namibia and Botswana in the period 2005 to 2007 and less than 1% in 2008 and 2009 (ITC, 2017a). Therefore, under a steady exchange rate and with a movement to regional self-sufficiency, the NRA to beef production rapidly approached zero leading up to 2011. This largely proves that the estimated NRA measure was skewed due to the highly tariffed South American imports.

However, while South African beef producers were experiencing a close to zero (but positive) distorted policy environment in 2011, these distortions turned negative in the three years post-2011. Given that the average ad valorem tariff for the small volume of imports declined from 24% to 4% from 2011 to 2014, beef producers all but lost the import protection, albeit on an extremely small volume of imports.

Potentially driving the negative NRAs estimated from 2012 to 2014 is the rapid depreciation of the rand from 2012 (Figure 5.8). Given that imports of beef are largely negligible, the depreciation would not have resulted in implicit output price protection for beef producers. However, the depreciation would have driven input costs up both directly and indirectly through raising the production costs of key inputs such as feed. The combination of the above is reflected in the strongly negative NRA for beef during the last three years of the study.

In contrast to beef, the NRA for sheep meat remained close to zero for the majority of the period. Like beef, imports of sheep meat all but diminished over the 10-year period, with less than 3 000 tons of sheep meat imports in 2014 compared to more than 30 000 in 2005 (Mathole, 2017). However, while declining imports occurred together with rising domestic consumption in the case of beef, sheep meat imports declined while domestic consumption plateaued.

The decline from an estimated NRA to sheep meat production of 17.5% in 2006 to -1.5% in 2009 (see Figure 5.3) was driven by the reduction in imports and thus smaller measured NRAs. However, in contrast to beef, estimated NRAs to sheep meat remained surprisingly close to zero for the last six years of the study. The measured NRAs appeared resilient to the rapid depreciation of the rand from 2012, dipping only slightly to -4.5% in 2012 but then quickly recovering to close to zero in 2013 and 2014. This resilience in the face of exchange rate depreciation indicates that sheep meat production was largely unaffected by increased input costs as a result of this depreciation. This is a unique feature of the sheep meat industry when compared to all of the other industries discussed thus far, and is possibly due to the extensive, low-input production systems characteristic of sheep meat producers in South Africa. However, the sensitivity of inter-industry production costs to exchange rate fluctuations would be required in order to confirm this proposition.

As highlighted earlier in the discussion, the poultry industry was the only livestock industry of the three covered in the study that experienced increased imports over the period. The most significant increase in these imports occurred between 2008 and 2012, when poultry imports increased by 83% – from 220 034 tons to 403 140 tons. This time period corresponds to an appreciation of the rand and a slight decline in the average ad valorem tariff, making it conducive for poultry imports to increase rapidly.

However, the average estimated NRAs between 2009 and 2012 do not reflect a considerably deteriorating policy environment for poultry producers. In fact, an improvement in NRAs is seen from 2009 until 2010, followed by a two-year decline thereafter to a level of -10.1%, 1,7% above the three-year average estimate in 2009 (see Table 5.1). This suggests that the effect of the appreciation of the exchange rate on input costs over this period had significant input cost-relief consequences, which counteracted the implicit decrease in protection on the output price side caused by the appreciating exchange rate.

The 2009 to 2012 stabilisation of estimated NRAs was short lived in terms of the long-run trend in estimated NRAs for poultry producers. As evident in Figure 5.3, the NRAs to poultry producers declined significantly throughout the 10 years studied. While the average poultry ad valorem tariff remained mainly consistent throughout the period, the decline in estimated NRAs is largely attributable to the two periods of rand depreciation on either side of the discussed period from 2009 to 2012. Both the period of NRA decline from 2005 to 2009 and that from 2012 to 2014 occurred during times when the rand was depreciating (orange and red arrows in Figure 5.8).

The hasty decrease in NRAs in the two periods accompanying the depreciation of the rand highlights the deterioration of the policy environment in which poultry producers were operating, driven by rapidly rising input costs. This trend was aligned with that of some of the other importable commodities discussed, such as wheat grain, and highlights the implicit effects of the exchange rate on agricultural producers' incentives.

5.3.1.3.3   Fruit Exports

Given the fact that no export-intervention measures such as export subsidies or taxes are in place for exportable fruit products, fruit export producers remain open to global market competition. Therefore, with no explicit policy intervention, the implicit effects of the exchange rate on fruit export producers characterise the policy environment that faces them. Consequently, the NRAs contained in Figure 5.4 and Figure 5.5 largely capture the distortions to producer's incentives purely as a result of fluctuations in the South African exchange rate.

For all three of the covered fruit exportables, a definite dip in measured NRAs is evident from 2007 until 2009 for oranges and until 2010 for apples and table grapes. During this period, exported volumes of oranges and apples experienced slight declines, while table grape exports remained at a constant level (DAFF, 2016). Furthermore, the exchange rate was depreciating between 2007 and 2009, which on the output side would implicitly have been incentive increasing for fruit exporters. Thus, the observed dip in NRAs is an anomaly that requires further analysis of the intrinsic workings of the individual industries and their respective global market environments in order to be explained.

However, the long-run trend in NRAs for both apples and oranges remained upward sloping, as did export volumes of apples and oranges over the period. Recalling the implicit assistance on the output side afforded to exporters via a depreciating exchange rate, export volumes of apples grew by more than 50% between 2005 and 2014, while the export volumes of oranges increased by around 48% over the same period (DAFF, 2016). This tremendous growth in exports reflects that the prolonged depreciation of the rand, which started in 2005 and accelerating from 2012, implicitly assisted apple and orange exporters on the output side significantly more than what it concurrently impeded them through raising input costs.

Throughout the period of prolonged exchange rate depreciation, table grape exporters experienced a steady decline in export volumes, from 240 656 tons in 2005 to 210 597 tons in 2013, before recovering in 2014 to a value of 253 211 tons (DAFF, 2016). This coincided with a decline in estimated NRAs from the high level estimated in 2007 to just above 10% in 2014. Although still positive, the trajectory of the NRAs to table grapes is suggestive of an export industry that possibly has been constrained equally on the inputs side – by the persistent depreciation of the rand – as it has been assisted implicitly on the output side. Therefore, although South African exporters have increased in competitiveness, as is evident from the decline in the REER (Figure 5.10), table grape exporters have been unable to raise export volumes, possibly due to adverse exchange rate effects on the cost of production.

Although declining for the first half of the study, the aggregate NRA to exportable commodities experienced a reversal in this trend after 2011. This reversal coincided with a rapid depreciation of the rand and a consequent increase in exports and estimated NRAs for both oranges and apples. This, together with the positive NRAs for table grapes, drove the aggregate NRA for exportables upward post-2011 as fresh fruit maintained their significant share in South Africa's export portfolio. Thus, while the aggregate NRA for exportables initially declined during the studied period, as it had been since the mid-1980s (see Figure 5.1), the competitiveness gains realised via the depreciation of the

rand have significantly altered the incentives and policy environment under which producers of exportable commodities now operate.

5.3.1.4 *Aggregate Distortion Estimates Conclusion*

The commodity-specific discussions have highlighted how each industry reacted uniquely to the prevailing policy environment over the 10-year study period, and what drove these reactions across industries. However, what is clear on an aggregate level is that, since 2008, primary agricultural producers have been operating in a policy environment that is incentive reducing. This negative aggregate environment initially was strongly influenced by the negative NRAs to white maize, which pulled the NRA to export-competing commodities firmly into negative territory due to its significant share in the value of production. However, during the latter years, since 2011, the aggregate NRA to primary agriculture were strongly influenced by the persistent decline in support estimates to import competing commodities.

These contradictory trends between the exportable and importable commodity groups observed in the second half of the period were primarily as a result of the opposite responses of these two broad primary sectors to the rapid depreciation of the South African rand post-2011. While the implicit taxation via increased production costs as a result of a depreciated rand in general had an impact on both the importable and exportable sectors, the impact of this depreciation on output prices differed.

The import-competing sector, having been faced with continued reductions in import tariffs, was implicitly supported via the rand depreciation on the output side. This was due to imports being relatively more expensive domestically, enabling domestic producers of competing products to increase their price. However, the NRAs reveal that. although explicit policy measures such as import tariffs have succeeded in moving towards a zero-distorting policy environment, the concurrent depreciation of the rand has adversely affected import-competing producers, primarily through the initiation of an exchange rate-driven cost price squeeze.

The combination of the above has therefore forced import-competing producers to rapidly adapt to global market forces on the output side, while being faced with rising input costs through the depreciating exchange rate. This has had a compounding effect on the policy environment facing import producers, and resulted in distortion estimates negatively overshooting the ideal zero distortion situation. The distortion estimates in Figure 5.1 reveal just this, and are evidence of a sector facing decreasing incentives to produce, and that these are in a firmly downward spiral.

Producers of exportables, on the other hand, have generally been assisted implicitly via the depreciation of the rand on the output side, coupled with increasing international competitiveness

indicated by the decrease in the REER index in Figure 5.10. This has enabled exporters, particularly fruit exporters, to rapidly increase exports to the global market. Furthermore, due to the upward trend in the NRA to exportables in Figure 5.1 initiated post-2011, it is clear that the implicit output assistance via the depreciating exchange rate has substantially outweighed the implicit exchange rate-induced input taxation. This is in stark contrast to the importables sector, and is likely driven by the fact that producers of exportables have had to compete in the global market without any form of explicit policy assistance. Thus, the sector is engrained with efficiency, enabling it to hugely capitalise on the implicit exchange rate-induced output assistance. This is in comparison to the import-competing sector, which historically has been supported by explicit border policy measures and has been forced to gain efficiency via the reduction of these border support policies in the face of rising costs of production as a result of a depreciating exchange rate.

Given the difference in NRAs between the covered commodities, there are considerable efficiency gains to be realised through the phasing out of the differences in inter-industry NRAs. However, the phasing out of these differences will require active policy instruments in order to counteract the implicit variation in NRAs caused by the South African exchange rate. These variations are unpredictable and are being increasingly politicised, as the dynamic macroeconomic and political environment often culminates in a change in value of the South African rand. This makes the formulation of effective policy focused on agricultural producer incentives near impossible to prescribe and implement.

What the distortion estimates to primary agriculture have highlighted in this study, however, is that the majority of primary agricultural production value in South Africa are being generated by industries with disincentives to produce that are intensifying. Furthermore, if the trends between the NRA to importables and NRA to exportables are continued, the policy incentives could soon reach a point at which contradicting results in terms of foreign exchange earnings are being achieved.

Albeit implicitly driven via the exchange rate depreciation, this contradicting situation in theory would occur when the NRA to exportables turns positive, with the NRA to importables continuing its trend in negative territory. Under this situation, positive NRAs would be incentivising exporters to produce foreign exchange-earning exportable commodities. At the same time, producers of importables are facing decreased incentives to produce, reflected in negative NRAs, and thus forcing domestic demand of importables to be met via increased imports and a consequent outflow of foreign exchange.

Therefore, the extent to which producers, particularly from formerly explicitly protected sectors, are disincentivised by the depreciation of the South African rand requires further investigation. Disaggregating all forms of policy assistance for agents within a specific value chain can shed light on

the extent to which policy incentives are transmitted and absorbed throughout a value chain. In line with the objectives of this study, the following discussion highlights this disaggregation of the distortion estimates for the South African wheat value chain through an in-depth discussion of the results of the NRAs to wheat farmers, wheat millers and wheat consumers, as presented in Figure 5.7.

5.3.2   Disaggregated Results

As highlighted in Section 2.6.2, the South African wheat value chain was extensively regulated through a single marketing channel between 1937 and 1996. Following the transition to a free market, the wheat milling industry grew increasingly concentrated, with fewer firms controlling the market. This culminated in a wheat flour cartel being active from 1999 until 2007, through which wheat flour millers were able to extract excessive rents from the market at the expense of both wheat grain producers and wheat flour consumers.

The aggregate NRA to wheat grain production in Figure 5.2 remained negative throughout the 2005 to 2014 aggregate period, reflecting that the production of wheat up to the point of processing was disincentivised during this time. Importantly, this aggregate measure reflects the incentives faced by both farmers and wheat traders, as both of these agents are involved in "delivering" wheat to the processing market. This aggregated estimate provides no information on the incentives facing wheat millers and wheat flour consumers, and therefore fails to shed light on intra-industry distortions between value chain agents.

In line with the objectives of this study, Figure 5.7 presents the distortion estimates for wheat farmers, wheat millers and wheat flour consumers, highlighting the large disparities between the incentives facing these three value chain agents between 2000 and 2014. The continued negative NRA for wheat farmers reflect the fact that all forms of tariff support were drastically reduced from 2001, along with an exchange rate-driven cost price squeeze (Section 5.3.1.3.1). However, the trends seen in the NRAs to wheat millers and wheat flour consumers need to be considered together and within the context of the competitive nature of the wheat milling industry.

5.3.2.1   *Competitiveness and Market Structure*

The market structure of the wheat milling industry has been and continues to be notoriously concentrated between four firms, namely Pioneer Foods, Tiger Brands, Premier Foods and Foodcorp (Mncube, 2013). However, although the industry is highly concentrated, the only agent within the industry that was deemed to be competitive via the relative trade advantage (RTA) measure was wheat millers, as found by Van der Merwe *et al*. (2016) in their investigation of the competitiveness of the South African wheat industry. Their results, however, highlight a significant decline in the

competitiveness of wheat millers from the early 2000s until 2007. Figure 5.11 depicts the RTA for wheat flour from 2000 until 2012, calculated by Van der Merwe *et al*. (2016). This is presented together with RTA measures for wheat flour, as calculated by Boonzaaier (2017), in order to have a comparable time period to that being analysed. Positive RTA values indicate competitiveness compared to international peers, whereas negative values signify a lack of competitiveness. Zero RTA values indicate marginal competitiveness.
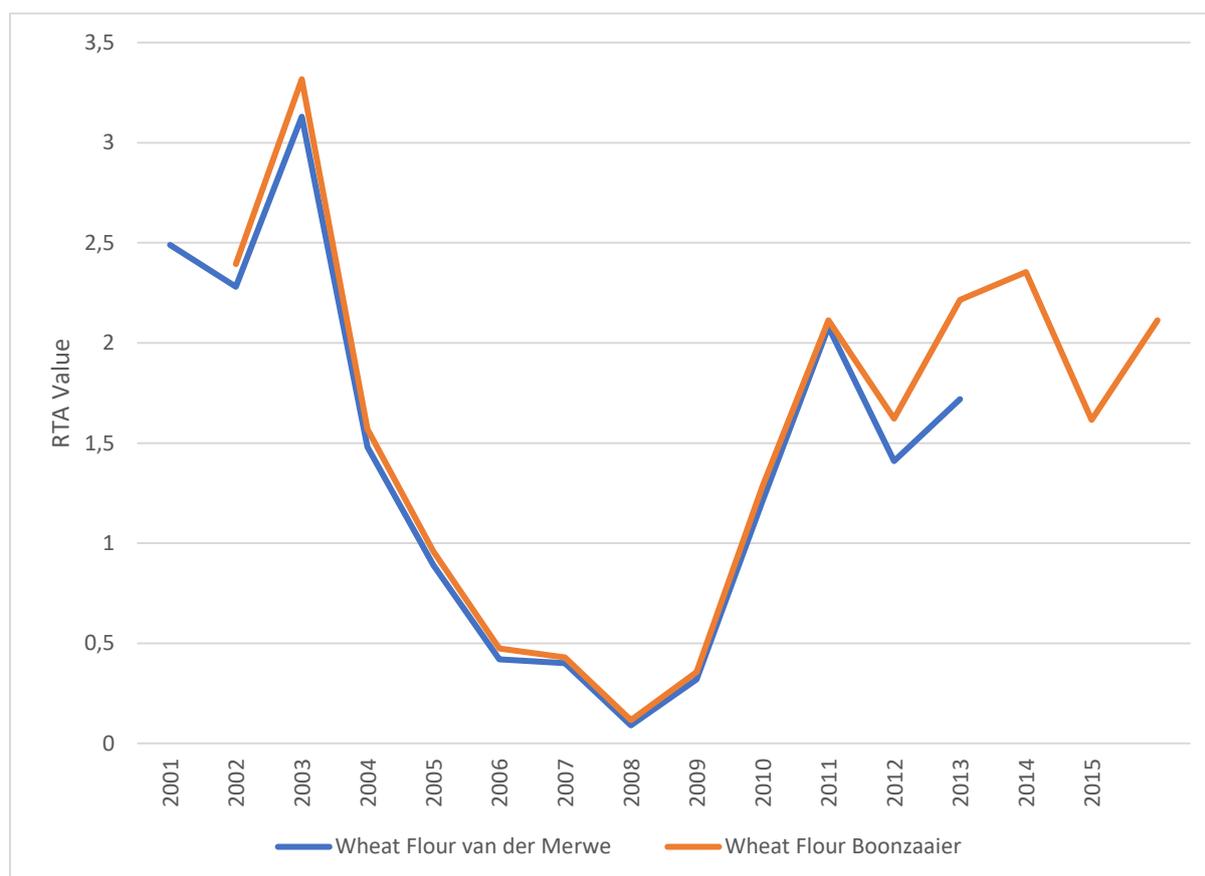

Figure 5.11. RTA competitiveness measure of wheat flour, South Africa, 2000 to 2015. Comparison between Boonzaaier and Van der Merwe data.
Source of data: Van der Merwe et al*. (2016) and Boonzaaier (2017)*

The RTA trend depicted in Figure 5.11 highlights a clear decline in the international competitiveness of wheat millers during the last four years that the wheat cartel was active (2003 to 2007). However, when competitiveness is viewed in relation to the NRA measures of wheat millers, a striking relationship is revealed. Figure 5.12 combines the NRAs for wheat millers calculated in this study with the competitiveness RTA measures calculated by Van der Merwe *et al*. (2016) and Boonzaaier (2017) respectively.

85
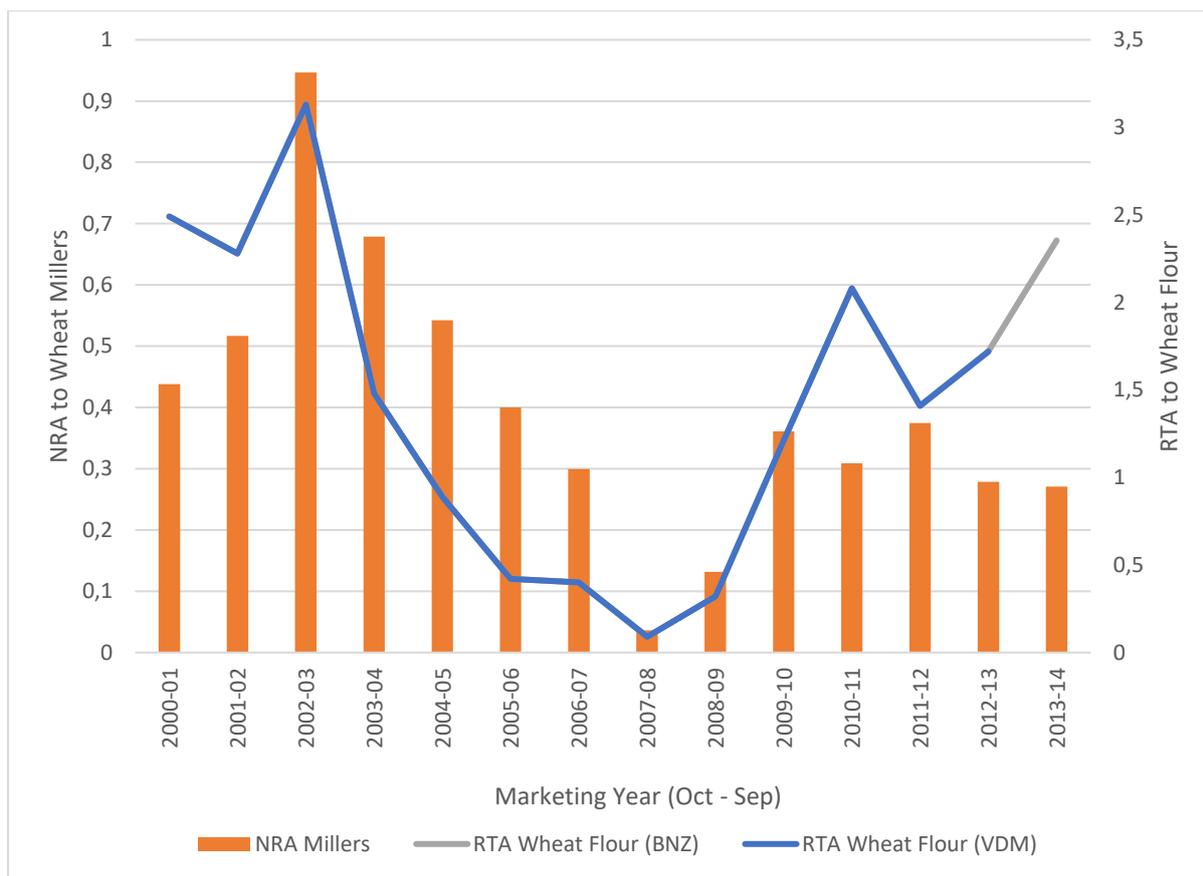
Figure 5.12. NRA to wheat millers and RTA of wheat flour, South Africa, marketing years 2000/2001 to 2013/2014.
Source of RTA data: Van der Merwe et al. *(2016) and Boonzaaier (2017)*
Source of NRA data: Author's own calculations

Figure 5.12 shows the peak of the NRA to wheat millers as well as the competitiveness peak of these agents during the 2002/2003 marketing year. The NRA value of close to 0.95 in this year reflects the fact that wheat millers were receiving close to double the price for their wheat flour than they would have been receiving in a free market. Unsurprisingly, the competitiveness of South African wheat millers was at its highest point of the 14-year study period during this marketing year. In line with this, Mncube (2013) found that cartel members' profits were approximately double during the collusion years than they were in the post-collusion years.

Arising from this is the intuitive question about how the large positive disparity arose for wheat flour in an open market system. Mncube (2013) highlights the fact that, due to the concentration in the wheat milling industry, the four major firms also had substantial control over imports of wheat grain and ensured they paid the lowest possible import price for this wheat grain. This contributed to supressing the domestic producer price for wheat grain and thus ensured a lucrative processing margin potential. Furthermore, the cartel (in place up until 2007) ensured both fixed selling prices and

market allocation of wheat flour. This further increased margins on the output side of the processing level and thus enabled excessive rents to be extracted.

It therefore should come as no surprise that the logical deduction from Figure 5.12 is that the presence of an over-enabling market and policy environment for wheat millers is what drove their international competitiveness. The decline of this incentivising policy support for wheat millers leading up to the cartel bust in 2007 corresponds nearly perfectly to the decline in the measured competitiveness levels over the same period. This consequently raises questions about the real competitiveness of South Africa's wheat milling industry if it were to be operating in an open, zero-distorted policy environment free of collusion. The results suggest that, during the "bust" year of the cartel, the measured NRA to wheat millers was just under 4% while the RTA was 0.09, which indicates near marginal competitiveness.

However, for the last six years of the period, NRAs were once again substantial and indicate that, in some years, wheat millers were receiving close to 40% more for their flour than would be the case under a free market. In addition to this, the competitiveness of wheat millers was once again strongly positive, in line with the incentivising policy environment. Although on a significantly smaller scale, these recent trends after the cartel investigation reflect the same environment that was evident during the cartel years, viz. positive NRAs and positive RTAs. This gives rise to the question whether the reforms and regulations initiated post-2007 have been successful in ensuring that collusion cannot manifest between millers.

While not directly in the scope of this thesis, the link between incentive distortions and competitiveness is interesting and requires extensive further research. However, from the results contained in this section, an important consideration that needs to be borne in mind in competitiveness studies is the degree of policy distortions in place and how these are contributing to either inflating or deflating the relevant industry's measure of competitiveness. One cannot simply assume that indicators of high competitiveness imply a highly competitive core industry, especially if the core industry is being faced by a policy and market environment that is incentivising production with price levels up to 90% higher than those under free market operation. The inverse of this statement is also justified and is of great relevance to this study due to its application to wheat farmers.

5.3.2.2   Intra-industry NRA Comparisons

The NRA trends presented in Figure 5.7 display three key trends. Firstly, the NRA for millers remained positive for all marketing years studied, although it declined up to the cartel "bust" year in 2007/2008 before increasing again thereafter. Secondly, the NRAs to both wheat farmers and wheat flour

consumers remained consistently negative throughout the period, with wheat consumers exhibiting substantially greater negative NRAs than wheat farmers. Lastly, the estimated NRAs between wheat millers and wheat consumers exhibited a strong negative correlation (-0.84), while the estimated NRAs between millers and farmers displayed a moderately positive correlation (0.51).

When considering the impacts of the nominal exchange rate on individual value chain agents, as in other importable industries, wheat farmers would be implicitly supported on the output side by a rand depreciation due to higher rand domestic prices for wheat grain. However, on the input side, the production costs of imported inputs would rise following a currency depreciation. A similar intuition would hold for millers, as imported flour costs would increase which would implicitly protect millers. Consumers, on the other hand, would face decreased support from a rand depreciation, as domestic flour prices would tend to increase, leading to higher retail prices for consumers.

The only explicit border policy change that occurred during the period was the lowering of the import tariff on wheat grain from 16% (% of CIF) in 2001 to less than 1% in 2004. Between 2004 and 2014, the import tariff saw no significant adjustments and remained between 0% and 3% (SAGIS, 2017). Isolating this tariff reduction shows that, although the removal of the tariff should technically lower the NRA to farmers, as a positive price wedge is being removed, the NRA to farmers in fact increased from 2000/2001 to 2003/2004. Theoretically, if the NRA to farmers was negative in the presence of an import tariff, as it was in 2000/2001 (-17%), the removal of a tariff should lead to a further decrease in the NRA, as the domestic producer price would decrease.

This anomaly in the movement of the NRA to farmers in response to the tariff removal gives rise to the question what the real impact of the tariff was on farmers. This is highlighted particularly when considering the exchange rate appreciation that occurred between 2001 and 2004, which would have implicitly decreased output support for farmers while implicitly increasing input support for farmers. Given the trends in the previously discussed importable commodities, the exchange rate tends to influence support estimates far greater on the input side than on the output side.

The overriding exchange rate effects on farmers' NRAs are exhibited throughout the rest of the period, as tariff protection was largely negligible. Evident from the exchange rate series in Figure 5.8 and the NRA to farmers estimates in Figure 5.7 is that, during time periods of exchange rate depreciation, the estimated NRA to farmers declined, whereas the NRA to farmers increased during times of appreciation. Thus, it is clear that the implicit impacts on wheat farmers' price incentives were driven primarily by the exchange rate and not necessarily by the import tariff in place. This questions the effectiveness of the protection provided to farmers by the wheat tariff.

The NRAs for wheat millers, on the other hand, exhibited an increase in NRA following the removal of the wheat grain import tariff and the appreciation of the rand over the same period. The appreciation of the rand, while resulting in decreased implicit output protection for millers, would furthermore increase input support through the decreased costs of imported inputs. Given that the major input into the milling industry is wheat grain, the removal of the import tariff leading up to 2004, together with the exchange rate appreciation, would have significantly decreased the input costs of millers and thus enabled greater processing margins to be realised.

However, the NRA for millers post-2003/2004 exhibit a rapid decline to close to zero in 2007/2008, signalling the breakup of the cartel. Interesting, however, is the fact that this decline occurred over a period (2003 to 2008) when the South African exchange rate did not depreciate nearly as much as in more recent years (2011 to 2014). Furthermore, this decline occurred during times when the removal of the wheat grain import tariff would have explicitly assisted wheat millers. Therefore, given the cartel's price-fixing agenda, the NRAs "conscious" decline suggests that there was perhaps anticipation from within the cartel of investigation and thus an impetus to align prices increasingly with those in the free market. This tendency contributed to reducing the disincentives facing consumers, as is evident from the opposite directions in which the NRA to millers and NRA to consumers moved over the period.

Therefore, there is evidence from these results to suggest that, while it was in place, the wheat cartel's presence absorbed the wheat import tariff benefits and consequently blocked its incidence on wheat grain farmers. Furthermore, wheat grain farmers were increasingly faced with implicit exchange rate incentive distortions, which predominantly affected production inputs, as the output impacts were governed by farmers' price-taking position at the liberty of the cartel and the lower quality of wheat grain imports. In addition to this, consumers were made to pay heavily for the anti-competitive behaviour of wheat millers through increased retail prices.

5.3.2.3   Conclusion on Disaggregated Estimates

The aggregate NRA measure to primary wheat grain production has indicated the challenging and worsening policy and market environment in which wheat production occurs in South Africa. While this was highlighted as being driven by the concurrent incidence of a depreciating exchange rate and the removal of tariff protection, the impact of intra-industry distortions could not be investigated given the nature of the aggregate measure. The empirical results of the disaggregated NRA approach enabled a key intra-industry comparison to be made between wheat farmers, wheat millers and wheat flour consumers with regard to the respective distortions facing these three value chain agents.

The ensuing disaggregated results have highlighted the extreme disparities in the way in which the market and policy environment altered the incentives of the three agents in the wheat value chain. While the discussion of these results in Section 5.3.2.2 centred on the impact of tariff removal, exchange rate depreciation and the presence of the wheat milling cartel, the results potentially have far wider reaching implications for the wheat industry and the manner in which policies are directed at specific value chain agents.

Despite it often being praised as a processing sector of high international competitiveness, the disaggregated results from this study highlight the substantial policy and market assistance afforded to wheat milling in South Africa. On the other hand, having had output price tariff protection all but removed over the period, together with input cost inflation via a depreciating exchange rate, wheat producers are often criticised for their inefficiency compared to their global peers. While this criticism is not unfounded on the basis of the competitiveness measures in the literature, the industry structure, as well as the intra-industry distortion estimates from this study, provide possible reasons for this perceived inefficiency.

The evident "bulge" of market power between the few firms at the processing level in the wheat value chain remains a toxic situation for all stakeholders in the industry, including the millers themselves. This market structure, in which a large number of wheat producers service a small number of millers who subsequently supply a large number of wheat flour consumers, concentrates market power and lobbying power at the processing level. As this study suggests, this situation enables millers to essentially self-regulate their market and, in doing so, force wheat producers to remain price takers while being able to dictate wheat flour prices through their control of supply. This market situation thus empowers millers to essentially extract all market and policy assistance out of the industry at the processing level, thereby blocking the majority of positive benefits from reaching wheat farmers and wheat flour consumers.

The intra-industry distortion estimates for the wheat industry reinforce this proposition, especially due to the fact that the period included NRAs for years either side of a cartel bust. If the years leading up to the cartel bust are interpreted as years during which wheat millers limited their self-regulating ability, up to the point where market regulation was instituted due to the Competition Commission's investigation, the negative impact of this self-regulation is evident. Where market regulation was enforced through the Competition Commission's investigation into the wheat cartel, millers' incentive distortions were largely negligible, while those facing consumers were at an all-time absolute low. Thus, the manner in which self-regulation by millers due to conducive market conditions distorted the incentives of consumers is evident. Furthermore, the means by which millers were able to utilise the

favourable policy environment in order to gain international competitiveness is highlighted by their loss of international competitiveness as a direct result of the decrease in market and policy support leading up to the year in which the cartel was bust.

Therefore, when considering the impact of explicit policy changes, such as the removal or implementation of a tariff, it is of great importance to consider the market structure of the specific industry, together with distortions facing the respective value chain agents within the industry. This is in contrast to the conventional approach of evaluating policy success or failure using measures that often culminate in a competitiveness index. What the disaggregated results of this study have highlighted is the need to consider quantitative support indicators when evaluating the performance of value chain agents. Although the wheat millers remain internationally competitive, a clear driver of this competitiveness is their position in the market and their ability "absorb" market and policy support. This is highlighted through the persistently large positive nominal rates of assistance estimated in this study. Therefore, their core industry competitiveness without substantial NRAs needs to be questioned.

On the other hand, wheat producers, who comprise a large number of farmers, are perceived to be uncompetitive and are often criticised for inefficient resource use. However, their position in the wheat value chain means they have minimal lobbying power, while remaining price takers. Furthermore, farmers remain exposed to exchange rate-driven input cost price squeezes, while not necessarily receiving the implicit positive output price benefits accompanying exchange rate depreciation. However, they persist with wheat production, albeit within a market and policy environment which disincentivises this activity. In addition to this, the study's results highlight how, over the 14-year period covered in the disaggregated approach, wheat farmers all but lost tariff protection within the first three years and were then faced with a sustained period of exchange rate depreciation, all while being price takers to a wheat-processing cartel.

Therefore, from the results of this study it is clear that two situations characterised the wheat value chain for the duration of the study period. Although being perceived to be uncompetitive internationally, wheat farmers on the one hand persisted with production under a forever challenging market and policy environment that persistently disincentivised wheat production. On the other hand, millers, who had been perceived to be exceptionally competitive internationally, had been left to self-regulate their market and collude while receiving substantial market and policy incentives to do so. These two situations are thus a conundrum for the wheat industry in South Africa and require further research in order to ensure better-directed support policies for agents. However, a review of the

current means used to evaluate the success or failure of the core competence of an industry is needed to choose which of the two situations is the better evil.

5.4   Conclusion

The content of this chapter forms the pinnacle of the entire thesis. In the presentation and discussion of the results of the empirical model, the aggregate distortion indicators have highlighted the contrasting policy environments facing primary producers of import-competing commodities in contrast to primary producers of exportable commodities. While individual industries face unique challenges, the NRAs highlight how, in general, producers of exportables are being incentivised by the general policy environment while producers of importables are being taxed. Although explicit border protection measures did play a role during the period, the major factor driving these different incentive levels was the contrasting impact that the long-term depreciation of the South African rand had on producers of importables as opposed to producers of exportables.

The seminal value chain extension applied to the South African wheat value chain uncovered extraordinary distortion estimate disparities between wheat farmers, wheat millers and wheat consumers. The NRA to farmers reflect a group of value chain agents who, during the period, had all major border support removed while being faced with rising input costs driven by the depreciation of the South African rand. This limited farmers' abilities to make significant productivity gains and increase their international competitiveness, and was further worsened by their price-taking position at the liberty of a wheat milling cartel.

The disaggregated support estimates for wheat millers and wheat flour consumers displayed a strong negative correlation, which highlights the negative impact that the collusion of millers had on consumers. In addition to this, the decline in support estimates to wheat millers. corresponding with the decline in their international competitiveness indicators leading up to the year of the cartel bust, questions the core competitiveness of the wheat processing sector if it were to operate under a zero-distorted environment.

Both the aggregated and disaggregated results thus confirm that, on aggregate, primary agricultural production in South Africa was disincentivised between 2005 and 2014. This was driven by the worsening disincentives in place for the production of importable commodities, driven primarily by an exchange rate cost price squeeze due to the long-term depreciation of the South African rand. This emphasises the vulnerability and exposure of South African agricultural producers to exchange rate shocks, albeit in an international trade environment tending towards free trade.

Furthermore, the disparities between inter-industry NRAs and intra-industry NRAs within the wheat industry highlight the potential efficiency gains to be realised through the phasing out of these disproportionate distortions. In addition, the disaggregated results indicate the need for urgent attention to be paid to addressing the disproportionate NRA levels between agents in the wheat value chain, which are approaching the levels that were seen during the active years of the wheat cartel.

Chapter 6   Conclusions and Recommendations

6.1   Introduction

This study has produced updated and detailed estimates of the distortions to primary agricultural producers' incentives in South Africa, as well as to three selected value chain agents in the wheat industry. From the results it is clear that, in the years from 2005 to 2014, primary agricultural producers experienced opposing incentives to produce, depending on the trade status of their commodity. While the producers of exportables experienced positive incentives to produce over the period, producers of importables were faced with negative incentives to produce. Although explicit border support measures and the lack or reduction thereof affected the distortion estimates, the implicit impact of the long-term depreciation of the South African rand was identified as a major driver of the estimated results. The relative exposure of the respective agricultural industries covered in this study to the currency depreciation strongly determined the magnitude of the distortion estimates and consequently highlighted the scope for efficiency gains to be realised through the phasing out of inter-industry producer incentive disparities.

Furthermore, the study's results provide critical insight into the manner in which the market power "bulge" at processing level in the wheat value chain has harmed both producer incentives as well as the incentives of consumers to consume wheat flour. The results highlight the need for effective market regulation within the wheat industry, as well as question the core competitiveness ability of the respective value chain agents.

This chapter presents a final overview of the study by providing a brief summary of each step of the study's approach. This is followed by a concise summary of the major findings and the implications that these findings have for policy makers and industry role players. Lastly, the scope for further research is presented in a manner that will enable this thesis to be a catalyst in driving a broader policy formulation approach.

6.2   Thesis Overview

Strongly related to the political economy of agriculture, this thesis has firstly highlighted the arguments present in the literature regarding the rationale behind government intervention in agriculture. This involved an analysis of the historical motives and patterns of intervention, as well as the discrepancies in this intervention between developed and developing countries. Centred on the general support for agriculture in the developed world and the consistent taxation of agriculture in the developing world, the structural transformation accompanying economic growth and development provided substantial explanations for the motives behind the intervention patterns.

Having provided a backdrop to the motives and patterns of state intervention in agriculture, the thesis then progressed to documenting global attempts that had comprehensively attempted to measure the magnitude of this intervention and furthermore to quantify the impact on producer and consumer incentives. This involved firstly providing a theoretical discussion of the theory of price distortions before highlighting the welfare implications of price distortions. The applicability of the theoretical approach to price distortions was then linked to agriculture, with the insights from Anderson *et al*. (2008) key in this regard.

The literature study portion of this thesis progressed to providing a historical perspective of price distortions in agriculture, before reviewing three major studies that had successfully quantified price distortions in agriculture across countries. While each was successful in its own regard, the primary purpose of the review of the studies was to highlight the suitability of the Anderson methodology in achieving the stated objectives of this thesis. In addition to this, the review enabled the downfalls of the respective studies to be examined, which paved the way for the seminal application of a disaggregated approach aligned to the methodology of Briones Alonso and Swinnen (2015) to be applied to the South African wheat industry. A motivation for a disaggregated approach to estimating distortions to incentives was then presented, followed by a brief outline of the structure and dynamics of the South African wheat industry.

Given the extensively documented theoretical context and comprehensive selection of the empirical approach used in this thesis, both the aggregated and disaggregated empirical methodologies were presented in a general form. However, due to the empirical nature of this thesis, a detailed discussion of the application of the respective general frameworks to the South African case was conducted, with a strong focus on adequately highlighting the sources of data used. This tailored approach synthesised the theoretical discussion as well as the empirical methodology into a framework applicable to South African agriculture and positioned to fulfil the thesis's core objectives through the generation of a range of distortion estimates.

The research results and findings were presented and discussed comprehensively, with a strong focus on the trend drivers of the respective commodity distortion estimates. Further policy and political explanations were also sought during the discussion in order to provide an objective presentation of the possible undercurrents observed in the distortion estimate results.

6.2.1   Summary of Major Findings

The key findings of this thesis were two-fold and separated into the aggregated distortion estimates for primary agricultural production and the disaggregated distortion estimates for the three value chain agents covered in the wheat value chain.

On an aggregate level, the clear result is that, between 2008 and 2014, primary agricultural producers operated in a policy environment that was incentive reducing. Driving these negative incentives to produce was the implicit strain placed particularly on the importables sub-sector as a result of the continued depreciation of the South African rand. While not necessarily a result of explicit policy factors as opposed to political factors, this depreciation provided implicit assistance to the exportable sub-sector through higher output prices. However, as highlighted in the detailed discussion of the exchange rate indicators, the nominal depreciation could further assist exporters if input price inflation were to be brought in line with that of South Africa's trading partners. This would ensure that maximum competitiveness gains are realised by exporters as a result of the nominal exchange rate depreciation.

The results of this thesis on the disaggregated wheat value chain highlight the tremendous disparities between the incentives facing wheat producers, wheat millers and wheat consumers. Although driven by a lack of efficient and effective market regulation at the processing level, the magnitude to which the wheat flour cartel was able to assert market dominance at the expense of both wheat grain producers and wheat flour consumers is indeed alarming. The disaggregated results highlight the need to avoid evaluating aggregate distortion estimates in isolation, and to ensure adequate consideration is afforded issues of market power and perceived competitiveness. However, as it stands, the results of the study provide empirical proof that, within the wheat value chain from 2000 until 2014, both wheat grain farmers and wheat flour consumers operated in an incentive-reducing environment, while wheat millers operated in an environment with substantial incentives to produce.

6.3   Implications for Policy Makers and Industry Players

6.3.1   Aggregate Results

Given the major findings of this thesis being as a result, firstly, of the long-term depreciation of the South African rand (aggregate results) and a lack of efficient market regulation (disaggregated results), the implications for both policy makers and industry players are several. The results do not oppose the zero-approaching trends in explicit border protection for the respective primary agricultural commodities, but rather call for consideration of both this tariff-reducing approach and broader macroeconomic occurrences.

The extensive literature study component of this thesis adequately highlighted the welfare benefits experienced when transitioning towards a zero-distorting environment. The focus was primarily on tariff removal as a catalyst for altering incentives for agricultural producers. Although incentive distortions as a result of exchange rate policy are provided for both within the literature and in the applied methodology of this study, these provisions focus on a dual exchange rate system where

importers and exporters face different exchange rates. However, the results of this thesis highlight how even in a floating exchange rate system, as is the case in South Africa, the sustained depreciation of the rand had a significant effect on the incentives of production facing primary agricultural producers.

Therefore, given the South African situation, the transition towards zero explicit trade barriers needs to be considered in combination with the macroeconomic and political environment of the domestic economy. The impact of tariff removal on the domestic agricultural sector was unsurprisingly found to have reduced output protection, particularly for agricultural importable commodities. This was coupled by the overarching impact of the weakened exchange rate, namely a significant rise in the cost of production. This left producers of agricultural importables having to try to make significant productivity gains in order to compete internationally despite reduced import protection while experiencing rising input costs driven by the depreciation of the South African rand. This toxic situation tremendously limits the abilities of the producers of importables to adapt to global competition in the domestic market, and highlights the need for policy makers not to overlook the macroeconomic challenges reflected in the exchange rate facing producers.

When determining border protection rates it is thus imperative for policy makers to consider the relative distortion impacts of the exchange rate on the producers of agricultural commodities. Furthermore, following changes to the macroeconomic environment as a result of the political or global economy, an adequate review is needed from the government's perspective in order to determine the policy incentives facing the producers of individual commodities. Failure by government to eliminate the traditionally isolated approach to border protection will compound the challenges facing producers.

6.3.2   Disaggregated Results

On aggregate, the situation described above was found to be no different in the wheat industry, with wheat production strongly disincentivised. The disaggregated results furthermore highlight the need to efficiently regulate markets and to include the market structure and its implications when constructing policies. The results of this thesis paint a bleak picture for the wheat industry and the manner in which policy incentives have been distorted throughout the value chain.

While the competitiveness of value chain agents often underpins their presumed efficiency, the distortions facing individual agents needs adequate parallel consideration. Although shown to be non-competitive in various studies, wheat production in South Africa continued throughout the period. This happened in the face of decreased output protection through the removal of tariff protection, as well as sustained input price pressure as a result of the depreciation of the rand. The culmination of

this situation was reflected in the negative distortion estimates to wheat farmers, thus reinforcing the challenging market and policy environment under which farmers had to produce. This challenging environment in which farmers found themselves was furthermore compounded by their price-taking position in the market. Yet, although being faced by a policy environment exerting downward pressure on their production margins, non-competitiveness was concluded through isolated competitiveness indicators and used as an argument against the primary activity and the support thereof.

On the other hand, wheat processing took pride as the lone activity in the wheat value chain that was perceived to be globally competitive and assumed to be highly efficient. This perception of high competitiveness and efficiency prevailed for an activity operating in a market and policy environment that highly incentivised wheat processing. Furthermore, the market structure and the lack of efficient regulation enabled collusion between processors, empowering them to exert market dominance and tailor the market and policy environment in their favour. Concurrent with the high positive distortion estimates are high measured competitiveness indicators for processors over the period. These competitiveness measures shaped policy makers' stance towards industry value chain agents.

However, this study shows that, leading up to the year in which the cartel was bust, the ability of the cartel to tailor the market and policy environment in its favour and thus incentivise processing rapidly diminished. This coincided with a rapid decline in the estimated competitiveness of wheat processors – to a level of marginal competitiveness during the year in which the cartel was bust. Thus, it is not unfounded to assert that the driving reason behind the wheat processors' high competitiveness was the lack of market regulation and the ensuing market and policy incentives provided to processors. Simply stated, the only reason why wheat processors were competitive is because they were receiving high levels of support. This perceived competitiveness only further increased their lobbying power and resulted in their ability to further tailor market and policy incentives for themselves, predominantly at the expense of wheat flour consumers. What should be of concern for market regulators from the results after the year in which the cartel was bust is that distortion estimates are once again highly positive for wheat millers, as are competitiveness indicators. This is indicative that the situation currently prevailing is similar to what prevailed during the known cartel years.

The disaggregated results therefore provide more questions than answers. The first is the obvious question of whether or not the wheat processing sector is being adequately regulated after the cartel bust. The second question challenges multiple literature studies on the South African wheat industry that have concluded that wheat should essentially not be produced in South Africa. While the conclusions of this thesis are by no means sufficient to refute the findings of these studies, the results introduce a new dynamic into the argument pertaining to the core competitiveness of value chain

agents in a zero-distorting environment. From a policy maker standpoint, it is rather core competitiveness that should be considered when designing and implementing policies, as this measure duly excludes distorting "noise" as a result of aspects such as market power. However, in order to measure this core competitiveness, extensive empirical research will be needed in order to develop a distortion-free competitiveness indicator.

6.4   Recommendations for Further Research

Given the data-intensive nature of this thesis, the primary challenge faced throughout the study was the availability of data. Although multiple industry organisations assisted extensively in providing the detailed data required, the time-consuming nature of the data collection and analysis limited the study from covering a wider range of South African agricultural commodities. In addition, the lack of availability of reputable data throughout specific value chains limited this study to selecting a singular value chain in order to estimate disaggregated distortion estimates. Therefore, on both the aggregate and disaggregate level, multiple extensions of this study's framework are possible to agricultural industries that were not covered in this thesis. Such extensions would increase the reliability of the picture portrayed in this study of primary agriculture distortions in South Africa, as the non-covered portion of the sector's estimate would be empirically estimated, rather than by making an assumption. Furthermore, additional value chain applications would enable distortions within value chains to be contrasted between industries; for example, the distortions facing a wheat processor could be compared to those being faced by a sugar or maize processor.

The results of this study suggest significant efficiency gains to be realised if inter-industry distortions were to be phased out. In addition, the disaggregated results of the wheat value chain show significant scope for intra-industry distortions to be phased out within the wheat industry, which would also lead to more efficient resource use. However, the results are indicative and are in no way able to quantify the magnitude of the efficiency gains or potential welfare impacts to be realised from the phasing out of distortion differences. Thus, the indicative nature of this study's results should serve as a precursor to research concerned with the measurement of potential efficiency and welfare gains.

From a policy analysis standpoint, the reasons behind the inter-industry differences between primary agricultural industries as well as intra-industry differences within the wheat value chain need further explanation. Conclusive evidence needs to be sought in order to determine whether there is preferential policy treatment behind the distortion disparities, or whether the disparities are driven by the inherent structural characteristics and adaptabilities of certain industries as opposed to others. Furthermore, establishing an adequate link between the competitiveness and market power of agents within a value chain in relation to their estimated incentive distortions could form an integral part in

unpacking the drivers of the inter- and intra-industry distortion differences. Once the key drivers of the respective disparities are identified, it will be possible to take a far more informed approach when attempting to eliminate the differences and ensure efficient resource use.

Lastly, a direct implication of the disaggregated results is the impact that supressing wheat farmers' incentives has on the production of other crops. Given that wheat is one of the major crops included in various crop-rotation strategies[6], the persistent disincentives faced by wheat farmers are likely to have significant "ripple" effects on the production of other field crops[7]. However, the apparent link between and magnitude of these ripple effects needs extensive research, both within the field of natural sciences and that of economics. Such research will likely serve to benefit the lobbying position of farmers applying crop rotations involving wheat.

It is highly likely that these differences in distortions within the wheat industry will be found in other industries. Government and industry role players should thus collaborate in order to ensure that an attainable and practical framework – similar to that applied in this thesis – is researched further in a wider range of industry value chains in South Africa. In this regard, it is imperative that a dynamic and comparable framework is used in order to ensure comparisons both between industry value chains and over time.

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[6] In the Western Cape, the predominant wheat growing region in South Africa, wheat is of paramount importance in multiple crop rotation strategies.

[7] For example, if wheat cultivation is halted, this will require a substitute crop to be cultivated in it's place which could be less beneficial to the entire rotation strategy than what wheat was.

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