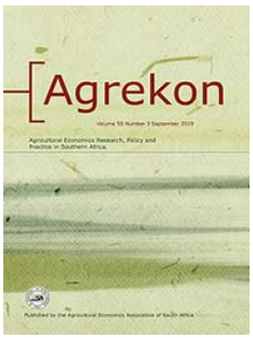

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The distortions to incentives in South African agriculture: a case study of the wheat industry*

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ABSTRACT

The aggregate distortions to the incentives of South African agricultural producers have been estimated, but these measures have not been disaggregated to reveal individual agents' incentives in a vertical value chain. In order to do this, the aggregate distortion estimates were first updated to account for the past decade, and then the wheat value chain was disaggregated for the marketing years starting in October 2000 and ending in September 2014. The results highlight how aggregate distortion estimates as developed by Anderson et al. (2006) and calculated by Kirsten, Edwards, and Vink (2009) for South African agriculture in essence mask the inter agent distortion differences in a vertical value chain. The focus in this article is on the measurement of the disaggregated distortions, while further research on the structure of the industry (its competitiveness at all levels of the value chain) and the role of the exchange rate is required to increase our understanding of the real incentives that confront these agents.

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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.

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

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*This paper is based on the MSc thesis of Day (2018b) as well as the Working Paper of Day (2018a). It provides a more focussed analysis on the methodology to disaggregate the measures used to estimate distortions to incentives in order to reveal individual agents' distortions in a vertical value chain. The findings compliment the broader narrative presented in Day (2018a) as well as in Day (2018b) that disaggregated distortion estimates reveal more granular intra industry insight into the drivers behind incentive distortions which is needed to ensure better targeted policy design.

growth, but also influence poverty and income inequality due to the importance of food prices in these parameters.

Policy intervention in agricultural markets has been reduced drastically in most countries over the past 25–30 years, largely as a result of the Agreement on Agriculture, signed as part of the Marrakech Agreement of 1994. Prior to the inclusion of agricultural commodities in international negotiations, individual countries had been left free to determine their respective agricultural policies, even when these policies had a disruptive effect on world markets (Butault 2011). Preceding the Uruguay Round Agreement on Agriculture (URAA), the Haberler (1958) Report to The General Agreement on Tariffs and Trade (GATT) highlighted the presence of 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, 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 made international comparisons of these country-specific studies nearly 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 a uniform methodology to measure the policy-imposed distortions on commodity level. The seminal study 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.

Second, 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, the nominal protection co-efficient and the producer support estimates. 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.

Third, the most comprehensive study 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 transitional 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, Edwards, and Vink (2009); however, the subsequent update of the empirical database to 2011 by Anderson and Nelgen (2013) did not incorporate an update of the South African estimates.

Kirsten, Edwards, and Vink'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 (2000–2004), the policy environment was such that resource allocation had shifted against the agricultural sector.

A common thread throughout the estimates published by the OECD, as well as those published as a result of the Krueger, Schiff, and Valdes (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, 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, because of the detailed value chain data required 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 provide 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 and Swinnen 2015).

This paper builds on the methodology applied by Kirsten, Edwards, and Vink (2009) as well as that developed by Briones Alonso and Swinnen (2015). It firstly updates the aggregate nominal rate of assistance distortion estimates for South African agriculture initially calculated by Kirsten, Edwards, and Vink (2009) and secondly calculates disaggregated distortion estimates for defined agents in the South African wheat value chain. The distortions to individual value chain agents' incentives within the wheat value chain provide critical insight which is masked by previously published aggregate industry distortion estimates.

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.

2. Theoretical motivation

2.1 Value chain approach to measuring distortions to agricultural incentives

2.1.1 Motivation for a disaggregated model

The methodology developed by Anderson et al. (2006) is able to indicate the degree to which agricultural producers and product consumers are taxed or subsidised under various policy environments. The nominal rate of assistance (NRA) and consumer tax equivalent (CTE) measures are able to be calculated

for specific commodities, as well as for aggregated groups such as exportable commodities or import-competing commodities. Furthermore, these indicators are able to be aggregated into sectoral indicators.

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 emphasise 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 and processors, throughout the value chain.

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.

2.1.2 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 2014). After maize, wheat is one of the most important grain crops in South Africa, with the wheat industry contributing significantly to agricultural GDP (Meyer and Kirsten 2005). Furthermore, milled wheat flour as an input for bread continues to grow in importance, with bread 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 numerous industry control boards, including the Wheat Board, together with commodity tariffication (Mncube 2014). 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 1997–65 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 2014).

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). Van der Merwe et al. (2016) show, however, 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 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 (2014) methodically evaluates these conditions that are conducive to collusion, while documenting the details of the wheat flour cartel that was active from 1999 to 2007. Neither Van der Merwe et al. (2016) nor Mncube (2014), however, seek explanations for possible policy drivers of the competitiveness of agents within the wheat value chain.

This paper extends the literature in two ways. Firstly, it updates the aggregate distortion measures initially calculated by Kirsten, Edwards, and Vink (2009) for South African agriculture to more recent years. Secondly, it disaggregates the distortion measure for the South African wheat industry across agents within the wheat value chain and thus provides a time series of disaggregate distortion estimates for value chain agents in the wheat value chain.

3. Study methodology and data used

3.1 General commodity framework

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 relationship shown in Equation (1) holds (Anderson et al. 2008):

$$DFP = CPP = (E \times P) \tag{1}$$

where 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 (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 (1).

3.1.1 Nominal rate of assistance and consumer tax equivalent

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 (NRA) 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 (2).

$$NRA_{BS} = \frac{E \times P(1 + t_m) - E \times P}{E \times P} = t_m \tag{2}$$

3.2 Disaggregated value chain extension

3.2.1 Adaptation of NRA and CTE

Briones Alonso and Swinnen (2015) present Equation (3) as a means for calculating the nominal rate of assistance to a specific agent[i] in a vertical value chain.

$$NRA^i = \frac{p^i_o - p^{i*}_o}{p^{i*}_o} + \frac{\sum_j (p^{i*}_j - p^i_j) \times \frac{Q^i_j}{Q^i_o}}{p^{i*}_o} = NRA^i_o + NRA^i_I \tag{3}$$

In Equation (3), P^i_o represents the actual domestic price of output "*o*", P^{i*}_o is the undistorted domestic price, Q^i_o is the quantity of output sold, P^i_j is the actual domestic input price of input "*j*", P^{i*}_j represents the undistorted price of input "*j*" and Q^i_j 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^i_j/Q^i_o. 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), the NRA_o^i 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 (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_o^i 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. 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 (4).

$$NRA^C = \frac{p_I^{c^*} - p_I^c}{p_I^{c^*}} \tag{4}$$

In Equation (4), 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.

3.2.2 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 REF _Ref482976394 \h * MERGEFORMAT (3)) is equivalent to the price of the input paid by agent "j" (p_I^j).

3.3 Data Used

The data required to calculate distortion estimates can be grouped in two tranches. The first tranche includes physical quantity data of products relating to production, consumption, processed volumes as well as imported and exported quantities. The second tranche includes price information on import parity prices and tariffs, international reference prices as well as producer prices for all commodities which aggregate distortion estimates are calculated for. For disaggregated distortion calculations, the second tranche also includes price information for each product traded between value chain agents (e.g., Wheat grain, Bulk Wheat Flour, etc.).

3.3.1 Physical quantity data

Due to the nature of this study being an update and extension of the work by Kirsten, Edwards, and Vink (2009), the quantity source data used is aligned to that used by Kirsten, Edwards, and Vink (2009). The two primary sources of this secondary data for the updated 10-year period are the FAOSTAT database and the 2016 South African Abstract of Agricultural Statistics. In the instances where FAO data is only available up until 2013, the International Trade Centre (ITC) TRADEMAP database's data is matched to the FAO data using the metadata provided for each data category by the FAO. Similarly, where the 2016 Abstract does not contain the required trade data, TRADEMAP trade data is used as the source of this

In specific commodity cases where none of the key data sources are sufficient, data from industry organisations is used. These cases are aligned to those of Kirsten, Edwards, and Vink (2009) 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 A1. As can be noted from Table A1, all wheat and maize quantity data, as well as the majority of the sunflower data, is sourced from the South African Grain Information Service (SAGIS). The Department of Agriculture, Forestry and Fisheries' (DAFF) import and export quantities are used for mutton while DAFF data is also used for production and consumption data for poultry as this is only available in an aggregated white meat form in the 2016 Abstract.

3.3.2 Price information

The key domestic price information includes, 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 domestic price variables is the 2016 Abstract of Agricultural Statistics. In the cases where the required data is 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.

Direct subsidies for individual agricultural products were unavailable for use in the study. However, as is consistent with the previous model of Kirsten, Edwards, and Vink (2009), non-product-specific subsidies net of abnormal taxes for primary agriculture are used.

For internationally traded products, the international reference price per product is of vital importance, as it serves as the base from which the free market price is calculated. 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 are obtained from the FAOSTAT database. In the case of fixed-point international reference prices, industry organisations such as SAGIS and SAFEX (in the case of maize) are used as the source of the data in the study.

In order to convert the international reference price per product to a value that can be compared to the domestic market price, the reference point of the international price needs 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 can be made. In this case, the international trading costs separating the two reference points is calculated and added (subtracted) to (from) the domestic (international) price in order to accurately compare the two prices. The international trading costs are assumed to be the sum of the freight costs between the two reference points together with the processing and handling costs per traded unit.

The price information for the wheat value chain is obtained through a triangulation of multiple data sources. The undistorted wheat flour price is calculated for a Randfontein reference point through adding the Durban – Randfontein transport differential obtained from Grain SA (2017) to the weighted average import parity price, reference Durban obtained from FAOSTAT. The wholesale price of wheat flour is calculated from a Stats SA (2017) wheat flour retail price through making assumptions on retail margins, milling costs as well as value chain losses. This top down calculation of the wholesale flour price is triangulated with a bottom up calculation using the wheat grain price, processing conversions and milling costs.

Table A2 summarises the sources of price data for the study. As can be seen, BFAP-supplied data is only used for the wholesale price of poultry and sunflower oil, as these values are unavailable in the 2016 abstract of agricultural statistics. SAFEX and Stats SA data is jointly used for field crops and field crop products, as this is consistent with the data sources used by Kirsten, Edwards, and Vink (2009).

4. Study results

4.1 Aggregate NRA to primary agriculture

Figure 1 presents the aggregate distortion estimates calculated in this study for the ten-year period leading up to and including 2014 in the context of the long-term trend from 1962 calculated by Kirsten, Edwards, and Vink (2009).

Following an initial increase in the total NRA to primary agricultural commodities in the beginning of the period, Figure 1 depicts a steady decline in NRA to primary agriculture over the most recent ten-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

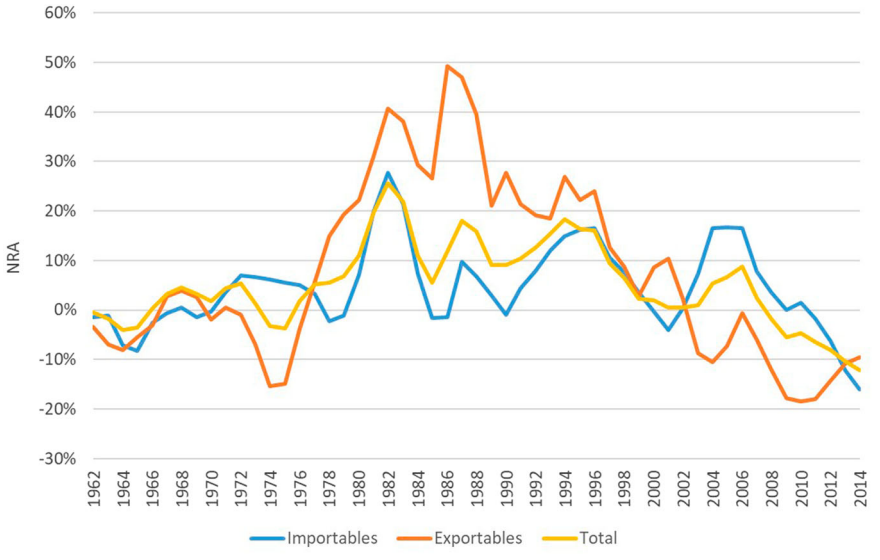

Figure 1. Aggregate NRAs for primary agricultural production – three-year moving average, South Africa, 1962–2014.

Source: 1962–2004: Kirsten, Edwards, and Vink (2009); 2005–2014: author's calculations. Author's calculations data source: FAO (2017); ITC (2017a); ITC (2017b).

1970s, the years after 2008 mark the first sustained period of negative NRA values for aggregate primary agricultural production in over 50 years.

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. Throughout this period, South Africa's real agricultural export value more than doubled, with this occurring at an increasing rate after 2012 (DAFF 2016). Agricultural net exports remained extremely volatile throughout the period, however, 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 1 where, after 2011, the NRA to primary agricultural exportables has been on an upward trend towards a zero-distorting environment.

The policy environment shift facing the exportable sector has predominantly been a passive shift. This is in stark contrast to the governmental policies until 1995 to support exporters and shield against losses, as highlighted by Kirsten, Edwards, and Vink (2009). Since the removal of these 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.

While the NRA to exportables remained negative throughout the period, the NRA to importables only turned negative after 2010, although it had been exhibiting a declining trend for all ten years of the study. 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.

4.2 Disaggregated wheat value chain results

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

In line with the objectives of this study, Figure 2 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 a cost price squeeze. However, the trends seen in the NRAs to wheat millers and wheat flour consumers need to be considered together, and in the context of the competitive nature of the wheat milling industry.

4.2.1 Intra-industry NRA comparisons

The NRA trends presented in Figure 2 display three key trends. Firstly, the NRA for millers remained positive for all marketing years studied, although it declined up to the 2007/2008 marketing year 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. On the input side, however, 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

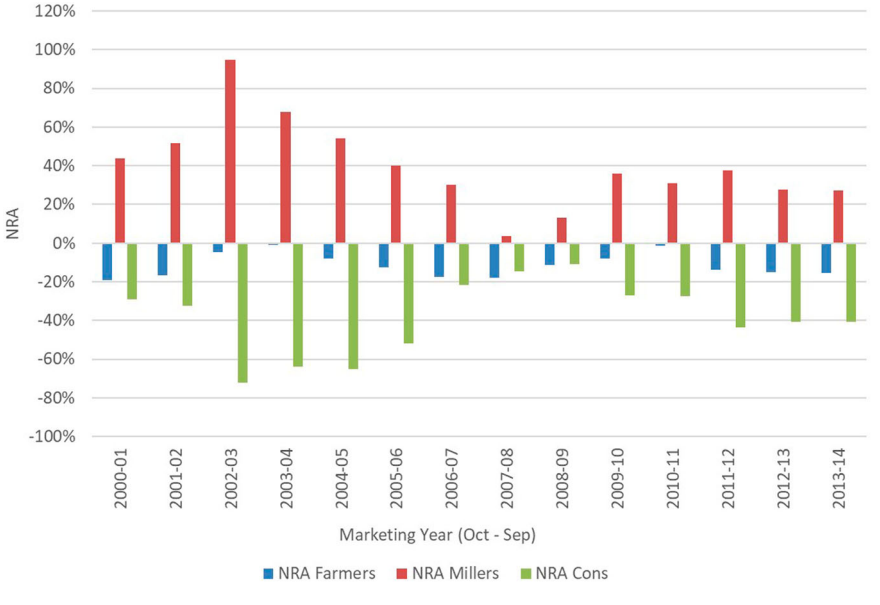

Figure 2. Disaggregated NRA per agent in the wheat value chain – marketing years, South Africa, 2000–2014.
Source: Author's calculations. Author's calculations data source: DAFF (2016); SAGIS (2017); Grain SA (2017).

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 2000/2001–2003/2004. 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. It is evident from the exchange rate series (see Figure A1) and the NRA to farmers estimates in Figure 2 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 exhibits a rapid decline to close to zero in 2007/2008. It is noteworthy, however, that this decline occurred over a period (2003–2008) when the South African exchange rate did not depreciate nearly as much as in more recent years (2011–2014). Furthermore, it occurred during a time when the removal of the wheat grain import tariff would have explicitly assisted wheat millers.

4.2.2 Conclusion on disaggregated estimates

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, together with the intra-industry distortion estimates from this study, provides 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 supply a large number of wheat flour consumers, concentrates market power and lobbying power at the processing level. This situation enables millers to essentially self-regulate their market and, in doing so, force wheat producers to remain price-takers, while they are 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. The wheat milling cartel, active between 1999 and 2007 had a stronghold on the industry and ensured both fixed selling prices as well as market allocation of wheat flour amongst the 5 largest wheat milling firms at the time. 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 important 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 potential driver of this competitiveness is their position in the market and their ability to "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 further researched.

On the other hand, wheat producers – 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. They persist with wheat production, however, 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.

It is clear from this study 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. 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. Conclusion

5.1 Implications for policy makers and industry players

5.1.1 Aggregate results

On aggregate the updated distortion estimates from this study exhibit how the policy environment shifted from one that incentivised primary agricultural production to one that disincentivised primary

agricultural production between 2005 and 2007. The results 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.

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 and Van Wincoop 2001). The results of the aggregate NRA to the importables sector in Figure 1, however, 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 suggests 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

Given the South African situation, therefore, 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 with 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 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 to not 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.

5.1.2 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 study 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 including Van der Merwe et al. (2016), 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 (Van der Merwe et al. 2016). 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.

This study suggests, however, 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 seemingly rapidly diminished. 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. 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 (2007) 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 that which prevailed during the known cartel years.

The disaggregated results provide, therefore, more questions than answers. The first is, obviously, whether the wheat processing sector is being adequately regulated after the cartel bust. The second challenges many 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 study 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 where NRAs are zero.

From the disaggregated distortion measurement framework applied in this study, it is clearly evident that more rigorous research is required to firstly analyse policy distortions beyond the conventional aggregate industry level and secondly to identify the key drivers such as industry structure and exchange rate which cause intra industry distortion differences. This will shed more light on the incentives facing individual agents in complex agricultural value chains and assist policy makers in designing effective policies that target the most vulnerable agents in these value chains.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix

A1 South African Rand Exchange Rate

Figure A1 Nominal monthly average exchange rate, United States dollar per South African rand, January 2000 to July 2017.
Data Source: SARB (2017).

A2 Data Sources of Quantity Data

Table A1. Data sources of quantity data for the respective covered products.

	Data Source					
	FAO (2017)	ITC (2017a)	DAFF (2016)	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

A3 Data Sources of Price Information

Table A2. Data sources of price information.

	Data source					
	STATS SA (2017)	SAFEX	DAFF (2016)	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.