



**Does the Current Sugar Market Structure Benefit Consumers and
Sugarcane Growers?**

by

**Brian Chisanga, Ferdinand H. Meyer, Alex Winter-Nelson,
and Nicholas J. Sitko**

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The Indaba Agricultural Policy Research Institute is a non-profit company limited by guarantee and collaboratively works with public and private stakeholders. IAPRI exists to carry out agricultural policy research and outreach, serving the agricultural sector in Zambia so as to contribute to sustainable pro-poor agricultural development.

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Any views expressed or remaining errors are solely the responsibility of the authors.

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EXECUTIVE SUMMARY

Over the years, the sugar sector has experienced tremendous growth which has been driven by increased Foreign Direct Investment (FDI). According to the United Nation's Food and Agricultural Organisation (FAO 2013), raw sugar production rose from 135,000 tons in 1990 to 430,500 tons by 2012, while exports grew from less than a thousand tons to 273,000 tons over the same period (FAO 2013). While increased investments have generated growth, they have also tended to create market structures in which a single multinational is dominant. This concentration raises concerns about the functioning of these increasingly important markets and the efficiency and equity implications. Moreover, Zambia is a low cost sugar producer (Ellis, Singh, and Musonda 2010) and exports over 60% of its production and yet the domestic price of sugar is high, exceeding the world price. This anomaly in pricing may be due to a number of factors such as high internal marketing costs or it may also be due to the exercise of market power by the dominant firm under the current market structure.

The current (near monopoly) market structure is also thought to be reinforced by policy. Current legislation requires all sugar meant for household consumption in the domestic market, to be fortified with Vitamin A, a requirement that has closed the market to external competition from imports because only a few countries in the region fortify their sugar. Administrative barriers such as lengthy and bureaucratic procedures for getting import permits are often encountered during the importation of sugar into the domestic market (Ellis 2010). This rigidity has also been extended to industrial sugar which does not need to be fortified.

While the market is highly concentrated, contract farming arrangements enable smallholders to be included in the value chain. Currently about 372 smallholder farmers produce sugarcane on a total of 1,975 Hectares of land under out grower schemes including the Kaleya Smallholder Company, Maggobo, and Manyonyo schemes (Palerm, Sierevogel, and Hichaambwa 2010). The relationship between processors and sugarcane producers is important in that it has potential to uplift the living standards of farmers as market participants. This relationship, including price determination, is governed by contracts whereby prices are set on an annual basis. Under the current market structure in the sugar market, the relationship between these increasingly important sugarcane producers and sugar millers has far reaching implications on equity in the sugar supply chain.

The main objective of this paper is to examine the sugar market structure in respect to pricing and how consumers and producers are affected. The paper also reviews the underlying policy framework in the sugar market with the view of identifying policy options for a well-functioning market.

The specific objectives of the paper are:

- i) To review the existing structure of the sugar market;
- ii) To determine whether the current market structure of the sugar industry benefits consumers and sugarcane growers; and
- iii) To evaluate the policy framework underlying the sugar market and identify options for improving the functioning of the market.

Conceptually price relationships are a broad indicator of welfare distribution between key players. In a market structure with one dominant player, there is a high likelihood for the exercise of market power which can affect welfare distribution between sugar millers, sugarcane producers, and consumers in the value chain. Price theory states that there should

be co-movement of prices in the value chain and the difference between prices should be explained by transaction costs (This is also referred to as the Law of One Price (Rapsomanikis, Hallam, and Conforti 2004).

The main findings of the study are summarized below:

1. The current market structure does not benefit consumers.

The study establishes that the existing market structure does not allow consumers to fully benefit from the sugar market through the price mechanism. Consumers' welfare is undermined because market power is vested in one key player who faces limited competition. Prices of sugar have been on the rise for most of the period under review despite production increasing over the same period. Zambia is reported to be a low cost producer of sugar which implies that consumers do not benefit from comparative advantage that Zambia is endowed with. The study further finds that the domestic sugar price is unrelated to the prevailing supply and demand conditions and exceeds the general price levels (inflation). Zambia has one of the highest prices of sugar in comparison to other sugar producing countries in the region.

2. The current market structure benefits sugarcane producers.

Sugarcane producers are becoming important as suppliers of sugarcane to sugar millers through out-grower arrangements. The price relationship between sugar millers and sugarcane producers is contractual and based on the division-of-proceeds which is based on the quality of the sugarcane and which is tied to the ex-factory (processors') price. In this way, sugarcane producers participating in out-grower arrangements are positioned to benefit from price rises.

3. Pricing in the sugar market is characterized by weak and distorted transmission of price signals.

Empirical analysis of the sugar market indicate that sugar millers are able to benefit from world price changes as there is co-movement between the domestic ex-factory price and the world price. However, the lack of co-movement between ex-factory and retail prices entails that consumers are less likely to benefit from these price movements. Sugar millers in Zambia allow much more rapid pass-through of world price increases to consumers than world price decreases. By contrast, sugar millers are more willing to transmit price increases to sugarcane producers than decrease. In this way, sugarcane producers stand to benefit from the relationship.

4. Current policy framework supports high domestic sugar prices.

The underlying policy framework in the sugar market may have led to the observed distortions in the market. The legislation on vitamin A fortification to a large extent has contributed to the observed high price which began to rise soon after its introduction and have continued to rise. In addition, the permit requirements are so cumbersome in that one has to obtain paperwork from three ministries.

Policy Options

There is need to re-evaluate whether fortification of sugar is still a good strategy for enhancing Vitamin A access to the Zambian population. Fortification of sugar has insulated

the sugar industry from competition and hence, the need to review the policy. Excessive market power is hurting the market. There are a number of other options for stepping up Vitamin A access including bio fortification of crops such as orange maize and orange fleshed sweet potatoes.

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ACRONYMS

| | |
|-------|---|
| APT | Asymmetric Price Transmission |
| CSO | Central Statistical Office |
| DRC | Democratic Republic of Congo |
| ECM | Error Correction Model |
| ECT | Error Correction Term |
| EU | European Union |
| FAO | Food and Agriculture Organisation |
| FDI | Foreign Direct Investment |
| FOB | Free on Board |
| GDP | Gross Domestic Product |
| JCTR | Jesuit Centre for Theological Reflection |
| LIFFE | London International Financial Futures and Options Exchange |
| ODI | Overseas Development Institute |
| OLS | Ordinary Least Squares |
| SADC | Southern African Development Community |
| USAID | United States Agency for International Development |
| USDA | United States Department of Agriculture |
| US\$ | United States Dollars |
| ZCC | Zambia competition Commission |
| ZDA | Zambia Development Agency |

1. INTRODUCTION

Starting in the 1990s, Africa began a period of sustained growth in many agricultural spheres. Much of this growth was supported by Foreign Direct Investment (FDI) into the agricultural sector, coupled with increased access to international markets and a more stable and supportive policy environment. While increased investments have sometimes generated explosive growth, they have also tended to create market structures in which a single multinational is dominant. For example, in Zambia, one firm commands about 90% of the total market share for sugar and another single firm is similarly dominant in milk. This concentration raises concerns about the functioning of these increasingly important markets and the efficiency and equity implications of potential market distortions.

The importance of the sugar sector to Zambia's economy cannot be over-stated. As one of the most successful non-traditional export crops for Zambia, it accounts for 3-4% of the national Gross Domestic Product (GDP) and 6% of total national exports in Zambia. The sugar industry provides employment for around 11,000 workers, with a total of dependents probably exceeding 75,000 (Palerm, Sierevogel, and Hichaambwa 2010). Sugar also places a noticeable burden on consumers' expenditure. According to the data compiled by the Jesuit Centre for Theological Reflection (JCTR), sugar constitutes about 5% of the total Basic Needs Basket for Lusaka consumers (JCTR 2013).

Since the liberalization of the sector, Zambia has experienced meteoric growth in its production and export of sugar. According to the United Nations' Food and Agriculture Organization (FAO 2013), raw sugar production rose from 135,000 tons in 1990 to 430,500 tons by 2010. At the same time, the country's exports grew from less than a thousand tons to 273,000 tons over the same period. While Zambia is a low cost sugar producer (Ellis 2010) and exports over 60% of its production, the domestic price of sugar is high, exceeding the world price. Zambia's domestic sugar prices are also among the highest in the Eastern and South Africa region. Public debates have often linked this failure to effectively transmit the economic benefits to the existing market structure where one firm is dominant in the market, controlling about 92% of the market.

Zambia's post-liberalization experience in the sugar industry is mirrored in several other countries in the region such as Malawi, Tanzania, Swaziland, and Mozambique. Following liberalization and privatization, one or a few dominant sugar milling firms have emerged in each of these countries. In an extreme case, Malawi's sugar industry is entirely in the hands of one sugar miller, Illovo Sugar Company. Meanwhile in Tanzania, Illovo accounts for 45% of sugar produced through its subsidiary called Kilombelo Holdings while three other millers account for the remaining 55% of total sugar production. Similarly, in Swaziland the majority of sugar production is controlled by two South African based sugar companies, Illovo and Tongaat Hullets. Tongaat Hullets also controls most of the sugar production in Mozambique and Zimbabwe (Pound and Phiri 2010; Rabobank 2013; Tongaat Hullets 2013).

While the market is highly concentrated, contract farming arrangements enable smallholders to be included in the value chain. Currently, this includes about 372 smallholder farmers who produce sugarcane on a total of 1,975 hectares of land under out-grower schemes including the Kaleya Smallholder Company, Maggobo and Manyonyo schemes in Southern Province of Zambia (Palerm, Sierevogel, and Hichaambwa 2010). Price relationships between the sugar millers and sugarcane growers are governed by contractual prices which are fixed and reviewed every year. This model is particularly seen to be important in delivering benefits to the smallholder farmers in an inclusive way. It is therefore, imperative to understand if

welfare gains are equitably distributed between the firm and the farmers through the price mechanism.

The main objective of this paper is to examine the effect of the sugar market structure in respect to pricing and how consumers and producers are affected. The paper also reviews the underlying policy framework in the sugar market with the view of identifying policy options for improving the functioning of the market.

The specific objectives of the paper are:

- i) To review the existing structure of the sugar market;
- ii) To determine whether the current market structure of the sugar industry benefits consumers and sugarcane growers
- iii) To evaluate the policy framework underlying the sugar market and identify options for improving the functioning of the market.

Following this introduction, the paper discusses the data and methods in section 2 and reviews the sugar market structure in Zambia in section 3. Results of the sugar market analysis are discussed in section 4 and the paper closes with conclusions and policy options in section 5 and 6.

2. DATA AND METHODS

2.1. Data and Data Sources

The market analysis part of the study utilized price data for sugar. This is monthly data is from 1996 to 2010 for the sugarcane producer price, the ex-factory at the processor's gate, the retail price and the world sugar price. The sugar cane producer price was obtained from sugarcane growers; the sugar ex-factory price was obtained from sugar millers while the sugar retail price was obtained from the Central Statistical Office (CSO).

The sugarcane producer price is the price paid to growers for sugarcane delivered to the sugar miller's factory gate. Producers are paid a contract price that is the result of negotiations between the millers and the out-growers contracted to deliver cane. The price is determined based in part on a formula that includes retail price, mill efficiency, sugar quality, and division of proceeds (World Bank 2009). During the period under study, only Zambia Sugar Co. was involved in contract farming with sugarcane growers. These transactions involved some 372 growers that accounted for about 40% of sugarcane supply for Zambia Sugar Co. The producer price varies with the sucrose content of the cane but is fixed for a year and does not vary monthly. The sugarcane is delivered to the millers soon after harvesting and growers are paid once the quality of the cane is determined. These transactions take place throughout the year with new prices set in April which is the start of the season for sugar production.

The wholesale price is the price of processed sugar at the factory gate. Processed sugar is sold into the domestic market to both household and industrial consumers and to the export markets. Differences exist in the quality, form, and packaging for the different markets. Refined sugar for household use is fortified with Vitamin A while industrial sugar and the raw sugar for external markets are not fortified. The price difference between the household fortified and industrial non-fortified sugar is marginal, which reflects the low cost of fortification when spread over high output volumes. The wholesale price series used in this study is for transactions in refined sugar. Sugar companies in Zambia maintain a uniform price of the wholesale sugar at all designated distribution points away from the factory-gate. For Zambia Sugar Co, these distribution points are located in all the 10 provinces of Zambia which is a company strategy. Wholesale price data represent the average price over all domestic transactions completed with the Zambia Sugar Co. during a given month.

Retail prices are taken from the Zambia Central Statistical Office, CSO (2010). These prices represent a monthly average price at which refined sugar is sold to domestic consumers. In practice, sugar is normally channeled through distributors that are either contracted by the sugar millers or purchase sugar from the factory. The retail price is not administered by any contractual arrangement and varies from location to location due to differences in distribution costs and variations in retail margins.

Two commodity exchanges provide representative world prices for sugar. The London International Financial Futures and Options Exchange (LIFFE) trades refined sugar and report a daily refined sugar FOB Europe spot price. A monthly world price for refined sugar is established based on the daily trades.¹ Meanwhile, the Intercontinental Exchange (ICE)

¹ June 2006, the LIFFE refined sugar spot price was replaced with the average of near month for which an entire month of prices is available.

trades a raw sugar contract from which a monthly average world price for raw sugar is reported by the United States Department of Agriculture in (USDA 2010). While one would expect the wholesale price of refined sugar in Zambia to move with the world price of refined sugar represented by the LIFFE data, the bulk of Zambia's exports are of raw sugar. Price transmission could therefore be expected from the ICE world price of raw sugar to Zambia's producer and wholesale prices for cane and refined sugar respectively. The mix of refined and raw sugar in Zambia's exports has been roughly constant during the period of study. The destination of exports has shifted increasingly towards the European Union (EU) since 2006, coinciding with the period of increasing convergence between the EU protocol price and prices available in other markets. This analysis uses the LIFFE refined sugar price as the world price, and conducts robustness checks using the ICE raw sugar price.

2.2. Sugar Market Analysis

To determine whether the current market structure of the sugar industry benefits consumers and sugarcane growers, we use price transmission analysis. The concept behind price transmission is that price differences in markets separated by space or at different stages of the value chain should be explained by transaction costs (Rapsomanikis, Hallam, and Conforti 2004). In price theory, flexible prices are responsible for efficient resource allocation, and price transmission integrates markets (Meyer and Von Cramon-Taubadel 2004). The concept and the analytical techniques of price transmission have been used to evaluate policy reform, such as the assessment of market integration in the context of the implementation of the structural adjustment programmes (e.g., Krivonos (2004) and (Mofya-Mukuka and Abdulai 2013). Another vein of research focuses on price transmission along the supply chain from the consumer to the producer level (Rapsomanikis, Hallam, and Conforti 2004).

In this paper, we consider the transmission of price changes in the world market to Zambian ex-factory, retail and sugarcane producer prices, as well as the transmission from ex-factory prices to sugarcane producer prices. Weak transmission from world prices to ex-factory, retail, or producer prices would suggest distortions in domestic prices. Finally, asymmetric transmission that passes price increases to consumers or price decreases to producers more readily than the reverse could suggest the exercise of market power. Asymmetric Price Transmission implies that some group is not benefiting from a price reduction (buyers) or increase (sellers) that would, under conditions of symmetry (Meyer and Von Cramon-Taubadel 2004). Details on the Vector Error Correction Model and the Asymmetric Error Correction Model can be found in Appendix 1 of this paper.

3. A REVIEW OF THE SUGAR MARKET STRUCTURE IN ZAMBIA

3.1. The Evolution of the Sugar Industry in Zambia

Zambia's sugar industry has been evolving since the 1960s with the establishment of Nakambala Sugar Estates in Mazabuka in the Southern Province of Zambia. Nakambala Sugar Estates (later called Zambia Sugar Company) was nationalized in the early 1970s following the attainment of independence. Zambia Sugar Company, which operated as a parastatal through the 1980s, was protected from any competition in domestic markets. The industry was regulated by the government, which determined market prices and shielded the domestic market from international competition through high tariffs and import restrictions.

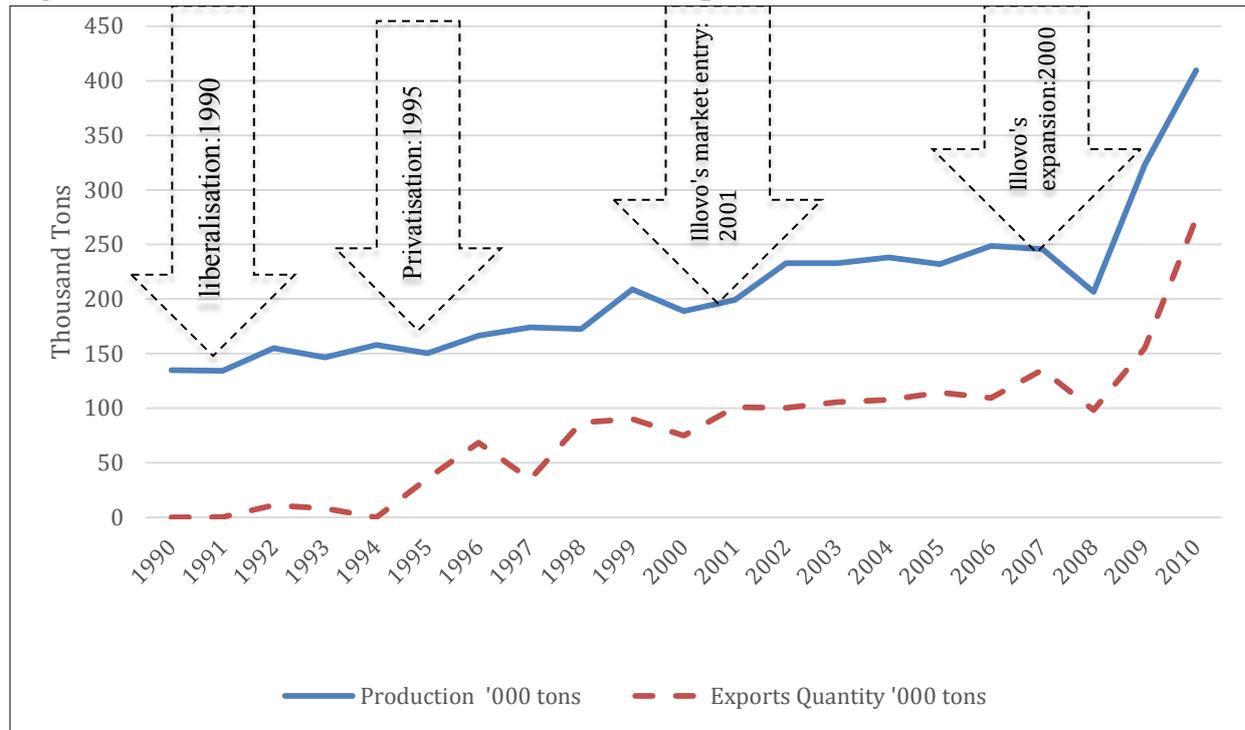
Prior to liberalization, the priority of government pricing was to ensure that sugar was affordable and accessible to the wider population. Profit maximization was not the management objective. Sugar depots were set up in provincial capitals supported by an elaborate distribution network. A uniform price was maintained at each of the depots regardless of the distance to the processing factory. Extreme management inefficiencies and poor access to technology in the sector prompted liberalization and privatization of sugar processing in the 1990s. Following market liberalization, the government ceased to regulate pricing and opened the market to international trade. The government abolished the import license fees and introduced a uniform tariff regime with rates set between 20% and 40%. Discretionary waivers and exemptions on import taxes were also revoked in preference of investment incentives through the Zambia Investment Centre. At present, prices are determined by sugar companies who set their factory gate prices and have set up their own distribution networks.

Zambia Sugar Co. was sold to a British firm, Tate and Lyle, in 1995. In 2001 Illovo Ltd., a South African based firm, took ownership from Tate and Lyle. Further, in 1999 and 2003 two additional processors (Kalungwishi Estates and Kafue Sugar) entered the market. As shown in Figure 1, production and exports rose immediately following privatization and have continued to grow since then.

Both Tate and Lyle and Illovo invested in plant facilities and in sugar production during their respective periods of ownership. They also engaged out-growers to supplement production on the core estate. The foreign investments have transformed the sugar industry. From 2006 to 2010 Illovo Sugar invested approximately U.S. Dollars (US\$) 200 million in plant facilities and estate expansion that more than doubled capacity to 440,000 tons of output. Illovo's takeover and the corresponding investments marked the start of tremendous growth in production and exports. The largest growth was recorded in 2010 following the completion of both sugarcane production and processing factory expansion at Zambia Sugar Co. (Zambia Sugar Co. 2010; FAO 2013). The two other sugar companies each maintain a single processing facility supplied entirely by a core estate and combine to account for well under 10% of total sugar production.²

² Between 2001 and 2010 Zambia Sugar produced an average of produced 236,000 tons annually (Zambia SugarCo. 2010), while national output averaged 251,000 tons (FAO 2013).

Figure 1. Volume of Production and Volume of Exports



Source: FAO 2013.

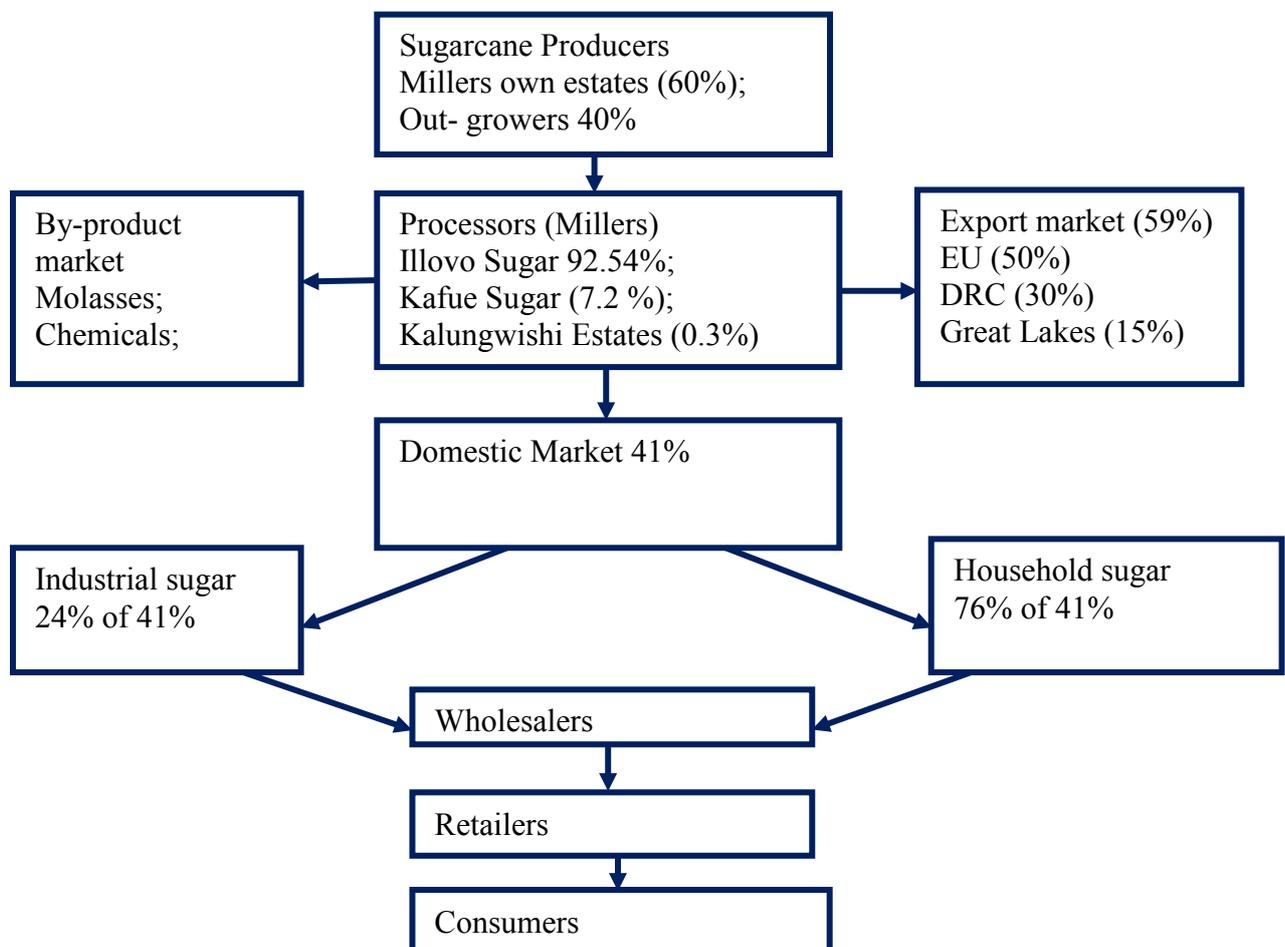
To a large extent, growth in investments in the sugar industry can be attributed to the government’s policy of providing tax and other incentives to large investors. The Zambia Development Agency (ZDA) Act of 2006 stipulates a range of tax exemptions and concessions such as duty free importation of machinery for investors who attain certain threshold of investments (for new investments and expansion in the case of established enterprises) (ZDA 2013). To date only Zambia Sugar Co. (Illovo’s subsidiary) has been able to access the concessions and tax exemptions under this Act. In addition to the incentives, Illovo also signed an Investor Promotion and Protection Act with the Zambian government, which allowed it to import machinery without paying duties and to access finance at reduced prices. Importantly, this act also obligated the government to treat sugar as a sensitive and priority product within government policy guidelines and existing bilateral, regional, and multi-lateral treaty obligations (Richardson 2010). The above developments in the sector have given rise to lopsided rates of growth within the sector, with Illovo doubling its production by 2010 while the other two firms have not recorded much growth. This type of skewed growth has far reaching implications on competition in the sector and consequently on the behavior of the dominant firms.

As Figure 1 indicates, between 40% and 67% of Zambian sugar has been exported each year since privatization, with 273,679 tons (67% of total production) exported in 2010. Export destinations for sugar include the European Union, Democratic Republic of Congo, the Great Lakes region, the Southern African Customs Union and more recently Zimbabwe (World Bank 2007; Agritrade 2010). Under the current EU trade regime, Zambia has duty and quota free access to the EU market. As a result of this opportunity, the proportion of sugar exports that are destined for the EU has been growing since 2007 relative to the share to regional markets.

3.2. The Sugar Value Chain in Zambia

The production end of the value chain in Zambia is divided between the large sugar estates belonging to the sugar millers and smallholders lined to these mills through out grower schemes. Figure 2 shows the sugar value chain in Zambia. About 40% of the total production of sugarcane in the industry is produced by out-grower producers while 60% of sugarcane is produced by the core estates owned by the sugar millers themselves. The sugar millers or processors convert the raw cane into processed sugar, which includes refined, raw sugar and other downstream products depending on the target market. From the sugar millers' factory-gate, processed sugar is delivered to the domestic market which makes up 41% of total sugar sales. In the domestic market, sugar is sold to wholesalers and retailers for direct consumption, which makes up about 76% of the domestic market. Industrial sugar is delivered to downstream industrial users for further processing and constitutes about 24% of the domestic market. The bulk of Zambia's sugar, about 59% is sold in the export market. This includes raw sugar sold to the overseas export market, mainly the EU, which accounts for about 50% of sugar exports, and household and refined sugar to regional markets, such as the Democratic Republic of Congo (DRC) which accounts for about 30% of exports, the Great lakes region which accounts for about 15% of exports, and the SADC region which accounts for about 5%.

Figure 2. Sugar Value Chain in Zambia



Source: Interviews with stakeholders in the sugar industry.

Among all the three sugar millers in Zambia, only Zambia Sugar Plc has established contractual (vertical) relationships with sugarcane growers in its supply chain. These out-grower arrangements include the Kaleya, Maggobo, and Manyonyo smallholder schemes. Kaleya Smallholder Scheme is the largest out-grower scheme which was initiated in 1981 by shareholders as a poverty alleviation strategy and an expansion strategy by Zambia Sugar Plc. The land was provided by the Zambian government and shareholders formed a holding company, the Kaleya Smallholder Company Limited. With Zambia Sugar's expansion programme, two other out-grower schemes have been established. These include Maggobo Cane Growers Association with support from the European Union and Manyonyo Water Use Association which is an initiative by the Ministry of Agriculture and Livestock with funding from the African Development Bank. Kafue Sugar and Kalungwishi Estates have indicated that they would be venturing into out-grower scheme developments. Table 1 shows the basic information on the out-grower schemes that are currently supplying Zambia Sugar Plc (Palerm, Sierevogel, and Hichaambwa 2010)

The relationship between Zambia Sugar Plc and out-growers is governed by contractual arrangements. The contracts are indefinite and reviewed every three years. Sugarcane out-growers are offered supply quotas for the supply of cane and these are awarded based on a three year average of cane supplied by a farmer subject to review. The sugarcane price is a contract price negotiated between the company and farmers. The sugarcane price is based on Estimated Recoverable Crystals and shared proceeds from the sale of sugar. Growers exclusively supply the sugar company over the period of the contract. Sugar millers and sugarcane out-growers' representatives meet every year in April to set the sugarcane price. April is the beginning of the sugar harvest period that takes about 34 weeks through to December annually.

The growing importance of out-grower schemes to Zambia's sugar industries is evident by the increasing cane deliveries over the recent past. In 2011/12 season out-growers supplied about 1.15 million tonnes of sugarcane. Small-scale growers' supplies were around 255,000 tons, with 22,000 tons delivered by the newly-completed Maggobo smallholder scheme, and 231,000 tons by the established Kaleya smallholder scheme. Smallholder sugarcane deliveries increased to about 300,000 tonnes by 2012/13 season. Payments to out-grower sugar suppliers in 2011/12 season amounted to ZMK 239 billion (US\$ 46.4 Million) (Zambia Sugar 2012). When the World Bank evaluated a number of value chains in Zambia where smallholders are involved, sugar growing under contract arrangements was found to be the most profitable enterprise (World Bank 2007). Thus, growth of the sugar industry which takes along smallholders in the value chain potentially has poverty reduction effects on the economy.

Table 1. Basic Information on Smallholder Sugarcane Out-grower Schemes in Zambia

| Out-grower Scheme | Hectares of Sugarcane | Number of Smallholder farmers | Average hectares per farmer |
|--------------------------|------------------------------|--------------------------------------|------------------------------------|
| Kaleya | 1,040 | 160 | 6.5 |
| Maggobo | 380 | 76 | 5 |
| Manyonyo | 555 | 136 | 4 |

Source: Palerm, Sierevogel, and Hichaambwa 2010.

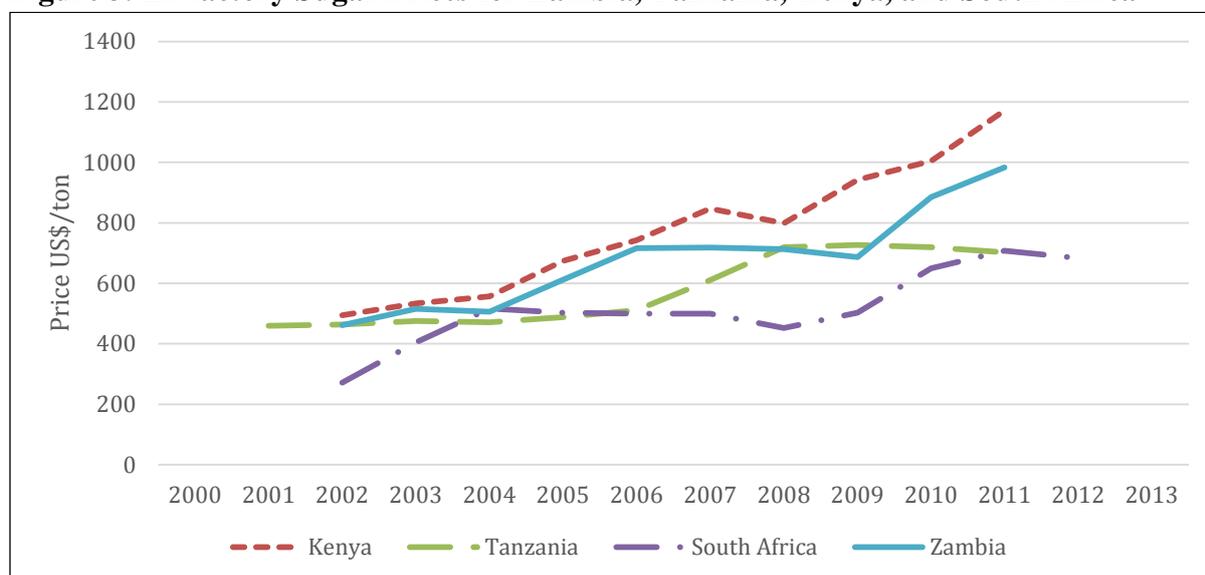
3.3. Sugar Pricing and Policies in Zambia

Consumer prices for domestic sugar in Zambia have been found to be high. In 2010, a study by the Overseas Development Institute (ODI) found that the average cost of sugar production in Zambia is US\$ 169 per tonne compared to the world average of US\$ 263 per tonne. More recently, a research by the ODI and LMC International ranked Zambia to be one of the low cost sugar producing countries with cost being less than US\$ 400 per tonne (LMC International and ODI 2012). Despite the wide variation in cost estimates, previous research points to the fact that Zambia is a competitive sugar producer. The low cost is driven in large part by high crop yields relative to those in other African and South Asian countries. Zambia’s domestic sugar price however, is higher than that found in other low-income sugar producing countries (Kenya, Vietnam, and Bangladesh) (Ellis, Singh, and Musonda 2010). By contrast, sugar millers contend that the cost of doing business in Zambia is generally high and this drives the price of sugar upwards. They have cited taxation, costs of energy, transportation, labor, and sugarcane purchases as major cost drivers (Chulu 2009; Boriyo 2010).

Industrial users of sugar have also felt the impact of high sugar prices. In response to the high domestic sugar prices which affects their competitiveness in downstream production, large industrial sugar users lodged a complaint to the Zambian Competition Commission (ZCC) about high sugar prices in Zambia. The companies had requested ZCC to bring prices down to world market levels plus a 10% surcharge to cover local conditions or allow sugar imports (Ellis, Singh, and Musonda 2010).

Sugar prices in Zambia’s domestic market appear to be higher than in other countries in the region, where costs of production could even be higher. Figure 3 shows the ex-factory price of sugar in Zambia, Kenya, Tanzania, and South Africa. Ex-factory price refers to the price at the processors gate, in this case at the miller’s gate. Zambia’s ex-factory price exceeds those of South Africa and Kenya although they are lower than Kenya. Noting that Kenya’s has been noted to be an inefficient (high cost) sugar producer (ACF 2014), Zambia’s sugar prices are high relative to other sugar producing countries in the region.

Figure 3. Ex-factory Sugar Prices for Zambia, Tanzania, Kenya, and South Africa

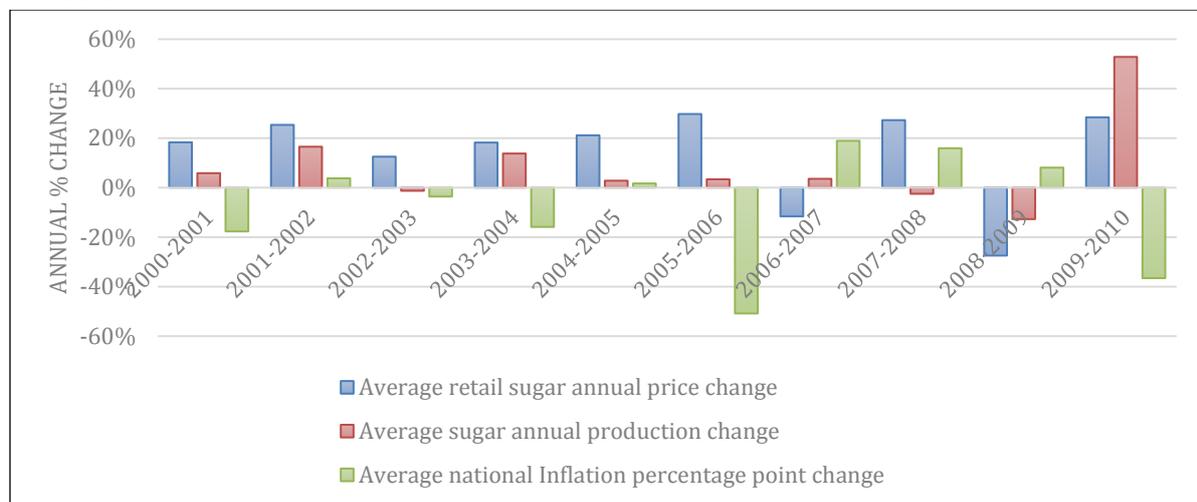


Source: ACF 2014.

Interestingly, there are cases where Zambia’s sugar has been found to be cheaper in countries who actually import from Zambia. One such example is the Democratic Republic of Congo which is Zambia’s largest importer of household sugar. In 2009, average retail sugar prices in Zambia were about US Cents 98.3/kg whereas the retail price of the sugar in Lubumbashi (imported from Zambia) was US\$ 920/ton equivalent to US Cents 92.0/kg (Chulu 2009). This price discrimination between the export and domestic market could reflect that sugar millers maybe price makers in the domestic market and yet when it comes to the export market they are price takers. In other words, sugar millers have significant influence in the domestic market and therefore the pricing has little to do with local demand and supply condition because there is one major player with no significant competitor. Hence, they can charge a high price. In the export market, where they have to compete with other suppliers such as Tanzania, Malawi, or Kenya, they charge a lower price.

Pricing of commodities should respond to demand and supply conditions and should be in line with general price levels (inflation rate). Figure 4 shows the annual percentage change in retail sugar prices, the annual percentage growth in sugar production, and the percentage point change in annual inflation rates between the period 2000 and 2010. It can be seen from the graph that sugar price have risen in most of the years while production (supply) of sugar has also been rising. By contrast, annual inflation rates in Zambia have been on the decline for most of that period. Retail sugar prices have actually increased at the average annual rate of 14% per annum, while production increased at the annual average rate of 8%. Inflation, however, declined at the annual average rate of eight percentage points. This implies, first and foremost, that sugar pricing does not necessarily respond to the prevailing supply conditions and appears to exceed the national general price increase levels (inflation). National population growth rate annually is about 3% and this suggests that demand conditions may have not increased dramatically over that period. Hence, sugar pricing appears to be driven by factors other than demand and supply condition. When we consider the period 2009 to 2010, sugar production grew by 53% and yet prices increased by 28% which is not what is expected based on laws of demand and supply. Exports might explain this boost in production considering that they have increased by about 15% annually on average over the same period.

Figure 4. Annual Percentage Change in Retail Sugar Prices, Production, and National Inflation



Source: CSO 2010; World Bank 2013.

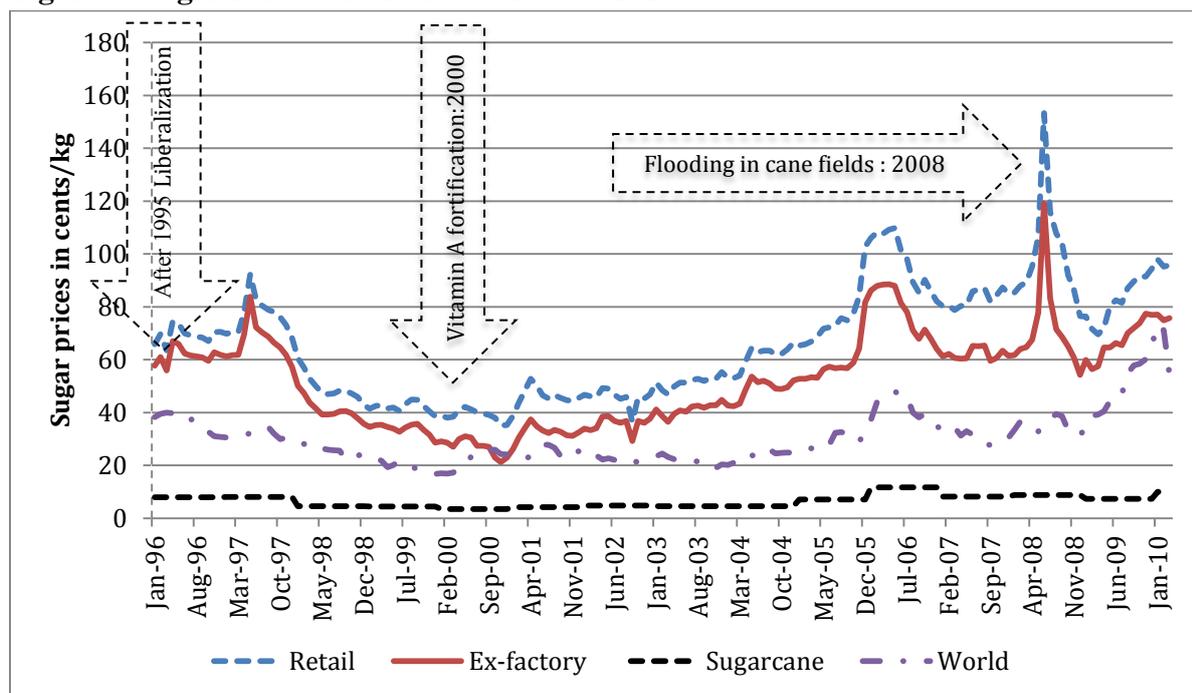
Policies play a significant role in shaping economic outcomes in the sugar market. Notably, liberalization, privatization, vitamin A fortification requirement for all directly consumed sugar, and administrative barriers have all played important roles in the observed outcomes in the sugar industry. The pattern of private investment has also shaped the industry. Figure 5 shows producer, wholesale, and world prices for sugar as well as policy initiatives (privatization and vitamin A legislation).

Following liberalization and privatization, domestic prices and world prices tended to fall and converge until the year 2000. This was possibly because of increased sugar production by Zambia Sugar Company under the ownership of Tate and Lyle coupled with trade openness under the now liberalized trade regime. In 2000, legislation requiring vitamin A fortification was implemented. This coincided with the change of ownership of Zambia Sugar when Illovo Sugar purchased a majority stake in the company.

In Zambia, sugar marketed for domestic household use is required by law to be vitamin A fortified, while exported sugar is not. Thus, sugar marketed for export is excluded from the domestic household market. By the same token, because few other countries fortify sugar, sugar from international markets cannot be imported into Zambia for household consumption.

The decision to fortify Zambia’s sugar was motivated by the high Vitamin A deficiency in the Zambian population which stood at about 68% in 1998 (National Food and Nutrition Commission 2003). Notably, the implementation of the fortification was championed by the Ministry of Health and USAID. At the same time, there were business incentives for private sugar millers, particularly Zambia Sugar Plc, to support the fortification legislation, which it hoped would bring a reduction in smuggling and lead to an increase in domestic sales that would offset the cost of fortifying sugar (Serlemitsos Fuscus 2001).

Figure 5. Sugar Prices and Policies: 1996 to 2010



Source: Zambia Sugar 2010; USDA 2010. Wholesale price is factory gate for refined sugar; Sugarcane price is factory gate, World price is FOB Europe for refined sugar.

Although the vitamin A policy was meant to achieve health objectives, its implementation could be viewed as a Non-Tariff Barrier to trade, preventing imports, and thus concentrating the market further. In this regard, the legislation could have played a significant role in concentrating the market further by consolidating Zambia Sugar Plc as the main supplier of sugar in the Zambian market. The legislation was supported by what has been termed an administrative barrier to trade in that it required sugar imports be approved by three government departments: the Ministry of Agriculture, the Ministry of Health and the Ministry of Commerce, Trade and Industry (Ellis, Singh, and Musonda 2010). Prior to the legislation, imports (originating from Malawi) had reached almost 25% of total domestic consumption.

Following the legislation, imports declined significantly and domestic prices began to rise, diverging from world prices. For the five year after the legislation, domestic prices rose, while world prices were roughly stable. From the end of 2005 onward, both domestic and world prices show a rising trend and begin to converge in 2009. The period since 2001 has also been characterized by the widening of the gap between the wholesale and producer prices suggesting a change in the distribution of profits between farmers and processing firms. Thus, the legislation may have contributed to escalating prices of sugar, working against the initial objective of making Vitamin A accessible to the wider population.

Vitamin A deficiency in children in Zambia declined to 54.1% in 2003 from the previous 65.7% 1997. It is, however, worth acknowledging that there this decline may not be wholly attributed to sugar fortification. There have been other means of providing Vitamin A to women and children that is, through Vitamin A supplementation. Vitamin A is provided to children under the age of five and to women who have just given birth. (National Food and Nutrition Commission 2003). It is therefore, unclear whether the reduction in Vitamin A deficiency is due to sugar fortification in sugar or through other complementary means. In addition, Vitamin A is also made available through bio fortification means which include orange fleshed sweet potatoes and orange maize which are rich in vitamin A.

A survey by the National Food and Nutrition Commission indicated that 59% of the sampled households consumed sugar. However, the survey recognized the high cost of sugar to be a challenge for most poor households accessing the commodity. Because of the high cost of sugar, most households only consumed sugar occasionally (mostly at the beginning of the month). This is mostly repackaged from the original package and sold in smaller units. For rural households their consumption was low during the rainy season (National Food and Nutrition Commission 2003). The high price of domestic sugar may have made it difficult for the poor to access the commodity.

4. RESULTS OF THE SUGAR MARKET ANALYSIS

4.1. Co-movement of Prices

First and foremost, the results of the market analysis indicate whether or not two prices tend to move together in the long-run. This means that, although prices may not move together in the short-run due to short-term volatility in price changes, there is a tendency for prices to establish equilibrium over the long term. This is also termed as long-run equilibrium or cointegration³. The importance of this result is that if there is long-run equilibrium between two prices, then changes in one price will be passed on to the other.

Table 2 shows the results of the test for the co-movement of prices. Empirical test procedures for each price and detailed results of cointegration are shown in appendices 2 and 3. The results show that world sugar prices and domestic ex-factory prices move together and also that ex-factory and sugarcane prices move together in the long-run. On the other hand, results show that world sugar price and domestic retail prices do not move together and that world sugar prices and sugarcane prices do not move together in the long-run.

In essence, these results imply that in the domestic market, sugar millers are able to benefit from world price changes. However, the lack of co-movement between ex-factory and retail prices entails that consumers are less likely to benefit from these price movements. Further, no co-movement of prices is established between retail and world prices. Although a number of transactions occur between processors and retailers (usually through wholesalers or distributors) the retail market appears to be characterized by fragmented price formation mechanisms. No co-movement is found between sugarcane and world prices which imply that although exports account for a significant proportion of transactions, changes in world prices do not filter through to the farm-gate prices. Finding that prices move together does not give us the details of the nature of the price relationships. There is a need to further examine the extent of the co-movement of prices. In this study, this was done through the analysis of the Error Correction Model (ECM). This tells us about how quickly price changes move from one market to the other.

Table 2. Results of the Test for Co-movement of Prices

| Prices | Co-movement of prices in the long-run |
|---|--|
| World sugar prices and Domestic ex-factory prices | Yes |
| World sugar prices and Domestic retail prices | No |
| World sugar prices and sugarcane prices | No |
| Ex-factory and retail sugar prices | No |
| Ex-factory prices and sugarcane prices | Yes |

Source: Authors.

³ Cointegration can be thought of as the empirical counterpart of the theoretical notion of a long run equilibrium relationship. If two spatially separated price series are cointegrated, there is a tendency for them to co-move in the long run according to a linear relationship. In the short run, the prices may drift apart, as shocks in one market may not be instantaneously transmitted to other markets or due to delays in transport, however, arbitrage opportunities ensure that these divergences from the underlying long-run (equilibrium) relationship are transitory and not permanent (Rapsomanikis, Hallam, and Conforti 2004).

The ECM analysis was only done for the prices which showed co-movement. Thus the ECM analysis was conducted between the world and ex-factory prices and between the ex-factory and sugarcane prices.

4.2. How Quickly Do Price Changes Transmit between the World and the Domestic Markets?

Table 3 summarizes the results of the ECM between the world prices and the ex-factory sugar prices. The results indicate that price changes in the world market do transmit into the domestic ex-factory market. However, the speed with which the prices transmit is very slow. In fact the model simulation shows that price changes in the world market take about three years to be transmitted in the domestic ex-factory prices. The ECM also shows that there could be a number of distortions in the transmission of the price changes in that there is a negative price response in the short-run in the domestic ex-factory prices to changes in world prices. The implication of these results is that sugar millers are positioned to benefit from price changes in the world market, although this is so to a limited extent. However, the fact that there is no co-movement between world prices and retail prices and between ex-factory and retail prices indicates that consumers are not likely to benefit from price changes under the current market structure in the sugar market.

4.3. How Quickly Do Price Changes Transmit between the Millers and the Sugarcane Growers?

Table 3 also summarizes the ECM results for the transmission of prices between the ex-factory price and the sugarcane price. This price relationship is important in the sense that it shows us whether sugarcane producers are positioned to benefit from price changes at the sugar miller level of the value chain. The results show that price do transmit and that they do so at a much faster rate than what was observed with the world price and the domestic ex-factory prices. There are less distortions in this price relationship in that the short-run prices response is positive although it minimal.

Table 3. Results of the Error Correction Model (ECM)

| Price 1 | Price 2 | Speed of price transmission (Error Correction Term) | Short-run price response | Long-run price response |
|------------------------|------------------------|---|--------------------------|-------------------------|
| Ex-factory sugar price | World sugar price | -0.093 | -0.294 | 0.909* |
| Sugarcane price | Ex-factory sugar price | -0.199* | 0.008 | 0.945* |

Source: Authors. Note: * Statistically significant at 10% Level, ** 5% and ***1%.

This is quite realistic, considering that in reality there is a contract based price formation mechanism between sugar millers and sugarcane farmers. The model simulation also shows that prices take about one year and six months to transmit from the ex-factory to the sugarcane price. In reality, contracts are fixed annually between sugar millers and sugarcane farmers.

4.4. Is there Exercise of Market Power in the Sugar Market?

The market analysis can also inform us about whether there is existence of market power in the market. This can be drawn from examining whether the market allows the pass-through of price increases to consumers or price decreases to producers more readily than the reverse. This is derived from the fact that an agent holding market power is more likely to pass on price increases than they are to pass on price decreases. This is also referred to as Asymmetric Price Transmission (APT). Table 4 shows the results of the APT analysis.

The results show that price increases in the world market are transmitted to domestic ex-factory prices, but price decreases are not transmitted⁴. More formal tests for Asymmetry show that there is a difference in the way price increases and price decreases in the world market are transmitted to the domestic ex-factory price. This implies that sugar millers in Zambia allow much more rapid pass-through of world price increases to consumers than world price decreases. Thus, there is evidence of the existence of market power based on the observed price relationships in the sugar market.

Within the domestic market, the price relationship between the processors (ex-factory price) and sugarcane farmers (sugarcane) price would show whether producers of sugarcane benefit from price changes. The results in Table 4 indicate that both price increases and decreases at processor level are transmitted. Further, both the short-run response due to a price rise and price decline are positive, reflecting normal transmission. The formal tests, however, show that price increases and decreases are not transmitted in the same manner.

Table 4. Results of the Asymmetric Price Transmission Model

| Price 1 | Price 2 | Speed of transmission due to a price increase | Speed of transmission due to a price decreases | Short-run response due to a price increase | Short-run response due to a price decrease |
|------------------------|------------------------|---|--|--|--|
| Ex-factory sugar price | World sugar price | -0.164* | 0.033 | -0.502* | 0.306 |
| Sugarcane price | Ex-factory sugar price | -0.125 | -0.062 | 0.092*** | 0.008 |

Source: Authors. Note: Statistically significant at: * 10% level, **5% and *** 1% Level.

⁴ Note that a negative speed of price transmission indicates that prices transmit while a positive speed of transmission shows that prices are not transmitted.

However, it would appear that sugar millers are more willing to pass on price increases to sugarcane producers than decreases. This implies that sugarcane producers stand to benefit from the price relationship. Thus, there could be some exercise of market power in this vertically integrated value chain but it is done to the benefit of sugarcane producers.

5. CONCLUSION

The investments that followed the restructuring of the sugar sector led to tremendous growth but also created a market structure that operates without effective competition. Under the current market structure, prices of sugar have been on the rise for the most part, although production has been increasing with the growing surplus increasingly being channeled to the export markets. Zambia's domestic sugar price has been higher than other sugar producing countries and has been reported to significantly exceed the cost of production which suggests that consumers may not fully benefit from the comparative advantage in sugar production that Zambia is endowed with. The pricing of sugar in Zambia's domestic market appears to be unrelated to the prevailing demand or supply conditions implying that domestic market forces play a limited role in determining the price. Further, the domestic sugar price generally does not follow the trends in national inflation.

Sugarcane out-growers have increasingly become important in the value chain led by key partnerships which include the private sector, the government, and development partners. This model of cane supply has the potential to increase smallholder incomes, as sugarcane production is a high value enterprise with income earning potential which exceeds most traditional crops. In this vertical relationship, farmers are likely to benefit in this relation especially considering that the sugarcane producers' price is tied to the ex-factory price through what is termed as division of proceeds. However, the number of smallholder farmers linked to the value chain is small and they are all affiliated to one company.

The policy framework underlying the sugar market in Zambia has implications on the pricing of sugar and especially affects consumer welfare. While liberalization and privatization can be hailed as successful policies that spurred the growth of the sugar industry, the effectiveness policy that requires Vitamin A fortification is questionable. The introduction of this policy corresponds with the period of rising sugar prices precipitated by reduced competition from imports and the consolidation of one major sugar miller. In effect this policy may have worked against the original intention of increasing Vitamin A access to the wider population.

The market analysis of the sugar market empirically confirms the assertions laid out above. Sugar millers are able to benefit from world price changes, as there is co-movement between world and domestic ex-factory prices. However, the lack of co-movement between ex-factory and retail prices entails that consumers are less likely to benefit from these price movements. Further, no co-movement of prices is established between retail and world prices. Although a number of transactions occur between processors and retailers (usually through wholesalers or distributors) the retail market appears to be characterized by fragmented price formation mechanisms. Price relationships are weak and they are characterized by slow transmission. The transmission of prices between sugar millers and sugarcane producers is much stronger and quicker which may be due to the commitment of the sugar miller to secure cane supplies which are critical to their production process. According to the model, sugar millers do not transmit price decreases to the domestic sugar price. The price transmission analysis suggests a caution that the market structure may be diminishing the potential economic gains from investment and trade. In this value chain, there is room for balancing the gains from the industry to ensure consumer welfare as well as producer welfare is enhanced.

6. POLICY OPTIONS

There is need to re-evaluate whether fortification of sugar is still a good strategy for enhancing Vitamin A access to the Zambian population especially the rural population. Most of the rural poor have low purchasing power and the rising price of sugar is a major impediment for them to access the commodity. One option is for the government to revise the legislation and make it optional for sugar millers to fortify their sugar. The government and co-operating partners can then step up alternative means of promoting Vitamin A such as bio fortified crops such as orange maize and orange-fleshed sweet potatoes.

APPENDICES

Appendix 1. Vector Error Correction Model

The Vector Error Correction Model (VECM) is used to assess price transmission (Johansen 1988; Hassouneh et al. 2012). Assuming two price series are each integrated of the same order, for example I (1) (integrated of order 1), their long run relationship can be described as:

$$a + P_{1t} - \beta P_{2t} = v_t, \quad (1)$$

where P_{1t} is the price of a commodity in the domestic market or at a producer (farm-gate) level; P_{2t} is the price in the, world market or at processor level (wholesale price); t indicates time period; and v is the residual from an OLS estimation of the relationship, known as the Error Correction Term (ECT).

The bivariate vector error correction model (Meyer and von Cramon-Taubadel 2004; Rapsomanikis, Hallam and Conforti 2004; Jensen and Moller 2007; Sheng 2009) treats changes in P_{1t} as a function of the lagged ECT and lagged changes in P_{2t} and P_{1t} , such that:

$$\Delta P_{1t} = \alpha_1 + \theta(P_{1t-1} - \beta P_{2t-1}) + \delta \Delta P_{2t-1} + \rho \Delta P_{1t-1} + \varepsilon_t \quad (2)$$

where Δ is a first difference operator; θ is the estimated coefficient of the lagged error correction term indicating speed of adjustment; $(P_{1t-1} - \beta P_{2t-1})$ is the long-run cointegrating relationship; β reflects the long run effects as in (1); and δ and ρ represent the short run effects. In this framework, the elasticity of price transmission may be estimated as π from long-run relationship, converted to its log form as shown below:

$$\ln P_{1t} = \lambda + \pi \ln P_{2t}. \quad (3)$$

The model in (2) has been extended to test for asymmetric price adjustments by incorporating specific ECTs for increases and decreases in P_{1t} . Following Meyer and von Cramon-Taubadel (2004); Traub et al. (2010); Sheng (2009); Rapsomanikis, Hallam, and Conforti (2004) among others, an Asymmetric Vector Error Correction Model can be described as:

$$\Delta P_{1t} = \alpha_1 + \delta^+ D^+ \Delta P_{2t-1} + \delta^- D^- \Delta P_{2t-1} + \phi^+ ECT_{t-1}^+ + \phi^- ECT_{t-1}^- + \varepsilon_t. \quad (4)$$

Here D^- and D^+ are dummy variables for increasing and decreasing changes in price with corresponding coefficients δ^+ and δ^- ; ECT_{t-1}^+ and ECT_{t-1}^- are the positive and negative error correction terms $(P_{1t-1} - \beta P_{2t-1})$ and ϕ^+ and ϕ^- are the corresponding speeds of adjustment. This specification allows for a test of asymmetry in the speed of price transmission by testing the hypothesis: $H_0: \phi^+ = \phi^-$.

Appendix 2. ADF Test Results for the Price Series⁵

| Series | Model | Lags | $\tau_\tau, \tau_\mu, \tau$ | ϕ_3, ϕ_1 |
|------------------------------------|---------------------|------|-----------------------------|------------------|
| Refined Sugar World Price | Trend and Intercept | 2 | -2.4915 | 8.867858*** |
| | Intercept | 2 | -1.6828 | 9.754453* |
| | None | 2 | -0.2298 | 8.867850 |
| Δ Refined Sugar World Price | Trend and Intercept | 1 | -7.3204*** | 19.64971*** |
| | Intercept | 1 | -7.2272*** | 28.26655*** |
| | None | 1 | -7.2696*** | |
| Raw Sugar World Price | Trend and Intercept | 4 | -2.5996 | 6.084416*** |
| | Intercept | 4 | -1.8347 | 6.288549** |
| | None | 4 | -0.1080 | |
| Δ Raw World Sugar Price | Trend and Intercept | 1 | -7.8079*** | 23.08865*** |
| | Intercept | 1 | -7.7305*** | 33.60630*** |
| | None | 3 | -5.0447*** | |
| Wholesale Price | Trend and Intercept | 0 | -2.4414*** | 2.376121 |
| | Intercept | 0 | -1.8899*** | 3.572052* |
| | None | 1 | -0.3572 | |
| Δ Wholesale Price | Trend and Intercept | 0 | -13.651*** | 93.18104 *** |
| | Intercept | 0 | -13.641*** | 186.0781*** |
| | None | 0 | -13.678*** | |
| Retail Price | Trend and Intercept | 0 | -2.4138 | 3.125932 |
| | Intercept | 0 | -1.5844 | 2.510324 |
| | None | 0 | -0.1265 | |
| Δ Retail Price | Trend and Intercept | 0 | -13.575*** | 92.15575*** |
| | Intercept | 0 | -13.571*** | 184.1981*** |
| | None | 0 | -13.603*** | |
| Sugarcane Prices | Trend and Intercept | 0 | -2.0878 | 2.797997 |
| | Intercept | 0 | -1.4395 | 2.072387 |
| | None | 0 | -0.2504 | |
| Δ Sugarcane Prices | Trend and Intercept | 0 | -12.985*** | 84.30728*** |
| | Intercept | 0 | -12.929*** | 167.1660*** |
| | None | 0 | -12.963 | |

Note: * Statistically significant at 10% level, **Statistically significant at 5% level, ***Statistically significant at 1% Level.

⁵ Stationarity tests were carried out using the Augmented Dickey Fuller (ADF) test to determine the order of integration. If data are not stationary, then the results of the ECM or the Asymmetric Price Transmission test could be spurious, and suggest that a relationship between the price series exists when in fact not (Hassouneh et al. 2012).

Appendix 3. Cointegration Results using ADF Test (Model without Trend Intercept)⁶

| P_{1t} | P_{2t} | α | β | R^2 | Probability (F-statistic) | Residual (C(p): ADF Test Statistic lags=0) |
|-------------------|-------------------|---------------------|---------------------|----------|------------------------------|---|
| $P_t^{wholesale}$ | P_t^{world} | 13.330 (0.000) | 1.285 (0.000) | 0.563 | 0.000 | -3.454** |
| P_t^{retail} | P_t^{world} | 18.93827 (0.000) | 1.560391 (0.000) | 0.542 | 0.0000 | -3.028 |
| $P_t^{producer}$ | P_t^{world} | 1.530884 (0.000) | 0.163423 (0.000) | 0.510027 | 0.000 | -2.669 |
| P_t^{retail} | $P_t^{wholesale}$ | 3.189697 (0.000) | 1.206193 (0.000) | 0.949285 | 0.000000 | -2.680153 |
| $P_t^{producer}$ | $P_t^{wholesale}$ | 0.295393 (0.000) | 0.118351 (0.000) | 0.780924 | 0.000 | -5.717694*** |
| P_t^{raw} | $P_t^{wholesale}$ | 17.44015 (0.000) | 1.410931 (0.000) | 0.552697 | 0.000000 | -2.657458 |
| P_t^{raw} | $P_t^{producer}$ | 2.198896 (0.000) | 0.173556 (0.000) | 0.470546 | 0.000000 | -2.490241 |

Note: *statistically significant at 10% level, ** 5% and ***1%.

⁶ The possible cointegrating long-run relationships between price series were estimated using Ordinary least Squares (OLS) applied to equation (1). To carry out the ADF tests, residual series were generated from the estimated long run relationship between different price series. ADF tests were carried out on the residuals with the model 'none' (no trend or intercept) and with the appropriate number of lags. The ADF test statistics were then compared with MacKinnon values $C(p)$, with the decision rule to reject H_0 (no cointegration) if the ADF statistic $< C(p)$. Appendix 2 summarises the cointegration test results. The long run relationships were tested for cointegration using: $P_{1t} = \alpha + \beta P_{2t}$, with world prices (P^{wd}) for P_{2t} and wholesale prices (P^{ws}) for P_{1t} ; world prices for P_{2t} and retail prices for P_{1t} ; world prices of P_{2t} and producer prices for P_{1t} ; wholesale prices for P_{2t} and retail prices for P_{1t} ; and wholesale prices for P_{2t} and producer prices for P_{1t} . In order to conduct the robustness check, long run relationships were tested for cointegration, with raw sugar world prices for P_{2t} and wholesale prices for P_{1t} ; raw sugar world prices for P_{1t} and producer prices for P_{1t} .

REFERENCES

- ACF. 2014. Competition in the Regional Sugar Sector: The Case of Kenya, South Africa, Tanzania, and Zambia. Presented at the Pre-International Competition Network (ICN) conference, 22-25 April 2014. Marrakech, Morocco.
- Agritrade. 2010. The Sugar Sector: Zambia Expands Regional Sugar Exports. Accessed April 29, 2010. Available from <http://agritrade.cta.int/en/Commodities/Sugar-sector>.
- Boriyo, N. 2010. Zambia Sugar: Export Prices Won't Be Hit by Rising Production Costs. Dow Jones Commodities News. Accessed May 20, 2010 at Trading Markets website. <http://www.tradingmarkets.com/>. However, news article is no longer available.
- CSO. 2010. Sugar Retail Prices: 1996 to 2010. Lusaka: Central Statistical Office.
- Chulu, K. SPAZ Justifies High Sugar Prices. *Maravi*. Tuesday, September 01, 2009. Accessed May 21, 2010 at <http://maravi.blogspot.com/2009/09/spaz-justifies-high-sugar-prices.html>
- Ellis, K., R. Singh and S. Musonda. 2010. Assessing the Economic Impact of Competition: Findings from Zambia. Westminster Bridge, London: Overseas Development Institute (ODI). Can be accessed at <http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/6066.pdf>
- FAO. 2013. FAOSTATS: Crops Processed. Rome: FAO. Accessed February 12, 2013 at <http://faostat.fao.org/site/291/default.aspx>.
- Hassouneh, I., S. von Cramon-Taubadel, T. Serra, and J. Gil. 2012. *Recent Developments in the Econometric Analysis of Price Transmission*. TRANSFOP Working Paper No. 2. Devon, England: Transparency of Food Pricing, University of Exeter.
- Jensen, J. G. and S.A. Møller. 2007. *Vertical Price Transmission in the Danish Food Marketing Chain*. Frederiksberg: University of Copenhagen Institute of Food and Resource Economics.
- Johansen, S. 1988. Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control* 12.2-3: 231-54.
- JCTR. 2013. Basis Needs Basket, January to December, 2013. Lusaka: Jesuit Center for Theological Reflection.
- Krivosos, K. 2004. *The Impact of Coffee Market Reforms on Producer Prices and Price Transmission*. World Bank Policy Research Working Paper No. 3358. Washington, DC: The World Bank.
- LMC International and Overseas Development Institute (ODI). 2012. The Impact of EU Sugar Policy Reform on Developing Countries. London: Department for International Development.
- Meyer J. and S. von Cramon-Taubadel. 2004. Asymmetric Price Transmission: A Survey. *Journal of Agricultural Economics* 55: 581-611.

- Mofya-Mukuka, R and A. Abdulai. 2013. *Effects of Policy Reforms on Price Transmission in Coffee Markets: Evidence from Zambia and Tanzania*. Indaba Agricultural Policy Research Institute Working Paper No. 79. Lusaka, Zambia: IAPRI.
- National Food and Nutrition Commission. 2003. National Survey to Evaluate the Impact of Vitamin A Interventions in Zambia. Lusaka: National Food and Nutrition Commission.
- Pound, B and Alex Phiri. 2010. Longitudinal Impact Assessment Study of Sugar Producers in Malawi. London: University of Greenwich.
- Palerm, J., T. Sierevogel, and M. Hichaambwa. 2010. Strategic Environmental Assessment (SEA) of the Sugar Sector in Zambia. Report Prepared for the Delegation of the European Union in Zambia. Lusaka, Zambia
- Rabobank. 2013. Tanzania Sugar: Foreign Investors Need an Enabling Environment. Rabobank Industry Note No. 386. Utrecht: Rabobank.
- Rapsomanikis, G., D. Hallam, and P. Conforti. 2004. Market Integration and Price Transmission in Selected Food and Cash Crop Markets of Developing Countries: Review and Applications. In *Commodity Market Review 2003-2004*, ed. David Hallam. Rome: FAO Commodities and Trade Division.
- Richardson, B. 2010. Big Sugar in Southern Africa: Rural Development and the Perverted Potential of Sugar/Ethanol Exports. *Journal of Peasant Studies* 37.4: 917- 38.
- Serlemitsos, J. and H. Fuscus. 2001. Vitamin A Fortification of Sugar in Zambia 1998–2001. Arlington, VA: MOST. The USAID Micronutrient Program.
- Sheng, T.Y.J. 2009. Symmetry in Farm-retail Price Transmission: Pork in Malaysia. *Munich Personal RePEc Archive*, 16693. Accessed: April 5, 2010 at <http://mpra.ub.uni-muenchen.de/16693/>
- Tongaat Hullets. 2013. Sugar Operations in Mozambique, Swaziland and Zimbabwe. Accessed December 21, 2013 at <http://www.huletts.co.za/ops/swaziland.asp>.
- Traub, N.L., R.J. Myers, T.S. Jayne, and F.H. Meyer. 2010. Measuring Integration and Efficiency in Maize Grain Markets: The Case of South Africa and Mozambique. Paper prepared for African Association of Agricultural Economists (AAAE) Third Conference, 19-23 September. Cape Town, South Africa.
- USDA. 2010. World Refined Sugar Price, Monthly, Quarterly, and by Calendar and Fiscal Year. Washington, DC: USDA.
- World Bank. 2007. Competitive Commercial Agriculture in Africa (CCA)-Zambia Competitiveness Report. Accessed February 3, 2010 at <http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICA>
- World Bank. 2009. *Zambia Commercial Value Chains in Zambian Agriculture: Do Smallholders Benefit?* World Bank Report No. 48774-ZM. Washington, DC: The World Bank.

World Bank. 2013. Inflation, GDP Deflator. Accessed October, 2014 at
<http://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG>.

Zambia Sugar Co.(2010). Annual Report 2010. Durban, South Africa: Illovo Sugar Group.

ZDA. 2013. Procedures and Guidelines. Investment Promotion Department. Lusaka: Zambia
Development Authority.