Quantifying the regional impact of export controls in Southern African maize markets

T. Davids¹; F. Meyer¹; P. Westhoff²

¹: Bureau for Food and Agricultural Policy - University of Pretoria, Agricultural Economics, Extension and Rural Development, South Africa, 2: Food and Agricultural Policy Research Institute - University of Missouri, United States of America

Corresponding author email: tracy@bfap.co.za

Abstract:

Despite well-researched benefits and stated policy goals of increasing intra-regional trade, African policy makers continue to rely on export controls in an effort to keep prices at tolerable levels. Within the Southern African region, Zambia has been particularly prone to such policy action, typically in the maize sector, which has strong connotations to food security. Against the backdrop of drought-induced supply shortages of white maize in Southern Africa in 2016, this study applied a partial equilibrium model with bilateral trade flows to simulate the impact on prices and trade flow of imposing export controls in Zambia relative to an open trade scenario. The goal of reducing prices for domestic consumers was achieved at the expense of producers, who lose the market-induced price increase that would offset some revenue loss if trade was allowed to flow freely. Contrary to most previous literature on Zambian export controls, the impact of Zambian policy was also related to neighbouring markets, highlighting higher prices, reduced consumption and changes to typical trade flows. Price increases in neighbouring countries supported area expansion in subsequent years, inducing a shift in production towards these countries and highlighting the detrimental impact of trade control policies on long term production growth.

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QUANTIFYING THE REGIONAL IMPACT OF EXPORT CONTROLS IN SOUTHERN AFRICAN MAIZE MARKETS

ABSTRACT

Despite well-researched benefits and stated policy goals of increasing intra-regional trade, African policy makers continue to rely on export controls in an effort to keep prices at tolerable levels. Within the Southern African region, Zambia has been particularly prone to such policy action, typically in the maize sector, which has strong connotations to food security. Against the backdrop of drought-induced supply shortages of white maize in Southern Africa in 2016, this study applied a partial equilibrium model with bilateral trade flows to simulate the impact on prices and trade flow of imposing export controls in Zambia relative to an open trade scenario. The goal of reducing prices for domestic consumers was achieved at the expense of producers, who lose the market-induced price increase that would offset some revenue loss if trade was allowed to flow freely. Contrary to most previous literature on Zambian export controls, the impact of Zambian policy was also related to neighbouring markets, highlighting higher prices, reduced consumption and changes to typical trade flows. Price increases in neighbouring countries supported area expansion in subsequent years, inducing a shift in production towards these countries and highlighting the detrimental impact of trade control policies on long term production growth.

Key words: Export controls, Partial equilibrium simulation, bilateral trade modelling
1. INTRODUCTION

The dramatic increase in world food prices in 2007 brought to the forefront a number of policies intended to stabilise domestic markets and protect consumers (Abbott, 2012). In many exporting countries, export restrictions were applied through the imposition of taxes, quotas or even outright export bans. Africa was no exception and particularly in maize markets, which have a strong connotation with food security, a number of countries resorted to export bans in recent years in an attempt to secure domestic supply and keep prices at tolerable levels. African policy makers are often faced with the need to balance such short-term food security objectives with the longer-term goal of raising productivity growth.

Export restrictions are generally aimed at achieving short run objectives. They tend to be motivated by food security, but at times they also carry political connotations (Mitra & Josling, 2009). This may explain their continued application, despite a body of literature noting the adverse impact on investment and consequently long term productivity gains (Jayne, 2012; Chapoto & Jayne, 2009; Dorosh et al., 2009; Jayne & Tschirley 2009). The nature of rain-fed agricultural production, which dominates in the Eastern and Southern African (ESA) region, results in fluctuating production levels. Intra-regional trade has the ability to reduce the resultant price volatility (Haggblade et al., 2008), while a closed border policy can lead to significant year on year price variations. While export bans continue to be implemented, the possible gains expected by policy-makers are often not realised in practice (Mitra & Josling, 2009) and it has been noted that, contrary to price stabilization objectives, prices in Africa tend to be more volatile in markets where governments intervene most actively (Chapoto & Jayne, 2009).

Within Southern Africa, predominantly in maize markets which are considered critical to food security, Zambia has been particularly prone to imposing export controls during periods of high prices (Figure 1). This has been achieved mainly through outright bans on exports, often imposed in a highly discretionary manner. Government positions on private sector trade often changed at short notice, due to a lack of trust in the private sector and market based factors (Jayne, 2012; Chapoto & Jayne, 2009; Dorosh et al., 2009). Its emergence as a fairly consistent surplus producer in the region in recent years implies that, in addition to the domestic impacts, the implementation of such policies in Zambia has the potential for far-ranging effects across the region. Davids, Meyer and Westhoff (2017) note that price transmission patterns in the region differ during periods of open trade as opposed to periods of export controls, implying that policy changes in Zambia could also affect prices in surrounding countries such as Zimbabwe, South Africa, Malawi and Mozambique.
Complex price relationships within Southern African maize markets are well noted in literature. The preference for white maize free of genetically modified (GM) technology differentiates the product traded in these markets from yellow maize, which dominates global trade. The infrequent integration and implied isolation of regional maize markets in the global context (Baffes et al., 2015; Baquedano & Liefert, 2014; Versailles, 2012; Minot, 2011;) is supported by trade patterns. The majority of trade occurs intra-regionally and apart from South Africa, which trades significant quantities of yellow maize for feed consumption in the rest of the global market, trade with other countries outside the region has been limited. The prevalence of informal trade in the region further suggests that the share of intra-regional trade is most likely higher than that indicated by formal trade statistics. Price transmission analysis suggests that such trade patterns also influence price transmission between markets, with the extent of long run co-integration and rate of price transmission found to differ across regimes defined by trade volumes (Myers & Jayne, 2012; Traub et al., 2010).

Within the context of global trade volumes, Zambia is a small country that would not be considered large enough to influence global markets. However, its influence in the differentiated non-GM white maize market in Southern Africa has increased with its growing exportable surplus (Davids, Meyer & Westhoff, 2017; Davids, Schroeder, Meyer & Chisanga, 2016). This growing influence necessitates the need to quantify the impacts of Zambia’s discretionary export control policies in a regional, rather than the purely domestic context which has been the focus of prior analysis.

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1 Formal trade refers to official trade statistics, whereas informal trade refers to cross border regional trade, often in small quantities, not captured in the official trade statistics. Total trade statistics quoted in this study includes estimates of informal trade by FEWSNET.
The purpose of the study is therefore to quantify the impact of Zambian export controls across 5 countries in the Southern African region during a period of reduced supply resulting from the 2016 drought. The analysis is conducted using a partial equilibrium model of Eastern and Southern African maize markets that includes a system of bilateral behavioural trade flow equations based on the principles of spatial equilibrium, but with trade not assumed to be perfectly elastic. The proposed system goes beyond the scope of traditional price transmission analysis as it considers multiple market interactions simultaneously, as opposed to multiple markets being linked to a single representative price. It also allows price relationships between markets to change over time as trade patterns fluctuate.

Within the context of the drought across Southern Africa in 2016, the study aims to illustrate the impact of substantial supply reductions on prices and trade-flows under a scenario where open border policy is maintained as opposed to a scenario where export controls are imposed in Zambia. It hypothesises that the implementation of export controls will reduce prices in Zambia, whilst increasing prices in neighbouring countries. Thus, in the country of application, consumers benefit at the expense of producers, yet in neighbouring countries the opposite will be true. This will result in some production shifting to neighbouring regions in subsequent years.

Following this introduction, the paper is structured as follows. Section 2 provides a literature review, which highlights the theoretical implications of export controls, before detailing the methodology applied in the analysis in Section 3. This is followed by a brief overview of the impacts associated with the 2016 drought in Southern Africa, after which Section 5 provides the simulation results before drawing conclusions in Section 6.

2. THEORETICAL IMPLICATIONS OF EXPORT CONTROLS

Quantification of the impacts of export controls entails two aspects, the in-country effects where they are applied, which are effectively the target of the policy action, as well as the spillover effects on the rest of the world (Abbot, 2012; Bouet and Laborde, 2010; Mitra and Josling, 2009). Due to the absence of world price effects from export controls imposed in a small country, the bulk of the analysis conducted in the global context has focused on export controls imposed in large countries that export substantial volumes. A greater focus has been awarded to export taxes, rather than outright bans or embargoes, possibly due to their more frequent use by large exporters. The detrimental impacts of outright export bans have however been shown to be larger than that of export taxes or quotas (Mitra & Josling, 2009).

Significant focus in literature remains on the reasons for imposing export bans and while the implications have been explored, it has often been in a qualitative context. Theoretical impacts have been illustrated in a partial equilibrium context by Abbot (2012) as well as Mitra and Josling (2009), while Bouet and Laborde (2010) provide both a partial equilibrium and general equilibrium view on export taxes. The analysis highlights important implications, such as the net welfare loss globally that results from export controls in the short and long term (Bouet &
Laborde, 2010; Mitra & Josling, 2009), the increase in global price volatility when large exporters limit exports, which can also offset the domestic price stabilization impact (Martin & Anderson, 2012) and a critical asymmetry between exporters and importers in a food crisis situation. Whereas net exporters can benefit from increased world prices, net importers are hurt and have no capacity to retaliate efficiently (Bouet and Laborde, 2010).

Within the African context, most countries are not considered large enough to move global markets and research related to export bans has tended to focus on the impact in the country where they are applied. This is mainly in Zambia, prior to its emergence as a consistent surplus producer (Chapoto & Jayne, 2009; Dorosh et al., 2009) and Tanzania (Makombe & Kropp, 2016; Baffes et al., 2015). All four of these studies report negative implications. No evidence of price stabilization effects from export bans is established in Zambia (Chapoto and Jayne, 2009), but several studies point to substantial domestic price declines. Using a simple economic model, Dorosch et al. (2009) illustrate the impact of production shocks in Zambia under various policy regimes and found that a 30% increase in production from long term average levels halves the price of maize when exports are banned completely, with a smaller but still negative impact associated with various levels of export quotas. In Tanzania, Makombe and Kropp (2016) used a household survey approach to evaluate welfare impacts, whilst Diao and Kennedy (2016) used a CGE model. Both highlight reduced prices, lower profits or even losses and consequently a reduction in investment, with maize cultivation reduced in favour of other crops. Thus, production growth stalls as a result of the bans, while private sector investment is reduced.

Only two studies attempt to consider the wider regional impacts of such export bans (Dabalen & Paul, 2014; Porteous, 2012). Findings are less consistent than the studies with a single country focus and somewhat in contrast to theoretical expectations. Porteous (2012) finds no significant effect on price differences between countries as a result of export bans and highlights an equivalent price increase in both origin and destination country. By contrast, Dabalen and Paul (2014) find a significant decline in Tanzanian prices when export bans are imposed, but with a similar decline evident in Kenya, which represents the usual destination of Tanzanian exports. Alternative import destinations such as Uganda are however not considered, and the authors acknowledge that their estimates may fail to isolate the true effects of export bans in the presence of other factors associated with market prices.

Despite the somewhat ambiguous results related to actual price impacts from export bans, theory suggests that they induce a redistribution of welfare from producers to consumers. The global impact is clearly negative when export bans are applied in large countries, but in the absence of a market failure, such interventions still lead to an aggregate welfare loss, even domestically when applied in a small country (Mitra & Josling, 2009). The extent of such welfare loss depends on the relative price elasticities of supply and demand, which suggests that application in basic food staple markets such as maize would result in a bigger welfare loss. As export bans increase availability to domestic consumers, prices decrease in order to absorb additional availability, leading to a price distortion, which is greater when demand is more inelastic.
Figure 2 illustrates theoretically the short term domestic impact of applying an export ban in a small exporting country. Initial equilibrium is illustrated by point E₀, the point where the country’s short run, perfectly inelastic supply curve (Sₚ) intersects global demand (Dₚ). The world price in this instance is represented by F, whereas B represents the quantity produced. A represents the quantity consumed domestically and AB the total volume exported. Consumer surplus is illustrated by the area enclosed by the domestic demand curve, the vertical axis and Dₚ. Producer revenue is represented by area OBE₀F. Imposition of an export ban shifts the equilibrium to point E₁, at a price C and quantity produced still constant at B. In this case, the consumer surplus increases by area CE₁GF, however producer revenue declines by CE₁E₀F. Consequently, the net welfare loss is represented by GE₁E₀.

Figure 2 clearly indicates how the relative elasticities of supply and demand are important determining factors in the magnitude of the welfare impact. It represents a static, short term view and fails to account for the dynamic response by producers in the long term. In Zambia, such impacts can be quantified within a simulation modelling framework detailed in Section 3. Zambian maize exports are not sufficient to move world prices, which make the small country assumption associated with Figure 2 valid, but its role in regional markets and prices through providing exports into neighbouring countries such as Zimbabwe still implies some negative impact on consumers in neighbouring countries. Thus the proposed model specification must allow for such effects to be quantified, despite the lack of world price impact, whilst also illustrating the trade-flow implications of the imposed export controls. The dynamic nature of
the model further allows quantification of the supply response in Zambia flowing from the imposition of export controls.

3. METHODOLOGY

A number of quantitative techniques have emerged for the evaluation of increasingly complex agricultural and trade related policies globally. The application of multiple models reflects differences in objectives and the resulting model structure, aggregation levels and data requirements (Van Tongeren, Van Meijl & Surry, 2001). Broadly, simulation models are categorized into Computable General Equilibrium (CGE) and Partial Equilibrium models, each of which is characterized by specific strengths and weaknesses. In deciding which is more appropriate for specific analysis, analysts must weigh the desire for broad country, sectoral and product coverage, with the need to incorporate detailed and accurate coverage of particular markets and policies (Westhoff, Fabiosa, Beghin & Meyers, 2004). For this study, the focus on maize, as well as the need for detailed policy inclusion and evaluation renders the partial equilibrium model more appropriate.

Partial equilibrium simulation models have been applied successfully by international institutes such the Food and Agriculture Organization (FAO) of the UN, the Organization for Economic Cooperation and Development (OECD), the European Commission, the International Food Policy Research Institute (IFPRI) and the Food and Agricultural Policy Research Institute (FAPRI). Whilst such models have proven useful for market analysis, price forecasts and strategic policy evaluation (Poonyth, Van Zyl & Meyer, 2000), they remain simplifications of reality (Binfield, Adams, Westhoff and Young, 2002). Despite the simplifying assumptions synonymous with the technique, it is essential that model specification reflects the reality of price formation within the market, given its influence on the accuracy and predictive power of such models (Meyer, Westhoff, Binfield & Kirsten, 2006).

The proposed model specification considers the isolation of Eastern and Southern African maize prices from the world market, as well as the need to reflect salient market features and complex interaction between regional maize markets in the trade and pricing solution. Across the spectrum of quantitative models applied in literature, differences in the structure of trade-flow incorporation and price linkage methodologies are mainly attributed to the assumptions regarding product homogeneity and the extent of spatial explicitness. Whilst more common in CGE than partial equilibrium context, occasional incorporation of spatially explicit features into the partial equilibrium framework has relied on two broad approaches, defined by the assumptions related to product homogeneity. At opposite ends of the scale, the spatial equilibrium approach assumes perfect homogeneity, whereas the so called Armington approach differentiates products based on country of origin, implying that the law of one price is no longer required to hold. Both approaches have specific strengths and weaknesses which influences relevance for specific analysis.
Literature suggests that the Armington specification performs well when trade flows are relatively constant (Dillen & Gay, 2014; Witzke et al., 2011; Nolte, 2006), however the historic volatility in trade patterns within the ESA region (Figure 3) suggests that a spatial equilibrium approach, which is able to shift from one regime to another, will be more successful. Given the frequency of government intervention in these markets, switching regimes are particularly relevant to the ESA region (Burke & Myers, 2014; Myers & Jayne, 2012; Traub, Myers, Jayne & Meyer, 2010) and cannot be ignored.

To reflect multiple market linkages and non-linearity of price transmission between different markets, spatially explicit bilateral trade-flows are incorporated into the partial equilibrium structure. As opposed to a traditional assumption of linear price transmission to summarises spatial arbitrage conditions, Meyer et al. (2006) notes that markets, characterised by a type of ‘regional autarky isolated from world markets,’ are more appropriately cleared based on equilibrium pricing which equates total supply to total demand. As such, trade-flow is modelled as behavioural equations based on principles of spatial arbitrage and markets will only interact when trade actually occurs. It is assumed that arbitrage conditions would push the two markets towards the spatial equilibrium condition. Exports from region $i$ to region $j$ ($E_{ij}$) could therefore be specified as follows:

$$
E_{ij} = \begin{cases} 
0 & \text{if } P_j < (P_i + T_{ij}) \times (1 + TR_{ij}) \\
\beta_i (P_j - (P_i + T_{ij}) \times (1 + TR_{ij})) & \text{if } P_j > (P_i + T_{ij}) \times (1 + TR_{ij}) 
\end{cases}
$$

(1)

Where $T_{ij}$ relates to the cost of trade from region $i$ to region $j$, $TR_{ij}$ refers to the import tariff in region $j$ applied to products originating from region $i$. If the trade-flow correction parameter
(β1) is infinitely large, the law of one price would be enforced and the spatial arbitrage condition would hold. Factors such as time required in exploiting arbitrage conditions, policy implementation, infrastructural restraints, imperfect information and agent expectations related to price movements all contribute to finite elasticities. The resulting imperfect substitution is embedded in the parameter β1, which imposes the strength of the arbitrage correction. Literature has confirmed that the size of deviations from equilibrium conditions between markets influence the rate of adjustment (Goodwin & Piggot, 2001), which suggests that the strength of adjustment should not be fixed. Flexibility in the strength of adjustment towards the arbitrage condition can be introduced through a constant threshold variable (kij) that would result in a much larger arbitrage correction if breached, in which case $E_{ij}$ can be specified as follows:

$$E_{ij} = \begin{cases} 
0 & \text{if } P_j < (P_i + T_{ij}) \times (1 + TR_{ij}) \\
\beta_1(P_j - (P_i + T_{ij}) \times (1 + TR_{ij})) & \text{if } P_j > (P_i + T_{ij}) \times (1 + TR_{ij}) \\
\beta_2(P_j - (P_i + T_{ij}) \times (1 + TR_{ij}) - k_{ij}) & \text{if } P_j - k_{ij} > (P_i + T_{ij}) \times (1 + TR_{ij})
\end{cases} \quad (2)$$

In this case, the arbitrage correcting parameter beyond the threshold ($β_2$) would be much larger than $β_1$. The remaining challenge with imposing strict spatial arbitrage conditions is embedded in temporal scale; the partial equilibrium model used for simulations is an annual model, whilst trade occurs on a daily basis and the response to conditions of spatial arbitrage takes time (Goodwin & Piggot, 2001). Hence while annual average prices may not be indicative of spatial arbitrage, trade may still be observed due to periods in the year when relative prices were conducive to trade. Consequently, an additional threshold parameter may need to be introduced to allow trade to occur close to the occurrence of spatial arbitrage, as opposed to only occurring when spatial arbitrage holds strictly on an annual basis. Under this condition, the behavioural equation could be specified as follows, with $m_{ij}$ reflecting the additional threshold:

$$E_{ij} = \begin{cases} 
0 & \text{if } P_j + m_{ij} < (P_i + T_{ij}) \times (1 + TR_{ij}) \\
\beta_1(P_j - (P_i + T_{ij}) \times (1 + TR_{ij}) + m_{ij}) & \text{if } P_j + m_{ij} > (P_i + T_{ij}) \times (1 + TR_{ij}) \\
\beta_2(P_j - (P_i + T_{ij}) \times (1 + TR_{ij}) - k_{ij}) & \text{if } P_j - k_{ij} > (P_i + T_{ij}) \times (1 + TR_{ij})
\end{cases} \quad (3)$$

The suggested specification is presented as an alternative methodology to replicate a switch in regime introduced by Meyer et al. (2006), without linking any prices directly. In avoiding direct price linkages, instead allowing transmission between markets to emanate from trade volumes, interactions between multiple markets can be simulated simultaneously. As suggested by Meyer et al. (2006), the absence of trade would imply that price transmission is weak, with domestic prices being influenced by domestic supply and demand conditions. Arbitrage conditions would however result in some trade-flow and imply transmission from market $i$ to market $j$, whilst a breach of the threshold would allow trade-flow to become significantly more elastic, implying a higher degree of price transmission between markets. Should relative prices shift to the extent that a country moves from a net importing to an autarkic or even net exporting...
position, the proposed setup would allow enough movement in prices for this to occur, whilst also allowing for impacts on other countries in the region. By implication, the specification would allow for stronger future price transmission between markets where it is historically weak if trade is initiated from very low levels. This would not be the case if a pre-estimated price transmission is imposed through direct price linkage.

The proposed model structure determines prices as a function of total supply and total demand, with trade providing influence from world and regional prices. Prices are therefore the result of the solution obtained from the entire system of equations. Figure 4 presents a flow diagram illustrating endogenous variables in blue and exogenous variables in white. Net trade by country and its impact on domestic prices (enclosed) is expanded in Figure 5 to enable illustration of more detail, but with the inclusion of only 3 countries for simplicity.

Figure 4: Flow diagram of model structure and price formation
Figure 5 indicated that within the trade-flow equations, different regional prices within each country are considered for trade with specific partners, based on its typical status as surplus or deficit market within the country and geographic proximity to trading partner. The price solution is however based on a single important market within each country (except for Mozambique which is closed on a national average price) and transmitted to alternative regions through a price linkage equation. In South Africa, a single Randfontein reference price is determined on the commodity exchange, but both yellow and white maize are traded. Closure is achieved through the yellow maize price, which is transmitted to white maize using an elasticity of 1.10 on the yellow maize price, as well as total maize production, as white maize prices are typically lower than yellow in a surplus year, but higher in a deficit year.

Domestic supply and demand specifications are based on traditional approaches employed by institutions such as the FAO, the OECD, the European Commission and FAPRI at the University of Missouri. Given the poor quality and short time series available within the Eastern and Southern African region, many parameters are synthetic in nature, being derived from literature, economic theory and analyst judgement. Theoretical specifications, as well as parameter assumptions are detailed in Davids (2017).

4. IMPLICATIONS OF THE REGIONAL DROUGHT IN SOUTHERN AFRICA IN 2016

The drought conditions experienced across most of Southern Africa in 2016 provided a scenario which prompted Zambia to impose an export ban and is therefore used to quantify the impacts of the policy response. Across most of Southern Africa, 2015 already provided a below average harvest, with shortfalls evident in South Africa, Zambia, Zimbabwe, Mozambique and Malawi. Markets were however well stocked following the bumper crops recorded in 2014,
which dampened the price impact. Towards the end of 2015, indications of a strong El Nino event started raising concern for another below average year in 2016. Zambia in particular had exported a substantial share of its surplus stocks in 2015, implying that the impact of a second consecutive drought on prices would be far more severe.

As the season played out, these fears were realised, as South Africa recorded the lowest annual rainfall in more than a century. Harvests in Zimbabwe and Mozambique were also well below average levels, however favourable conditions in the North of Zambia resulted in a year on year increase in production from 2015 levels. Nonetheless, the crop remained short of the three-year average and well below what could be expected in a normal rainfall year. Generally, grain traders were anticipating a regional shortfall of more than 5 million tons of white maize for the 2016/17 marketing season and concern grew rapidly around the potential sources of white maize imports as the world mainly trades yellow maize and not white maize. Figure 6 illustrates the projected production levels for 2016 based on normal trend yields, relative to the drought scenario that ultimately played out in the region. The impact was concentrated in Southern Africa, with little change evident in production levels across Eastern Africa.

In response to the regional shortage and to secure domestic supply, Zambia imposed export controls in April 2016. To illustrate the impact of these export controls, the simulation is conducted in 2 steps. The starting point is a baseline outlook, reflecting simulated production levels, trade-flows and the associated price impacts based on projected trend yields. This is derived from an assumption of stable weather conditions and provides a benchmark against which the impact of the drought can be measured and understood. This baseline also assumes that trade is not restricted and occurs freely.

The first alternative scenario retains the assumption that trade occurs without restraint, but area and yield levels are reduced to bring production in line with the actual scenario that played out
in the region. This yields regional price levels that “might have been” had export controls not been imposed in response to the drought. The second alternative scenario then reduces Zambian exports to simulate the imposition of export controls. Given the prevalence of informal trade, as well as the fact that trade controls are not always imposed for the full 12-month period, Zambian exports are reduced to 10% of the value simulated based on price differences between Zambia and the various destination countries. This results in total exports from Zambia of approximately 270 thousand tons in 2016. The absolute export volumes from Zambia to the various Southern African countries under both the baseline and trade control scenarios is presented in Table 1.

Table 1: Zambian exports to selected destinations in 2016 drought – open borders vs. trade controls

<table>
<thead>
<tr>
<th>Export destination</th>
<th>Drought: Open borders (Thousand tons)</th>
<th>Drought: Trade controls (Thousand tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malawi</td>
<td>7.23</td>
<td>14.45</td>
</tr>
<tr>
<td>Mozambique</td>
<td>10.13</td>
<td>2.06</td>
</tr>
<tr>
<td>South Africa</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>541.42</td>
<td>254.30</td>
</tr>
<tr>
<td>Other</td>
<td>0.77</td>
<td>0.20</td>
</tr>
</tbody>
</table>

5. SIMULATION RESULTS

The production shortfall illustrated in Figure 6 implied that South Africa, which is typically the largest surplus producer in the region, required substantial imports of both white and yellow maize, which also limited the extent to which it could supply white maize to the rest of the region. This left Zambia as the only significant surplus producer amongst Southern African countries and the consequent price increase affected all countries in Southern Africa (Figure 7). The biggest price impact in percentage terms is observed in Malawi, South Africa and Zambia, but in absolute terms, the increase is similar in all five Southern African countries. By contrast, prices in East African countries such as Uganda, Tanzania and Kenya remained largely unchanged due to the lack of changes in production levels. The El Nino weather phenomenon which was present through 2016, is typically associated with drier conditions in the Southern African countries and wetter conditions in the central and Eastern African countries.

The price response generated by the drought simulation highlights a key difference from the simulation model applied in this study relative to what would be observed in a traditional price linkage approach. In a year when world prices declined, a price linkage approach would have yielded declining prices in the region, combined with higher imports. The alternative specification of using the South African price as a representative world price for white maize would have resulted in rising prices across all of the Southern and East African countries.
The price increase in South Africa is a result of moving from export parity to import parity levels due to the production shortfall. In domestic currency terms, depreciation in the exchange rate further exacerbated the increase through rising import parity prices. Mozambique is a consistent importer of South African maize into Maputo in normal years, hence the South African price increase is also passed through to the Mozambican market. By contrast, the increase in Zambian prices is derived from increased regional import demand, more so than an inability to supply its domestic market. As the only remaining surplus producer in the region, prices increase in line with prices that can be attained in neighbouring countries. This creates a situation where the Zambian government reacts to secure domestic supply, but also to shield domestic consumers from the rising prices across the region. Imposing this response in the modelling framework yields a reduction in Zambian prices, but also an extended influence across the rest of the region.

Figure 8 presents the price impact of the drought shock, as well as the export control policy response across the five Southern African countries modelled. In Zambia, controlling exports has the desired effect of reducing domestic prices, which fall by more than 35% from the levels associated with the drought shock in an open border scenario. In neighbouring countries however, prices increase further due to the reduction in maize available for import. This is particularly true in Zimbabwe and Malawi, where prices increase by a further 4% and 2% respectively. In South Africa and Mozambique, the price increase is negligible, as South African is already expected to import significant quantities from outside the region in the open border scenario and while this volume increases as a result of the export controls imposed by Zambia, price movements are minimal due to the source of additional imports remaining the same. This result is based on the assumption that South Africa is able to procure white maize in the global market, or alternatively import more yellow maize for use in the animal feed market, which allows additional white maize exports into the region.
Price movements in Zimbabwe and Malawi are underpinned by the changes in trade flows that originate from the export controls. Figure 9 indicates that Zimbabwe has to procure imports from other sources, which comes at a premium relative to its usual imports from Zambia and results in higher domestic prices. The bulk of the deficit is filled by South Africa, with some imports accruing from outside the modelled region and some also procured in Malawi. This increase in export demand supports an increase in the Malawian maize price.
Within Zambia and across the region, the price impacts have important implications for supply and demand decisions, particularly for maize which represents the core food staple in the region. The objective of short term policies such as the export controls applied relate to ensuring domestic supply at reasonable prices, which implies a benefit to consumers. This is evident in Figure 10, which illustrates the change in consumption under drought conditions when export controls are applied, relative to the open border but still drought affected scenario across the five Southern African countries. In Zambia, consumption increases markedly due to lower prices, whereas a reduction in consumption is evident across all the other countries where prices increased significantly. In neighbouring countries such as Zimbabwe, which rely on Zambia for imported maize, the negative impact of the drought is exacerbated by the imposition of trade controls in Zambia. The positive impact for Zambian consumers is however much larger than the negative impact on consumers in neighbouring countries.

![Figure 10: Change in per capita maize consumption in drought scenario: Export controls vs. open borders](image)

Numerous researchers, such as Chapoto & Jayne (2009), Jayne (2012) as well as Jayne and Tschirley (2009) have indicated however that this support to consumers comes at the expense of producers and Mitra & Josling (2009) suggested that the net impact on welfare is negative. This is particularly relevant in African countries, where a large number of smaller producers depend on agriculture for their livelihood. In an open market situation, a drought induced reduction in output volumes results in significant price increases, particularly for food staples, which are typically associated with inelastic demand. This increase in prices compensates for the loss in output and depending on specific supply and demand elasticities, producer revenue could even increase. When exports are controlled to reduce domestic prices, this market based mechanism is removed and producers face lower volumes at reduced prices. Figure 11 illustrates this impact, through the change in gross revenue in the drought and export control scenario relative to the drought affected open trade scenario in the five Southern African countries included in the model.
The simulated price impact results in higher gross revenue relative to the open trade situation in South Africa, Zimbabwe, Malawi and Mozambique, whereas gross revenue declines in Zambia. The implication is that, due to the export controls, Zambian producers do not receive the benefit of higher prices in a year when output volumes are already reduced, resulting in a 35% decline in gross revenue relative to the open trade scenario. This reduction in revenue from maize will not incentivize production in 2017, leading in a smaller area response relative to the open border scenario (Figure 12).

Given the limited price response, the increase in area in South Africa relative to the open trade scenario is limited, but a response is evident in Zimbabwe, where the price impact of the Zambian export controls was the largest. The decline of almost 5% in Zambian area planted in 2017 under the trade control scenario relative to the open trade situation under drought conditions suggests that in the long run, the discretionary imposition of short term export controls is detrimental to expanding production in Zambia, which results in it producing a smaller share of regional maize production in subsequent years. In the short run, consumers are indeed better off, but the loss of producer revenue far exceeds the benefit to the consumer.
6. CONCLUDING REMARKS

Literature related to the impact of export controls in ESA maize markets remains sparse, especially when related to wider regional impacts than the country in which its applied. Within the existing literature, a lack of consensus related to cross border price impacts remains, with Porteous (2012) as well as Dabalen & Paul (2014) noting co-movement of prices in markets that trade regularly even when exports are banned. Such findings contrast with theoretical expectations and disagreement remains on the direction of price movements when evaluating historical export bans. This suggests that the regional impacts of such bans are yet to be quantified satisfactorily and warrants further research.

Despite various methodological approaches, which include single equations, CGE model simulations and household survey data analysis, greater consensus emerges amongst studies focused on a single country where the export ban is applied. Authors consistently point to reduced investment and a lack of production growth, but conclusions remain limited in that they fail to account the wider regional context. Arguing that Zambia has become too important a regional supplier over the past decade to ignore the wider impacts of its policy actions, this study applied a partial equilibrium framework that examines both the in-country impacts of export controls in Zambia through the 2016 drought, as well as the cross-border effects.

The dynamic partial equilibrium model applied considers both the impact of the export controls imposed by Zambia and the response by producers and consumers in Zambia and neighbouring countries. The model structure further allows for quantification of alternative trade flows in response to the policy imposed. In country impacts in Zambia are similar to prior studies, with a reduction of 35% in domestic prices relative to the baseline simulation. This compares to a decline of 17% in Tanzania reported by Dabalen and Paul (2014) and a decline of 20% to 50%
depending on the severity of the export reduction reported by Dorosh et al. (2009) in Zambia. Cross border price impacts from the reported simulations contrast reviewed literature (Dabalen & Paul, 2014; Porteous, 2012) in that prices in typical export destination are found to increase due to export controls. This is supported by theoretical expectations, as well as negative global impacts reported by Mitra and Josling (2009), Bouet and Laborde (2010) as well as Martin and Anderson (2012). While Zambia, with its growing prominence as an exporter, was used to illustrate the existence of cross border impacts when export controls are applied, it is not the only country in the region where they have been prevalent. Export bans have also been utilised in countries such as Tanzania and Malawi, thus principles from the results from this study can also be useful to these countries.

Having confirmed the negative aggregate impact of imposing export controls in Southern Africa, both within Zambia where the policy is applied and across borders, but also noting the reasons for continued application, one must question possible alternatives. Haggblade et al. (2008), Jensen and Sandrey (2015), as well as Morrison and Saris (2016) note the potential benefits from keeping borders open and encouraging intra-regional trade in Africa, but few have suggested alternatives that achieve the same price reducing effect for consumers. Domestic consumption management measures, such as government procurement at market prices combined with subsidized sale to low income consumers will protect the consumer without the direct price impact on producers, but the fiscal burden falls to government (Mitra & Josling, 2009), which must also generate revenue from tax income. In least developed countries, where agriculture continues to account for a large share of the economy, the difficulties with making such a program viable through taxation of luxury goods is clear. Supply augmenting measures, such as increased investment in irrigation and other agricultural infrastructure tends to be neglected by cash strapped governments (Mitra & Josling, 2009). Policies that redistribute welfare from producers to consumers do not encourage private investment into such measures. Hence the well documented need to prioritize production and productivity growth due to its long term benefits for both consumer and producer (Dorosh et al., 2009; Mitra & Josling, 2009; Haggblade et al., 2008).
7. REFERENCES


