Western Cape Government
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The Impact of South Africa's Carbon Tax on Agri Processing

(Draft Working Paper)

Andrew Partridge

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Introduction

A recent study by Partridge, Cloete-Beets and Barends (2015) at the Western Cape Department of Agriculture in South Africa utilised a static computable general equilibrium (CGE) model in an effort to assess the potential impact that South Africa's proposed 2017[1] carbon tax will have on agricultural production in the country. The study found that despite the tax being initially structured in a way which will not have a significant direct impact on agricultural production, there are indirect impacts which have the potential to seriously hinder performance in the sector. These indirect impacts are expected to come through the rise in the price of intermediate inputs needed in agricultural production, particularly electricity and gas distribution; fertilizers and pesticides; petroleum products; metal products; animal feed; and water distribution. In light of these findings, this study looks to assess what the impact will be on agri processing industries further along agricultural value chains.

The use of CGE models for analysing the impacts of the carbon tax is optimal due to the fact that the models allow for the identification and measurement of not just the direct impacts but also the indirect impacts (Lofgren, et al., 2002). This is important as in industries such as agriculture, and given the proposed design of South Africa's 2017 carbon tax, these indirect impacts far outweigh the direct impacts of the tax (Partridge, et al., 2015).

There are significant development benefits which can be achieved through the expansion of industries all along the different stages of agricultural value chains (Da Silva, et al., 2009; Kaplinsky, et al., 2011; Kaplinsky & Morris, 2015). South Africa has also acknowledged the development potential of agri processing as evident by it being highlighted in numerous important national policy documents including the Industrial Policy Action Plan (DTI, 2013), the New Growth Path (EDD, 2011) and the National Development Plan (NPC, 2011).

In the Western Cape agri processing has been identified as one of three key sectors to be targeted under "Project Khulisa". Khulisa means "to grow" and the three sectors identified have been selected due to their potential for growth and employment creation, with the idea that expansion of these sectors will lead to higher economic growth and a faster reduction in unemployment in the Province (Meyer, 2015; WCG, 2015; Zille, 2015).

The next section will briefly discuss the methodology employed for the study, following this some key results will be laid out and discussed before the paper concludes with some of the key overall implications of the analysis.

[1] Initially 2015 and postponed twice, once to 2016 and then again to 2017

Methodology

This study utilises the static CGE model used by Partridge, Cloete-Beets and Barends (2015). The model is based on a static CGE model developed by the International Food Policy Research Institute (IFPRI) by Lofgren, Harris and Robinson (2002), which has been adapted and applied to South Africa's 2009 Social Accounting Matrix (Davies & Thurlow, 2011). In line with the original study, the tax is modelled as an activity tax based on each sector's fossil fuel usage and fossil fuel emissions factors provided by South Africa's Department of Energy (DE, 2009).

Whereas the previous study uses four scenarios to analyse one sector, this study will utilise one scenario to analyse the impact on three key agri processing sectors. The scenario chosen is called "Elementary Carbon Tax" and involves a straightforward activity tax of R200 per tCO2-eq emissions for each sector based on fossil fuel usage.

The following assumptions are made in the model in accordance with Partridge, Cloete-Beets and Barends (2015):

- "The Consumer Price Index (CPI) is fixed, and the Domestic Producer Price Index is flexible
- Investment is savings-driven (neo-classical). The economy's marginal propensity to save remains constant and investment adjusts to maintain equality between investment and savings.
- The exchange rate is fixed, and foreign savings can adjust. This assumption is made under the pretence that South Africa's activities do not exert a strong influence on global prices.
- All other direct tax rates are held constant, and government savings is allowed to adjust …
- Capital was assumed to be fully employed and activity specific …
- Labour was assumed to be unemployed and mobile, except highly skilled labour (labour with a tertiary education) which was assumed to be fully employed and mobile. The reason for this is South Africa's high rate of unemployment among unskilled workers and shortage of skilled workers" (Partridge, et al., 2015, p. 5)

The AC Index provides a means of measuring the relative degree to which the various intermediate inputs will affect activity within a particular sector (Partridge, et al., 2015). Calculating the AC Index within a sector thus allows for the identification of those inputs which are going to be the source of the biggest indirect impacts on production. Put formally:

"**AC = α.β**

Where:

***α** = the magnitude of the increase in the price of the commodity following the shock*

***β** = the amount of the commodity required to produce one unit of output from the activity*" (Partridge, et al., 2015, p. 7)

For each sector analysed, the AC Index is calculated for all intermediate goods and the top 10 Indices are shown for discussion. The focus of the results is on the relative amounts, rather than the absolute index values which are of less value.

Results

Agri processing is a vast and complex sector, spanning a number of different industries and processes. For the purpose of this study, three key sectors are analysed due to their strong roots in primary agriculture. These three sectors are:

- Food processing
- Beverages and tobacco
- Leather products

Industries such as textiles, wearing apparel and footwear could also fall under agri processing in certain cases but due to the inability to disaggregate out those products from agricultural origin and those not, these were not analysed. Additionally agri processing industries involving the processing of forestry products (i.e. wood and paper products) were also not included in order to focus the analysis on agricultural value chains.

Figure 1 shows the change in output resulting from the carbon tax. Food processing is particularly vulnerable to the carbon tax impacts, declining by 9.33% in the model. This decline is 2 percentage points more than the observed decline in primary agriculture which falls by 7.33%. Beverages and tobacco output falls by slightly less than primary agriculture, 7.01%, whereas leather products appears to be able to better weather the impact of the tax, falling by only 5.64%.

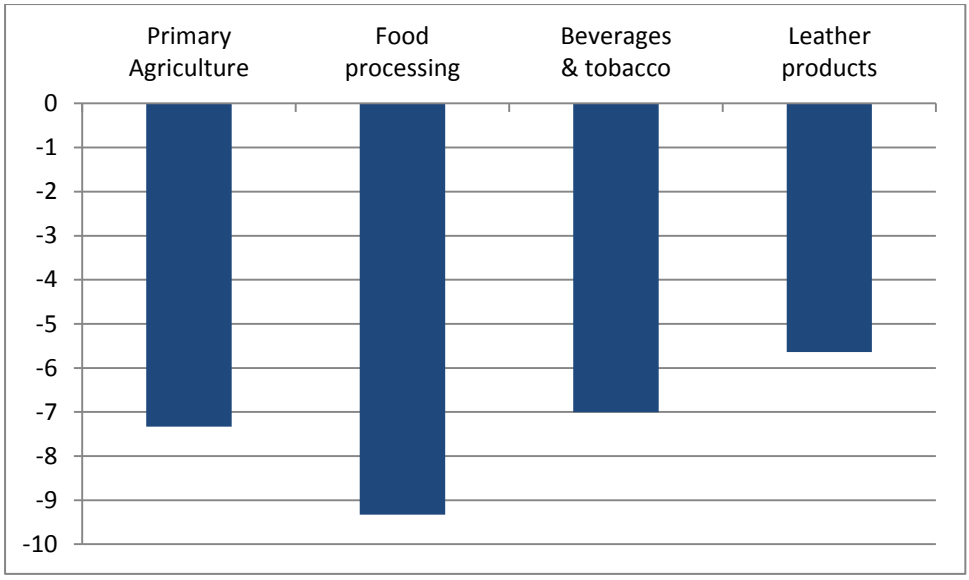

Figure 1: Percentage Change in Agricultural and Agri Processing Activitivities

To calculate the emissions intensity (EI) for each activity the following emissions factors were used as calculated by Partridge, Cloete-Beets and Barends (2015):

- Coal: 9 274.86 tCO_2-eq per million Rand output
- Petroleum: 471.09 tCO_2-eq per million Rand output

Table 1 below shows the calculation of the EI for each of the sectors analysed in the study. Food processing is the highest emitting sector per unit output, and is also the sector with the biggest output. Beverages and tobacco and leather products both emit less per unit output than primary agriculture.

Table 1: Emission Intensity (EI) for Agriculture and Agri Processing Industries

	SAM Data (Million Rand)			**EI**
	Coal Use	Petroleum Use	Total Output	(tCO2-eq / Million Rand)
Primary agriculture	0.02	6.29	125.48	**24.96**
Food processing	0.79	0.02	189.24	**38.60**
Beverages & tobacco	0.12		67.44	**16.79**
Leather products	0.01		5.38	**14.51**

It may seem logical for food processing to have the highest EI after exhibiting the greatest output decrease as a result of the carbon tax in Figure 1, however this is not necessarily true. As shown in the Partridge, Cloete-Beets and Barends (2015) study, the greatest cause of activity decline with regards to the carbon tax for agriculture came from indirect impacts. In

fact it was estimated that the direct impact of the tax was responsible for only 7% of output decline, the remaining 93% came from indirect impacts.

The AC Index discussed in the methodology section provides a means of assessing the biggest causes of indirect impacts as a result of the carbon tax, accounting for both the degree to which the price of that intermediate input has risen, as well as the intensity with which it is used in production in that particular setting. The AC Index for Agriculture has already been discussed (Partridge, et al., 2015), but the top 10 are provided in Table 2 below as a reference for the new indices. In total there are 85 different commodities in the model.

Table 2: AC Index for Agricultural Activity

#	Commodity	Percentage Price Change After Shock (α)	Intermediate Units Per Unit Activity Output (β)	AC (α.β)
1	Electricity & gas distribution	47.70	0.0207	0.9894
2	Fertilizers & pesticides	3.93	0.1979	0.7769
3	Petroleum products	6.14	0.0559	0.3435
4	Metal products	3.63	0.0369	0.1339
5	Animal feeds	0.80	0.1461	0.1165
6	Water distribution	11.63	0.0052	0.0604
7	Pharmaceuticals	1.36	0.0291	0.0395
8	Made-up textiles	1.62	0.0202	0.0326
9	Special purpose machinery	3.96	0.0074	0.0294
10	Vehicles & parts	1.92	0.0132	0.0254

Table 3 shows the top ten AC Indices with regards to food processing. As with primary agriculture, electricity and gas has the greatest impact. Food processing uses electricity and gas distribution more intensively than primary agriculture, making it more vulnerable to being impacted by price increases. Interestingly actual food items only come in at numbers nine (dairy) and ten (grain milling). Instead there is a greater impact coming from the increase in the price of paper products and plastics, products used in the packaging and transportation of processed products. There is also a significant impact expected from the increase in the price of basic chemicals and water distribution, due more to a substantial price increase than being used very intensively in production.

Table 3: AC Index for Food Processing Activity

#	Commodity	Percentage Price Change After Shock (α)	Intermediate Units Per Unit Activity Output (β)	AC (α.β)
1	Electricity & gas distribution	47.70	0.0224	1.0679
2	Paper products	14.54	0.0193	0.2813
3	Plastics	1.13	0.0360	0.0405
4	Basic chemicals	4.46	0.0066	0.0296
5	Water distribution	11.63	0.0018	0.0212
6	Construction	2.88	0.0060	0.0173
7	Miscellaneous business activities	0.26	0.0644	0.0167
8	Miscellaneous chemicals	2.31	0.0053	0.0122
9	Dairy	0.17	0.0558	0.0095
10	Grain milling	0.11	0.0704	0.0079

With regards to beverages and tobacco, shown in Table 4, the biggest impact does not come from electricity and gas, which is used far less intensively in this sector than the ones analysed thus far. Instead the greatest impact comes through the increasing cost of paper products. This would seem to be due to the paper needed in the manufacture of cigarettes, but also other packaging materials in the sector. Electricity and gas does still come out strong in the sector with the second highest AC Index. Other key inputs affecting activity are water distribution, glass products, basic chemicals and plastics

Table 4: AC Index for Beverages and Tobacco Activity

#	Commodity	Percentage Price Change After Shock (α)	Intermediate Units Per Unit Activity Output (β)	AC (α.β)
1	Paper products	14.54	0.0419	0.6094
2	Electricity & gas distribution	47.70	0.0085	0.4061
3	Water distribution	11.63	0.0237	0.2750
4	Glass products	3.79	0.0439	0.1667
5	Basic chemicals	4.46	0.0188	0.0839
6	Plastics	1.13	0.0538	0.0606
7	Construction	2.88	0.0101	0.0291
8	Weaving & finishing of fabrics	4.72	0.0052	0.0246
9	Miscellaneous chemicals	2.31	0.0065	0.0150
10	Miscellaneous business activities	0.26	0.0501	0.0130

The AC Indices for the final sector, leather products, are calculated in Table 5. As with primary agriculture and food processing, the biggest impact is likely to come through the rising cost of electricity and gas. The next biggest concern to producers of leather products

should be the rising cost of basic chemicals and metal products. Other significant impacts are likely to come from rising prices of packaging materials such as paper products and plastics, as well as certain fabrics and textiles.

Table 5: AC Index for Leather Products Activity

#	Commodity	Percentage Price Change After Shock (α)	Intermediate Units Per Unit Activity Output (β)	AC (α.β)
1	Electricity & gas distribution	47.70	0.0103	0.4912
2	Basic chemicals	4.46	0.0324	0.1444
3	Metal products	3.63	0.0255	0.0925
4	Paper products	14.54	0.0034	0.0493
5	Weaving & finishing of fabrics	4.72	0.0036	0.0169
6	Plastics	1.13	0.0076	0.0086
7	Miscellaneous textiles	6.49	0.0011	0.0068
8	Construction	2.88	0.0021	0.0061
9	Soap & related products	0.56	0.0108	0.0061
10	Water distribution	11.63	0.0004	0.0048

There are clear differences in the AC indices for the different sectors, but also some definite similarities. Electricity and gas distribution had a huge impact across the board, having the biggest impact across 3 of the sectors and the second biggest in the remaining one. Water distribution also featured in the top ten for all four sectors. In terms of the three agri processing sectors, four inputs featured in the top ten across all three sectors: paper products, plastics, basic chemicals and construction.

Conclusions

In addition to putting strain on South Africa's agricultural sector, the 2017 carbon tax also has significant implications for downstream agri processing industries. This study looks at three particular industries which involve the processing of goods originating from primary agricultural production: food processing; beverages and tobacco; and leather products.

Previous analysis has shown that, despite agricultural emissions being excluded from the carbon tax base, the sector will face significant strain in the form of the indirect impact of the rising price of key intermediate inputs (Partridge, et al., 2015). This analysis has shown that the impact of the tax will be even greater for food processing, slightly less for beverages and tobacco, and significantly less for leather products.

As was observed for primary agriculture, the biggest impact on agri processing will generally come through rising electricity prices. The exception is for beverages and tobacco where paper products will have the biggest impact, followed by electricity. The rising price of water also came out as having a very significant impact for agriculture and for the agri processing industries analysed

Interestingly, aside from electricity and water, the biggest impact on agri processing industries generally doesn't come from the rising price of the agricultural goods being processed but rather in the rising price of packaging products such as paper products and plastics, as well as other key support industries such as chemicals, construction and business services.

Going forward, there is much to be concerned about. Agri processing industries already have a lot of pressure on them as one of the expected vehicles to deliver on growth and employment in the country. With the introduction of the carbon tax firms will find their profit margins squeezed as they are not only faced with having to pay more taxes but also face the daunting prospect of the rise in the price of key intermediate inputs.

The reality of the hardships will depend on the ability of firms to become more efficient in the use of key resources, but also on the assistance given to industries to help them adapt. Unfortunately the draft carbon tax bill (National Treasury, 2015) released in November 2015 is not specific on a number of key issues such as the revenue recycling mechanisms to be employed and the incentives to be put in place in order to guide firms towards the desired behavioural outcomes. Without these details it is hard to accurately assess what the outcomes of the tax will be, but this study has highlighted some of the main pressures which will result from the tax in its proposed structure.

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