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Impact of the Zambian Agricultural Policy on Grain Trade

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

The agricultural sector in Zambia is supported through the government use of public expenditure programs to spur the production and subsidize the consumption of key grains to stabilize prices. Previous research has documented the effects of public spending on agriculture in terms of food prices and food security. The effects of government spending on the trade of key grains, however, is not well understood. As such, there is a gap in knowledge regarding the impact of agricultural policy on the agricultural trade. The purpose of this study was to determine the impact of Zambian agricultural policy on grain trade. A combination of 2 trust-based theories formed the theoretical foundation of this study. These theories included ecology of games theory and Kingdon's garbage-can model. Secondary data were acquired from the Food and Agriculture Organization Corporate Statistical Database and Michigan State University. A vector autoregression analysis of time-series data covering a 10-year period from 2003 to 2012 showed that grain quantities purchased by the Food Reserve Agency significantly impacted grain trade ($p = 0.000$), whereas the Farmer Input Subsidy Program did not significantly impact grain trade ($p = 0.843$). However, the combined effect of these 2 policy instruments was found to be statistically significant ($p = 0.000$). The key finding of this study is that for every 1 metric ton purchased by the Food Reserve Agency, grain trade increases by 0.342 metric tons; whereas for every 1 Kwacha spent on Farmer Input Subsidy Program, grain trade decreases by 0.187 metric tons. Positive social change may be achieved through recommendations to policy makers to increase appropriations to postharvest management and extension to increase tradable volumes and farmers' income.

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Chapter 1: Introduction to the Study

Introduction

Agriculture is the economic sector that provides food and income to the poor and the rich all over the world (Fischer & Qaim, 2012). Agriculture is also the main source of employment for the majority of rural poor people, especially in sub-Saharan Africa, where this sector employs "60% of the economically active population" (Meijerink & Roza, 2007, p. 4). Agriculture and its allied industries play an important role in the livelihoods of people in developing economies, and their multiplier effects spur growth "in the non-farm economy" (Meijerink & Roza, 2007, p. 15). In addition, agriculture constitutes an important part of most African countries' gross domestic product (Omigie et al., 2013). The crucial role that the agricultural sector plays in sustaining livelihoods and maintaining social and economic order has attracted the attention of policy and decision makers in the public and private sectors. As many African governments continue to classify agricultural production and marketing in the domain of public goods, private sector operators look for ways to increase investment and make money in this sector. In recent years, the real and potential growth of the agricultural sector have attracted local public and private investments and led to "a surge of direct foreign investment in developing country agriculture" (Hallam, 2009, p. 2).

However, the search for optimal levels of food production and marketing sometimes put governments and the business community on a collision course. Through agricultural policy, governments decide on the "trade-off between consumer and producer interests" (Thomson, 2013, p. 20). Moreover, governments must decide on the

right mix of private and public investments in agriculture. There is still no consensus on the level and type of government spending that would foster private-sector-led agricultural development; nevertheless, Omigie et al. (2013) found a positive relationship between government spending and investment in agriculture.

African governments support their agricultural sector through input subsidies, government grain purchases, and trade restriction (Druilhe & Barreiro-Hurlé, 2012). The objectives of these policy instruments rotate around "increasing the production of key agricultural commodities, stabilizing prices, ensuring food security, and reducing poverty" (Druilhe & Barreiro-Hurlé, 2012, p. 19).

The application of these policy instruments has had both positive and negative impact on the agricultural sector and its different actors such as farmers, input dealers, and grain traders. Subsidies are credited with having increased agricultural production and stabilized food prices in some African and many Asian countries (Odozi & Omonona, 2012). However, in some instances, subsidies have had negative effects on the performance of agribusinesses. Subsidies programs that were designed and implemented without the participation of the private sector had crowding-out effects on private sector investments (Druilhe & Barreiro-Hurlé, 2012).

Governments face a challenge of designing and implementing business-friendly agricultural subsidy programs. The use of vouchers redeemable at private sector input outlets has been viewed as an appropriate solution that can contribute to the development of private-sector entities involved in input businesses (Banful, 2011). Instruments that would crowd in agribusinesses involved in the output market are still are still

underdeveloped in Africa. These instruments include the use of commodity exchange which is an efficient price discovery mechanism, contract farming that ensures that farmers have access to inputs, and agricultural insurance schemes that enable producers to minimize their risk exposure (Demeke et al., 2012; Odozi & Omonona, 2012).

The key assumption in the agricultural sector is that production-enhancing policy instruments increase tradable volumes, whereas price stabilization measures may produce negative effects on grain traders' profits (Druilhe & Barreiro-Hurlé, 2012; Jayne & Boughton, 2011; Kodamaya, 2011). However, the combined effect of both production-enhancing and price-stabilizing instruments on grain trading has not been studied.

To contribute to the policy debate about government intervention in agriculture and its effects on key constituencies, I conducted a study on the impact of the Zambian agricultural policy on grain trade. This study investigated the relationship between the Zambian government's main agricultural policy instruments and grain trade. The key instruments of the Zambian agricultural policy include subsidies for agricultural inputs and government spending on grain purchases for its food reserve. Investigation into the impact of these instruments on grain trade provided insights for public policy makers on whether the existing dispensations and practices have enabling or debilitating effects on international grain trade. The findings of this study may inform subsequent policy decisions that Zambian government officials make to achieve the goal of building a private-sector-led agricultural sector (Tembo, Chapoto, Jayne, & Weber, 2009).

This chapter provides information on the study background through the lens of agricultural political economy in Zambia, a description of the problem under study, and

the purpose of this research. This chapter also contains a discussion of the theoretical underpinnings of the study, its variables, limitations, delimitation, assumptions, and its contribution to positive social change.

Background to the Study

The agricultural sector employs one third of Africans and sustains the livelihood of 70% of rural dwellers (Bates & Block, 2013). Meijerink and Roza (2007) estimated that "in Sub-Saharan Africa, 60% of economically active population works in the agricultural sector" (p. 4). The importance of this sector pushes African governments to protect it from potentially debilitating competition. Agricultural subsidies constitute the main policy instruments that governments use to support the agricultural sector (Ellis & Maliro, 2013). The main policy objectives of agricultural subsidies include addressing market failure that prevents farmers from recouping their investments in agriculture, increase crop production, and strengthen political loyalty of the farming community (Banful, 2011; Bates, 2013; Reichert, 2006).

Agricultural subsidies target both agricultural input and output markets. The combination of yield-enhancing technologies and price stability contributed to the transformation of the agricultural sector in Asia and Africa (Odozi & Omonona, 2012). However, in Africa, agricultural subsidies often lead to market distortion and crowd out private sector investments in the agricultural sector (Ciaian, Pokrivcak & Szegenyova, 2012; Dorward, 2009). This situation led to mistrust between government and private-sector agribusiness operators. In addition, government interference prevents producers and buyers from creating long-term and trust-based business relationships (Tadesse &

Shively, 2013). In fact, African agricultural markets function as "flea markets" in which there are no trust-based relationships between producers and buyers (Tadesse & Shively, 2013, p. 1172). The dearth of "repeated transactions" between traders and farmers amplifies market failure and leads to "frequent government interference" (Tadesse & Shively, 2013, p. 1173).

The trust between private- and public-sector actors is the *sine qua non* of inclusive and broad-based agricultural growth, as it ensures predictability in the agricultural marketplace (Jayne & Boughton, 2011). However, "in recent years the agribusiness community has increasingly been viewed as a major cause of social, environment, and economic problems" (Porter & Kramer, 2011, p. 1). This perception has contributed to increased government intervention in key economic sectors such as agriculture. In fact, McMichael (2013) advocated for the transformation of "debt relations" between agribusiness and farmers into "public subsidy relations" to avoid private-sector exploitation of African farmers (p. 697).

In addition to shielding farmers against price instability and high production cost, political interests influence government intervention in directing the allocation of resources or factors of production (Zahariadis, 2005). Acemoglu and Robinson (2013) suggested that even though "market failure" should be the main guiding hand for government intervention, policy analysts and makers should not ignore "political equilibrium" for a successful implementation of any policy proposal (pp.189-190). Moreover, trade reforms that promote private investments into the agricultural sector do

not guarantee the reduction of "extreme poverty" (Bussolo, De Hoyos & Medvedev, 2011, p. 2041; Duygan & Bump, 2007).

Dorosh and Mellor (2013) disagreed with the notion that increased investment in agriculture did little to reduce poverty. They argued that it takes a long time for the growth of the agricultural sector to have an impact on poverty levels because agricultural growth works through prices and employment. These authors insisted that in open economies, agricultural production has little effect on domestic prices and could be the driving force for the development of other sectors. They basic assumption is that massive numbers of farmers with spending capacity can spur growth in nonfarming sectors of the economy (Jayne & Boughton, 2011). Barret (2008) also asserted that growth in the agricultural sector has assumed reduced importance in a country's gross domestic product, leading to farmers' "migration out of agriculture" to other sectors with higher labor productivity (p. 300).

Until recently, agricultural finance was an area reserved for the public sector in most African countries. The creation of the Comprehensive Africa Agriculture Development Program (CAADP) rekindled African governments' commitments to agricultural investments, and the 2007-2008 food crisis prompted private agribusinesses to increase their investment in agriculture (Dorosh & Mellor, 2013, p. 429). Grain traders and processors have better access to finance than farmers do, so their interest in out grower schemes and other input financing schemes may spur an increase in agricultural production and lead to poverty reduction (McMichael, 2013). However, government agricultural subsidy policies may crowd out private-sector investments because of the

lack of transparency and predictability of government policy (Jayne, Chapoto, & Chamberlin, 2011).

The government of Zambia invests heavily in grain production and marketing because grains are the staple food for human consumption and animal feed. In 1990s, the government of Zambia embraced a free market economy and privatized many state-owned enterprises (Hansen, 2010). To continue its economic reform, the government "stopped subsidizing the production and consumption of maize" in 1991, a decision that led to high agricultural commodity prices and subsequent food riots threatening to overthrow the government (Chapoto, 2012, p. 3; Poulton, 2014). In order to avoid food shortages and high prices for staple foods, the government of Zambia decided to create the Food Reserve Agency (FRA) in 1995, and it has continued to subsidize grain production and consumption ever since (Dorward, 2009; Kuteya & Jayne, 2012). The government tried to solve supply side problems by providing subsidized agricultural inputs to farmers. Government subsidies to the agricultural sector "cover price and production risks" and aim to increase the production of staple foods, mainly maize, and reduce the retail price of maize meal (Odozi & Omonona, 2012, p. 96). The inception of FRA was geared toward solving demand problems by providing a guaranteed market for farmers' produce and stabilizing agricultural prices, whereas the main goal of the Farmer Input Support Program (FISP) was to increase production, ensure food security, and achieve poverty reduction (Mason, Jayne, & Mofya-Mukuka, 2013).

The combined impact of these input and price stabilization subsidies on international grain trade in Zambia has not been investigated. This study fills a gap in the

existing literature on the intervention of the Zambian government in the agricultural sector. Most studies in this area have focused on the impact of Zambian government policies on agricultural production, food prices, and poverty reduction (Chirwa & Dorward, 2013; Jayne & Rashid, 2013; Lunduka, Ricker-Gilbert, & Fisher, 2013; Mason, Jayne, & Mofya-Mukuka, 2013). There are no studies that have addressed the relationship between government agricultural policy and volumes of grain imports and exports.

This study provides an empirical basis for trust building between grain traders and the government of Zambia. Trust between these two main actors in the Zambian grain value chain has the potential to create synergy, improve the allocation of resources, and promote the adoption of an appropriate mix of agricultural policy that improves the performance of the agricultural sector (Yang & Wang, 2013).

Problem Statement

The agricultural sector is the main source of income, food security, and nutrition for the Zambian people. Sustainable and broad-based growth of the agricultural sector requires efficient markets and a policy environment that is conducive to private-sector investment (Jayne & Boughton, 2011). In fact, stated objectives of the Zambian agricultural policy for the period 2010-2015 included “the reduction of production and marketing distortions of maize” and “facilitating the growth of the private sector” (Tembo, Chapoto, Jayne, & Weber, 2009, p. 60). Despite these promarket intentions, the government of Zambia continued to intervene in the agricultural sector through public expenditure and regulatory instruments.

Input subsidies and food price stabilization policies did not result in the production of food surpluses in sub-Saharan Africa (Galtier, 2013). In fact, "a large proportion of smallholder farmers are only buyers or net buyers of the main staple grains" (p. 75). Mason and Myers (2011) estimated that nearly 50% of Zambian smallholder farmers are net buyers of maize.

This tepid performance of the agricultural sector in countries that spent a lot of money on input subsidies and price stabilization prompted the recommendation to use market-based solutions. Demeke, Dawe, Tefft, Ferede, and Bell (2012) recommended the use of instruments such as warehouse receipt systems, commodity-exchange-related contracts such as spot prices and forward contracts, as well as futures and options to stabilize prices and strengthen price discovery mechanisms. However, opponents of market-based instruments argue that "price volatility is an inherent" characteristic of agricultural markets due "market failure" and missing market opportunities (Bell, Dawe, Demeke, Ferede, Tefft, 2012, p. 5). They argue that governments should intervene to set up food reserves and use their fiscal policy to stabilize prices. Abbot (2010) argued that governments should coordinate their policy actions with the private sector, and that government intervention should be rule-based, transparent, credible, and predictable to minimize negative effects or loss of livelihood.

Barret (2008) recommended the combination of public policy instruments and private-sector investment to enable farmers to produce "marketable surplus" (p. 300). Galtier (2013) argued that any government intervention or subsidy can be "non-targeted" or "targeted," depending on whether policy objectives are meant to protect the consumer

or the farmer (p. 77). Input subsidies in Africa tend to be targeted, whereas price stabilization efforts become nontargeted (Mason & Ricker-Gilbert, 2012). In any case, governments should ensure that their subsidies are temporary, solving market failure, and do not have a negative impact on private-sector companies participating in input or output markets (Banful, 2011; Gilbert, 2011).

The impact of Zambian agricultural policy instruments on grain trade has not been ascertained yet. All of the research on the government agricultural policy and spending has focused on the impact that subsidies had on rural poverty, food prices, and production levels (Chirwa & Dorward, 2013; Jayne & Rashid, 2013; Lunduka, Ricker-Gilbert, & Fisher, 2013; Mason, Jayne, & Mofya-Mukuka, 2013). So far, there has been no study to determine the effects that Zambia's agricultural subsidies and other agricultural policy instruments such as the export ban, tax expenditures, trade tariffs, and price stabilization had on the trade of key grains. The lack of clarity on this issue is both an economic and a social problem that may affect sustainable development of the agricultural sector and the livelihoods of the Zambian people. Abbott (2010) noted that although researchers and policy analysts recommended the "coexistence of both public and private trade," the roles of each of these grain market players had not been delineated (p. 45). A clear understanding of how and to what extent actions and policies of these actors in grain markets affect each other's performance must precede the definition of roles and trigger events that can lead to government intervention (Gilbert, 2011). This study begins to fill this gap by clarifying the effect of Zambian agricultural policy instruments on grain trade volumes.

Purpose of the Study

The purpose of this quantitative study is to determine the impact of Zambian agricultural policy on grain trade. Studies on Zambian agricultural policy have focused on food production, food prices, and poverty reduction (Chirwa & Dorward, 2013; Jayne & Rashid, 2013; Lunduka, Ricker-Gilbert, & Fisher, 2013; Mason, Jayne, & Mofya-Mukuka, 2013). It is evident that the intervention of the Zambian government in key grain markets resulted in a "paranoia effect" (Abbink, Jayne, & Moller, 2011, p. 226). The fear of losing money due to government intervention reduced the involvement of grain traders in the production and marketing of agricultural commodities. On the other hand, the fear of private-sector dominance and the potential for loss of farmers' livelihoods increased government spending on both upstream and downstream activities of agricultural value chains (Jayne & Moller, 2011).

Trust between governments and private- sector operators "may promote entrepreneurial activities and spur growth and development" (Baliamoune-Lutz, 2011, p. 344). However, the extent to which the private sector is affected by the instruments that the government of Zambia uses to influence the grain markets has not been studied.

This study was conducted to detect causal relationships between government spending on input subsidies, government grain purchases, and combined volumes of grain imports and exports. The study used two independent variables: government spending on input subsidies and the quantity of government grain purchases through its Food Reserve Agency. The dependent variable was the combination of export and import volumes of key grains.

Research Questions and Hypotheses

Research questions influence the design of a study and "focus the purpose of the study," whereas hypotheses show the "predictions the researcher makes about the expected relationships among variables" (Creswell, 2009, p. 132). This study investigated the impact of the Zambian agricultural policy on grain trade. It sought to answer and test the following research questions and hypotheses:

Research Question 1 (RQ1): What is the impact of the Zambian food reserve agency's purchases on grain trade?

Null Hypothesis 1 (H_01): The Zambian food reserve agency's purchases do not significantly impact grain trade.

Alternative Hypothesis 1 (H_1): The Zambian food reserve agency's purchases significantly impact grain trade.

Research Question 2 (RQ2): What is the impact of government spending on input subsidies on grain trade?

Null Hypothesis 1 (H_01): Government spending on input subsidies does not significantly impact grain trade.

Alternative Hypothesis 1 (H_1): Government spending on input subsidies significantly impacts grain trade.

I gathered secondary data about the main policy instruments, including the government's grain purchases and spending input subsidies. I ran a time-series analysis to investigate the causal relationship between these policy instruments and grain trade.

Data on grain trade included imports and exports of key grains such as maize and rice. All of these data are available from secondary sources.

Theoretical Framework

Researchers use theoretical frameworks to place their research studies in context as they seek to establish congruence between concepts and observations. Frankfort-Nachmias and Nachmias (2008) asserted that theoretical systems enable researchers to explain and predict phenomena through empirical research. I used a combination of trust-based theories to explain and predict the effects of the Zambian agricultural policy on grain trade. These theories included ecology of games theory and the Kingdon garbage-can model.

Ecology of Games Theory

This theory was developed by Norton E. Long in 1958. It addresses the interaction between institutions, also referred to as *games*, that pursue different interests, and how "players in each game make use of players in the others for their particular purposes" (Long, 1958, p. 251).

The prevailing wisdom is that collaboration between institutions reduces transaction cost and maximizes policy outcome. Scholars in the policy arena refer to this collaboration as "institutional rational choice" and define it as "inclusive decision processes that bring together multiple stakeholders, [and] help build networks and trust (Lubell, McCoy, & Henry, 2010, pp. 287-288). However, the "ecology of games theory" suggests that collaboration between institutions may increase transaction costs as it introduces "a new game overlaid on" the existing policy and institutional configuration

(p. 290). *Policy games* are defined as "arenas of competition and cooperation structured by a set of rules and assumptions about how to act in order to achieve a particular set of objectives" (Lubell et al., 2010, p. 289). Using this theory, Long (1958) distinguished governance polity as a "more contrived artifact" and the economy that can function even when unplanned (p. 251).

The paradigm of competition and cooperation between the activities of the agribusiness sector and government socioeconomic policies contributes to the analysis of trust-related issues among Zambian grain industry players. In fact, Abbink, Jayne, and Moller (2011) argued that the lack of trust between the private sector and the agricultural policies of the government of Zambia produced a "paranoia effect" that tends to crowd out private-sector agricultural trade and amplify government intervention (p. 3). The authors argued that this situation tends to increase the level of public spending on the agricultural sector, as the government fears the eventuality of food insecurity if the sector is left to other players.

The ecology of games theory also indicates that collaborative institutions may be trapped in the formulation of symbolic policies that are geared to simply "quell political discontent" (Lubell et al., 2010, p. 291). In addition, due to the effects of "institutional rational choice," political survival strategies can direct government spending to areas where other institutions can serve more efficiently (Araral, 2009, p. 867). Bates and Block (2013) concluded that electoral competition led to an increase in agricultural growth in African countries and influenced a policy shift from urban-bias to rural bias. However, they did not investigate the effects of this shift on agribusinesses (Bates &

Block, 2013, p. 373). Experts argue that public policies create winners and losers as governments struggle to strike the right balance between equity and efficiency (Hyman, 2014). Porter and Kramer (2011) addressed this policy dilemma by promoting "the concept of shared value," which reflects an assumption that policy trust leads to more value creation and higher public benefits than government spending alone (p. 66). This concept makes a case for inclusive business practice and partnerships between the private and public sectors.

Kingdon Garbage Can Model

Politicians and public administrators develop and implement public policies in a complex environment. In addition to different streams such as problem, politics, and policy streams, there is a myriad of stakeholders with divergent goals that make the policy formulation process an "organized anarchy" (Kingdon, 2011, pp. 84-86).

The Kingdon garbage can model helps in framing and contextualizing the Zambian government's intervention in the agricultural sector. This model also helps in analyzing and interpreting the impact that government spending has on other "policy games," including trust between agribusinesses and government agencies (Lubell et al., 2010, p. 289).

I collected secondary data on grain trade in Zambia and investigated the relationship between grain trade volumes and government agricultural spending levels, focusing on input subsidies and grain reserve. This research provides additional empirical evidence that explains and predicts the indirect effects of the theory of trust in the agricultural policy domain.

Nature of the Study

To fill the gaps identified above, I conducted a time-series study to investigate the impact of the Zambian agricultural policy on combined grain import and export volumes. The study had two independent variables: the quantity of government grain purchases for its food reserve agency and government spending on input subsidies. Grain purchases were measured in metric tons, whereas government spending on input subsidies was measured in monetary terms using the Zambian Kwacha. The study also had one dependent variable that consisted of grain trade volumes combining volumes of grain importation and exportation. The dependent variable was measured in metric tons and focused on key grains, including maize and rice.

I used secondary data that were published by the Zambian Central Statistical Office (CSO) and Food and Agricultural Organization of the United Nations (FAO), as well as Michigan State University. The data covered a 10-year period from 2003 to 2013. I used multivariate time series analysis to analyze these time-series data. Vector autoregressive analysis enabled the assessment of causal relationships between the variables of this study.

Variables and Operational Definitions

Below are operational definitions of the key variables that I sought to measure and analyze in this research:

Grain Trade

Grain trading is a step in the agricultural value chain that fulfills the function of moving grains from areas of surplus to areas of deficit as dictated by the market

fundamentals of supply and demand (Odozi, 2015). Grain traders "play a central role in the decisions that producers make about what to grow, where and how, in what quantities, and for which markets" (, Burch, Clapp, & Murphy, 2012, p. 10). The Zambian grain is traded at both domestic and international markets. The government of Zambia controls the supply and demand of grain at the domestic marketplace. The government uses both input subsidies and grain purchasing to influence market forces and deal with the dilemma of ensuring that food remains affordable in urban centers while maintaining incentives for rural farmers to continue the production of key grains (Bates & Block, 2013).

Agricultural trade is usually measured as export plus imports (Brigham, 2011). Zambia uses two policy choices to influence the international agricultural trade. These policy choices include import substitution and export promotion. It is evident that increased export boosts the growth of the Zambian economy (Chimfwembe & Seshamani, 2014). This research focused on international grain trade and used data on import and export of key grains, including maize and rice.

Food Reserve

Governments intervene in the grain market through the creation of strategic grain reserve (Mason & Myers, 2013). The main goal of food reserves is to "overcome supply shortage in markets as a result of harvest failures or unavailability of international supply" (Kornher, Kalkuhl, & Mujahid, 2015, p. 6). In addition, food reserves help governments manage price volatility and keep enough stock that can be distributed to

people affected by drought, flood, or any events that prevent them from having enough food (Galtier, 2013).

Input Subsidy

Agricultural input subsidy is one of the mechanisms for transferring public resources to producers in order to reduce farmers' cost of production and encourage the adoption of productivity-enhancing inputs such as improved seed and fertilizer (Chirwa & Dorward, 2013). Policy objectives of agricultural input subsidies in developing countries include "short-term private input market development, replenishment of soil fertility, social protection for poor subsidy recipients, and national and household food security" (p. 22).

Assumptions

Agrarian societies engage in export when they produce significant surplus. In fact, Saverimuttu and Rempel (2004) analyzed the determinants of grain imports and found that "a policy that increased the price farmers receive for food crops, relative to the price received for export crops, would reduce the need to import food" (p. 534). My study assumes grain export and import quantities represent the true image of grain trade. The government of Zambia restricts grain trade, especially exports; however, it rarely imposes a total ban. It uses export quota to control export volumes. In general, Zambian farmers are net buyers of grain; therefore, volumes traded on domestic markets can be misleading as farmers sell and go back to buy the same grain from traders, who manage to store and speculate with price increase (Mason & Myers, 2011). These dynamics transform many smallholder farmers into net buyers because of lack of access or limited access to

appropriate storage facilities and risks of incurring high postharvest losses (Armah & Asante, 2006).

Scope and Delimitations

The government of Zambia uses public expenditure and trade restrictions to achieve its agriculture-related goals. This study focused on the two public policy instruments that the government uses: spending on agricultural input subsidies and government purchases of grains. This means that the study did not investigate the effect of agricultural trade restrictions in terms of an export ban or export quota.

Limitations

Grain trading, one of the economic activities that dominate the Zambian formal and informal sector, has employed many Zambians since 2002 (Resnick & Thurlow, 2014). However, available data on imports and exports of key grains cover the formal sector. This means that the study did not cover occasional or ad hoc, informal grain trade. This may affect the external validity of the study, in that the extrapolation of study results to the whole universe of grain trade may erroneous. However, the study population is implicitly defined by the fact that time-series data assume consistency in grain trading.

This study used quantitative methods; therefore, it did not capture opinions or interpretations of the study population. A “sequential explanatory strategy “of mixed methods would have added qualitative data to explain what the numbers revealed (Creswell, 2009, p. 211). Qualitative data would have enabled the study to gain insights into causal relationships between Zambian agricultural policy instruments and external trade volumes. A rigorous time-series analysis of data addressed these limitations. In

addition, a political economy analysis included in the literature review helped in dissecting the reasons behind specific annual budget allocations and grain purchases.

Significance

There has been a lot of research on the impact of agricultural subsidies on production, productivity, and poverty in Zambia. However, the impact of the key instruments of the Zambian agricultural policy on grain trade has not been ascertained. The Zambian government uses input subsidies and price stabilization mechanisms to support the development of its agricultural sector. These two instruments are supposed to increase the volumes of grain traded. Saverimuttu and Rempel (2004) suggested that export parity pricing boosts local production, which leads to a surplus. However, Caracciolo, Depalo, and Macias (2014) found that Zambian agricultural policy forces the exit of many international grain traders.

The best policy outcome makes "at least one person better off while making no one worse off" (Mikesell, 2013, p. 22). In the grain industry, government policies may affect farmers, traders, and consumers. This research on the impact of Zambian agricultural policy on grain trade provided additional empirical evidence to explain and predict the indirect effects of the theory of trust embedded in policies regulating the grain industry in Zambia.

This study fills this gap and raises public policy makers' awareness of the need to consider both intended and unintended consequences during the agricultural policy making process. The public and private sectors perform complementary functions to improve people's quality of life. Government policies must strike the right balance

between equity and efficiency of the marketplace. This research contributes to the existing literature about the appropriate role of the public sector and the private sector in supporting key sectors of the economy such as agriculture to create value and sustain social and economic development.

Summary

This study was designed to investigate the impact of the Zambian agricultural policy on grain trade. The study used time-series data to detect the relationship between grain trade and the level of government involvement in terms of spending on agricultural subsidies as well as government grain purchases over a 10-year period.

This study bridges a gap in the existing literature by focusing on the impact that the Zambian agricultural policy has had on grain trade. Prior research focused on how the policy impacted the general populace, especially the poor segments of the Zambian population.

Chapter 2: Literature Review

Introduction

The growth and sustainability of the African agricultural sector depend on private sector investments and the ability to sell agricultural commodities to high-paying export markets. Zambia shifted its economic policy from import substitution to export promotion to accelerate its economic growth. In fact, Chimfwembe and Seshamani (2014) found "bidirectional causality between export and economic growth" (p. 14). This means that export causes economic growth and, at the same time, economic growth causes export. These authors recommended that the government of Zambia put in place policies that promote export because their econometric analysis showed a "stronger causality from export to economic growth" (p. 14). However, Caracciolo, Depalo, and Macias (2014) asserted that "the unpredictability of the Zambian government policy over the last decades has forced the exit of almost two-thirds of the major international grain trading firms present in the country" (p. 496).

The government of Zambia has prioritized the agricultural sector and invests in grain production and marketing. Government spending on agriculture has increased the production of grains but has not significantly reduced poverty in Zambian rural areas (, Burke, Jayne, Mason, & Shipekesa, 2011).

Past research has investigated the impact of Zambian agricultural policy on food security and poverty; however, the impact of this policy on grain trade has not been ascertained. A review of existing literature enables researchers to contextualize their research topic and "clarify the relationship between the proposed study and previous

work conducted on the topic" (Rudestam & Newton, 2007, p. 62). Creswell (2009) recommended that the literature review for quantitative studies focus on secondary data and information "related to major independent and dependent variables" (p. 44).

This chapter provides an overview of previous research on the interaction between government agricultural policies and the performance or livelihoods of nonstate actors. I also discuss existing literature on agricultural policy and its instruments, as well as the effect of Zambia's agricultural policy mix.

Key sections of this chapter include literature on the impact of public policy, and specifically agricultural policy; the context in which the Zambian agricultural policy was developed; the scale of government intervention in the agricultural sector; and the operations of grain traders. The chapter also shows gaps that exist in the research conducted on the impact of Zambian agricultural policy.

Literature Search Strategy

Most of the articles cited in this literature review were retrieved from the Political Science Complete databases available at the Walden University online library. Sage and John Wiley & Sons publications feature highly in this literature review. I also used relevant working papers, books, and reports from various institutions. The key search words included *policy*, *agriculture*, *Zambia*, *grain*, and *trade*. Boolean operators that I used to combine search words included AND, OR, and NOT. Most of the peer-reviewed articles, books, working papers, and reports included in this review were written in the last 5 years.

Theoretical Foundation

Poverty and Trade Theories

Theory of poverty. There are several theories of poverty; two of these are relevant to political and public policy arenas. These theories include "individual deficiencies" and "social phenomena" (Bradshaw, 2006, p. 6). The design and effectiveness of interventions to address poverty-related issues depend on the theory that dominates the views of policy makers. Proponents of "conservative" views postulate that individual deficiencies are the dominant cause of poverty, whereas those who ascribe to "liberal" views point fingers at social phenomena (Bradshaw, 2006, p. 6). These views influence the choice of antipoverty policies and programs.

The recent impressive economic growth in Mozambique epitomizes the limits of both conservative and liberal views when considered separately. Economic growth did not change the status of poverty significantly in Mozambique, where the agricultural sector employs "about 80 per cent" of its population (Cunguara & Hanlon, 2012, p. 627). Mozambican economic growth hinges on increased foreign direct investment in "megaprojects" for the extraction of minerals, infrastructure development, and international development aid (Cunguara & Hanlon, 2012, p. 626). Some development partners and donors who represent the liberal theory of poverty argue that the most effective strategy for reducing poverty is investing in "health, education, water, and roads" (Cunguara & Hanlon, 2012, p. 634). These views led the government of Mozambique and its donors to neglect the agriculture sector. On the other hand, Malawi and Zambia defied development partners or donor countries and decided to initiate

subsidy programs to shore up the agricultural sector. Rickard (2012) asserted that "subsidies are one of the most direct ways government can protect citizens from the costs of trade using national budgets" (p. 1181). To protect consumers from high prices of maize meal, the Zambian Food Reserve Agency offloads its stock to millers at a subsidized price (Kuteya & Jayne, 2012).

The cumulative and circumstantial theory combines both individual deficiencies and social phenomena theories of poverty. The cumulative and circumstantial theory of poverty involves the argument that "economic, political, and social distortion or discrimination" represent the main cause of poverty and that antipoverty programs should be complex to address this complex phenomenon (Bradshaw, 2006, p. 10). Addressing both systemic and individual-related causes of poverty in agrarian economies requires adequate incentives for farmers to adopted yield-enhancing technologies and access stable markets. In fact, Cunguara and Hanlon (2012) noted that "surplus households in northern Mozambique that have the assets and favorable conditions to produce much more staple food for the market are discouraged from doing so by the instability of prices and markets" (p. 626).

Political economy analysis of policy choices reveals winners and losers of policy proposals. Taking a forward-looking approach to poverty analysis to identify "who is likely to remain poor in the future," governments of countries in which agriculture employs the majority of people put in place policies that subsidize the cost of inputs for smallholder farmers and ensure that they have guaranteed markets for their produce (Carter & Barrett, 2006, p. 178).

Appropriate targeting is essential for the success of subsidy programs. In Zambia, the subsidy program increased total production but did not reduce poverty significantly because of lack of surgical targeting (Mason, Burke, Shipekesa, & Jayne, 2011). This study brought grain trade into the equation for reducing poverty and investigated the impact of such subsidies on grain trade.

Theory of trade. Trade is the concept of exchanging goods and services between entities. This study focused on international trade, which deals with the exchange of goods and services between countries. The trade theory is built on the work of Adam Smith, as refined by David Ricardo (Birgham, 2011). Most trade theories consider absolute and comparative advantage as the basis for free trade among nations (Schumacher, 2012).

Trade increases access to goods and services as it opens economic sectors. In fact, trade openness was the basis of the rapid growth in the "South Asian Tigers" countries (Birgham, 2011, p. 732). Chimfwembe and Seshamani (2014) found a strong relationship between export and economic growth in Zambia. However, Abizadeh and Pandey (2009) found that "trade openness had a small and possibly negative effect on the growth of total factor productivity for the agricultural sector" (p. 555). This study focuses on the effect of the Zambian agricultural policy on international grain trade.

Conceptual Framework

Concept of Trust in the Public Policy Domain

I anchored this study on the "theory of trust" in the public policy domain (Lubell, 2007, p. 237). The concept of trust integrates two theories of public policy: the Kingdon garbage can model and ecology of games theory.

Kingdon garbage can model. According to this model, public policies are developed and implemented in a complex environment. In addition to different streams such as problem, politics, and policy streams, there is a myriad of stakeholders with divergent goals who make the policy formulation process an "organized anarchy" (Kingdon, 2011, pp. 84-86).

The Kingdon garbage can model helped in framing and contextualizing the Zambian government's intervention in the agricultural sector and the political economy of the Zambian grain market. This model also helped in analyzing the impact that government spending had on other "policy games," including trust between agribusinesses and government agencies (Lubell et al., 2010, p. 289).

Ecology of games theory. This theory was developed by Norton E. Long in 1958. It involves the interaction between institutions, also referred to as *games*, that pursue different interests and how "players in each game make use of players in the others for their particular purposes" (Long, 1958, p. 251).

The prevailing wisdom is that collaboration between institutions reduces transaction costs and maximizes policy outcomes. Scholars in the policy arena refer to this collaboration as "institutional rational choice" and define it as "inclusive decision

processes that bring together multiple stakeholders, [and] help build networks and trust" (Lubell et al., 2010, pp. 287-288). The institutional rational choice framework enables the analysis of "incentives of actors involved, the context that influences their behavior and the outcomes of strategic interaction among rational actors" (Araral, 2009, p. 869). However, the "ecology of games theory" suggests that collaboration between institutions may increase transaction costs as it introduces "a new game overlaid on" the existing policy and institutional configuration (p. 290). Policy games are defined as "arenas of competition and cooperation structured by a set of rules and assumptions about how to act in order to achieve a particular set of objectives" (p. 289).

The paradigm of competition and cooperation between agribusinesses and government socioeconomic policies contributes to the analysis of trust-related issues among Zambian grain industry players. In fact, Abbink, Jayne, and Moller (2011) argued that lack of trust between the private sector and the agricultural policies of the government of Zambia produced a "paranoia effect" that tended to crowd out private-sector agricultural trade (p. 3). The authors argued that this situation also tended to increase the level of public spending on the agricultural sector because those in the government feared the eventuality of food insecurity if the sector were left to other players.

Ecology of games theory indicates that collaborative institutions may be trapped in the formulation of "symbolic policies" that are geared to simply "quell political discontent" (Lubell et al., 2010, p. 291). In addition, political survival strategies can direct government spending to areas where other institutions can serve more efficiently

due to the effects of an "institutional rational choice" approach to policy making (Araral, 2009, p. 867). Bates and Block (2013) also concluded that electoral competition led to an increase in agricultural growth in African countries and influenced the policy shift from "urban-bias" to "rural bias" (p. 373). Bates and Block's findings support the argument that the development of public policies should always take into consideration "political equilibria" even when stated policy objectives are to "remove market failure" or "correcting distortion" (Acemoglu & Robinson, 2013, p. 190).

Experts argue that public policies create winners and losers as a government struggles to strike the right balance between equity and efficiency (Hyman, 2014). However, the "shared value" theory can help in contextualizing the assumption that policy trust leads to more value creation and higher public benefits than government spending alone (Porter & Kramer, 2011). This concept makes a case for inclusive business practices and partnerships between the private and public sectors.

Key Variables and Concepts

Impact of Public Policy

Development projects and business initiatives have a hierarchy of measurements that policy makers and investors track to ensure that a specific policy or program achieves its goals and intended impact. Rossi, Lipsey, and Freeman (2004) argued that "impact theory" defines "the nature of the change in social conditions brought about by program action" (p. 64). Impact represents the highest effect that a specific policy or program has on the target group or a segment of the population. However, policy or program evaluators also assess the relevance and efficiency of the "organizational plan

and service utilizations plan" that the administrators use to implement policies or programs (Rossi at al., 2004, p. 64). Policies or programs have two types of indicators that enable evaluators to ascertain effectiveness and efficiency: impact indicators and process indicators. These indicators enable policy makers to make informed decisions in the process of designing, renewing, or discontinuing a particular program or policy.

Rosenbloom, Kravchuk, and Clerkin (2009) defined *policy impact* as "the extent to which a policy causes change in the intended direction" (p. 349). These authors argued that policy impact relates to the causal relationship between policy prescriptions and the results of implementing proposed policies. Public policies may result in expected outcomes or produce unexpected impacts on the target sector or population. Economists and public policy analysts use the "Pareto criterion" to measure or predict the overall impact of a policy and ensure that "at least one person is better off from a policy action and no person is worse off" (Mikesell, 2013, p. 22).

However, most research on the impact of the Zambian agricultural policies has focused on the effects that these policies have on the food security and poverty of the general population, both urban and rural. None of these studies have closely looked at the impact that policy instruments have had on the agribusiness sector, especially in the area of grain trade. In this research, I looked at import and export data and analyzed the relationship between these data and policy instruments that prevailed during each period covered in this study.

Agricultural Policy

Agricultural policy refers to "the set of government programs directly influencing agricultural production and marketing decisions" (Casavant, Infanger & Bridges, 1999, p. 353). Agricultural policy is one of the public policy areas that impact people living in both urban and rural settings, as well as small businesses and multinational corporations. In fact, public policy is a tool that governments use to direct investments in different areas of the economic and social life of their citizens. Governments use public policy to redistribute resources and achieve equity and efficiency (Hyman, 2014; Mikesell, 2013).

In many African countries, the performance of agriculture affects the survival of political figures due to the dominant role that agriculture plays in these countries' social and economic sectors (Bates & Block, 2013). The agricultural sector is the main source of income, food security, and nutrition for the Zambian people. Therefore, the production and marketing of agricultural commodities take center stage in Zambian social and economic policies. The government of Zambia has prioritized this sector by using public expenditure instruments to shore up grain production since "the early days of independence" (Sitko & Kuteya, 2013, p. 4).

Contextualizing the Zambian Agricultural Policy

Chapoto (2012) conducted an analysis of the political economy of the food price policy in Zambia that was consistent with Kingdon's multiple streams agenda-setting framework. Chapoto's account showed the need for a "policy window" where problem, policy, and politics converged to create an opportunity for an equitable and efficient

agricultural policy (Kingdon, 2011, p. 165). Kingdon argued that public policies are a product of multiple streams, including problem, politics, and policy streams.

Problem Stream

In 1990s, the government of Zambia embarked on macroeconomic reforms. To transition from a planned economy to a market-based economic system, the government liberalized economic activities, and privatized many state enterprises. It is in this context that the Zambian government "stopped subsidizing the production and consumption of maize" in 1991; a decision that led to high agricultural commodity prices and subsequent food riots threatened to overthrow the government (Chapoto, 2012, p. 3; Poulton, 2014). Furthermore, in order to mitigate the effect of "several drought cycles in 2004" the government decided to diversify the agricultural portfolio rather than focusing solely on maize (Sichoongwe, K., Mapemba, L., Tembo, G., and Ng'ong'ola, D., 2014, pp. 150-151).

Policy Stream

To avoid food shortage and high prices for staple foods, the government of Zambia decided to intervene at both upstream and downstream levels of the grain supply chains with a major emphasis on maize. The government created the Food Reserve Agency (FRA) in 1996 to solve demand problem by guaranteeing the market for farmers' produce. The original mission of FRA was "hold buffer stocks and dampen price variability"; however, the agency became a dominant player in the market and paid a price that was above the market equilibrium (Chapoto, 2012, p. 3).

In addition to buying farmers' products, the government introduced subsidies for agricultural inputs in 2002. This program started with subsidizing fertilizer and later the government added subsidized seed. By the end of the 2012/2013 agricultural season, the expanded range of crops benefiting from the Farmer Input Support Program (FISP) included maize, rice, sorghum, peanuts, and cotton (Mason, Jayne, & Mofya-Mukuka, 2013).

Politics Stream

During an election year, politicians tend to promise an increase in public expenditure on agricultural subsidies. In fact, the government of Zambia scaled up the input subsidy program in 2008 following the election of President Banda and spent unprecedented amount of money on FISP in 2011 - an election year. Mason and Ricker-Gilbert (2013) analyzed the distribution and targeting of the FISP program and found that from 1991 to 2011, constituencies that voted for the ruling party received more inputs than others as a token of appreciation for their votes.

Election as a Policy Window

In unitary states, elections can predict the governance and policy options as presidential majority in legislative bodies and their allies or satellite parties endorse most of the ruling party policy proposals (Tewfik, 2010). This means that policy streams (problem, policy, and politics) converge at the election time to provide a policy window for the agenda that the governing coalition prefers. Bates and Block (2013) argued that electoral competition led to an increase in agricultural growth in African countries and

influenced the policy shift from “urban bias” to “rural bias” (Bates & Block, 2013, p. 373).

However, Zambian politicians and policy makers seem to embrace a renaissance of the premultipartism era policies that focused on keeping agricultural commodity “prices low for urban consumers while maintaining remunerative prices for maize producers” (Mason, Jayne, & Mofya-Mukuka, 2013, p. 4). This policy alternative may become fiscally unsustainable in the long-run and deliberate efforts might be necessary to attract private investments in agriculture.

Scale of the Zambian Government Intervention in Agriculture

Common policy instruments that governments use to influence the agricultural sector include “price support, direct payments, production controls, and credit” (Bates & Block, 2013, p. 366). Zambia uses both supply and demand side instruments to influence the production and marketing of agricultural commodities.

Supply side policy instrument. The government of Zambia spends a significant portion of the agricultural budget on Farmer Input Support Program (FISP) that provides farmers with subsidized fertilizer and seed for maize, sorghum, and millet. The government uses input subsidies to increase the overall production of staple crops and ensure that poor smallholder farmers also participate in the agricultural production. However, most smallholder farmers are still net buyer of key grains (Mason & Myers, 2011).

Table 1

Zambian Government Spending on Input Subsidy Program (FISP and Food Security Pack Program), 2003-2012 Budget Years

Budget year	FISP (million ZMK)
2003	98050
2004	139990
2005	184050
2006	204540
2007	492080
2008	565120
2009	589010
2010	895390
2011	500000
2012*	499970

Note. Data from "Zambia's Input Subsidy Programs," by N. M. Mason, T. S. Jayne, and R. Mofya-Mukuka, 2013, *Agricultural Economics, 44*(2013).
* Based on budgeted amount. The budget execution takes place in the subsequent year.

Implementation of the Zambian agricultural policy focused on grain production and consumption subsidies that crowded out private sector companies (Abbink, Jayne, & Moller, 2011). In addition to subsidies and price support, the government uses other policy instruments including export bans, trade tariff, and licensing to influence the quantities that are sold in domestic and export markets. However, these other instruments are not regular and their use depends on lobbying or fear for food shortage (Sitko & Jayne, 2011).

Demand side policy instrument. To ensure that smallholder farmers have a guaranteed market for their produce, the government of Zambia put in place a Food Reserve Agency (FRA) that is primarily in charge of buying and holding a strategic food

reserve. However, the government has been using the agency to provide smallholder farmers with a market that pays "pan-territorial prices that frequently exceed prevailing market prices" (Jayne & Sitko, 2014, p. 10).

Table 2

Grain Reserve Agency's Grain Purchases

Season	FRA purchases in metric tons
2003	54,846
2004	105,279
2005	78,666
2006	389,509
2007	396,450
2008	73,876
2009	198,629
2010	883,036
2011	1,751,660
2012	1,046,000

Note. Data from *The Maize Price Spike of 2012/13: Understanding the Paradox of High Prices Despite Abundant Supplies* (p. 5), by N. Sitko and A. Kuteya, 2013, Lasaka, Zambia: Indaba Agricultural Policy Research Institute (http://fsg.afre.msu.edu/zambia/wp81.pdf).

FRA's practice of buying maize, rice, and cassava from farmers at a price above the market equilibrium crowds out private sector grain traders (Chipoto, 2012). Grain trading use market fundamentals of supply and demand to determine the price and quantity of commodities they trade. This study clarifies the extent to which the supply side policy instruments affect the involvement of the private sector in the Zambian grain trading.

In addition to investigating the effect of each of these two policy instruments, this study also investigated the combined effect of these instruments. The table below proves

the argument that Bates and Block (2013) advanced on political and policy biases. In fact, the data shows that in 2008, the government of Zambian more than doubled its expenditure on Farmer Input Support Program (FISP) as the ruling party wanted to attract rural voters. The government campaigned on "expanding the share of fertilizer it subsidized from 60 to 75 percent" (Resnick & Thurlow, 2014, p. 14). Data for the subsequent election cycle of 2011 suggest that the incumbent wanted to attract the rural producer by increasing government purchases to guarantee high prices and increasing subsidies on agricultural inputs.

Table 3

FRA Purchases and Government Spending of FISP

Year	FRA purchases in metric tons	% change	FISP in billion ZMK	% change
2003	54,846		98.05	
2004	105,279	92%	139.99	43%
2005	78,666	-25%	184.05	31%
2006	389,509	395%	204.54	11%
2007	396,450	2%	492.08	141%
2008	73,876	-81%	565.12	15%
2009	198,629	169%	589.01	4%
2010	883,036	345%	895.39	52%
2011	1,751,660	98%	500	-44%
2012	1,046,000	-40%	499.97	-0.01%

Note. Author's calculations using data from *The Maize Price Spike of 2012/13: Understanding the Paradox of High Prices Despite Abundant Supplies* (p. 5), by N. Sitko and A. Kuteya, 2013, Lasaka, Zambia: Indaba Agricultural Policy Research Institute (http://fsg.afre.msu.edu/zambia/wp81.pdf).

Private Sector Involvement

A sustainable growth of the agricultural sector requires efficient markets and a policy environment that is conducive to private sector investment. Abbot (2010) argued

that governments should coordinate their policy actions with the private sector, and that government intervention should be rule-based, transparent, credible and predictable to minimize negative effects or loss of livelihoods. Barret (2008) recommended the combination of public policy instruments and private sector investment to enable farmers to produce "marketable surplus" (p. 300). In fact, stated objectives of the Zambian agricultural policy include "the reduction of production and marketing distortions of maize" and "facilitating the growth of the private sector" (Tembo, Chapoto, Jayne, and Weber, 2010, p. 60). However, "in recent years business increasingly has been viewed as a major cause of social, environment, and economic problems" (Porter & Kramer, 2011, p. 1). This perception led to an increased government intervention in key economic sectors such as agriculture. In fact, McMichael (2013) advocated for the transformation of "debt relations" between agribusiness and farmers into public subsidy relations" to avoid private sector exploitation of African farmers (p. 697).

In Zambia, there are different categories of grain traders ranging from small-scale, medium size and corporate traders. Small-scale traders buy grains at farm gate; thereby saving farmers' time and money to transport their grains to the market. Medium size and corporate traders provide centrally located infrastructure when small- scale trader deliver the grains they buy from smallholder farmers. Medium size and corporate traders also offer market opportunity to farmer organizations that aggregate grains and transport truck loads to these traders' warehouses and other storage or aggregation facilities.

In 2014, there were more than 150 trading entities dealing in grains and members of the Grain Traders' Association of Zambia (GTAZ). GTAZ subdivided its members

into three categories including corporate, medium sized and small grain traders. Studies on the Zambian agricultural policy focused on food production, food prices, and poverty reduction. Even though it is evident that the intervention of the Zambian government in key grain markets resulted in a "paranoia effect" that reduced the involvement of grain traders in the production and marketing of agricultural commodities, the effect of the Zambian agricultural policy on grain trade has not been determined yet (p. 226).

Small traders in Zambia become profitable by "rapidly turning around stock" (Shepherd, 2012, p. 5). Government policies may slow and accelerate grain traders' stock turnover; thus, affecting the volumes of grains traded on both international and internal markets. Whereas government agencies can afford to keep high inventory levels for a long time, grain traders must avoid storage costs and increase their stock turnover to make money in this business whose profitability depends on volume traded.

Jayne and Sitko (2014) asserted that government procurement of grain elevate farmers' price expectations and crowds out traders from trading in commodities being purchased by the government. However, the same authors showed that traders still play a key role in the marketing of key grains especially maize in both "remote" and "accessible" areas (p. 10).

Most corporate grain traders in Zambia target the export market. Brigham (2011) noted that "the export of agricultural products is increasingly seen as one of the few viable instruments for reducing hunger and poverty in the developing world" (p. 729). This notion prompted a shift in the Zambian economic policy from import substitution to export promotion in order to accelerate the country's economic growth. In fact,

Chimfwembe and Seshamani (2014) found "bidirectional causality between export and economic growth" (p. 14). These authors recommended that the government of Zambia put in place policies that promote export as their econometric analysis showed a "stronger causality from export to economic growth" (p. 14). However, Caracciolo, Depalo and Macias (2014) asserted that "the unpredictability of the Zambian government policy over the last decades has forced the exit of almost two-thirds of the major international grain trading firms present in the country" (p. 496).

Table 4

Rice and Maze Imports and Exports

Year	Maize and rice imports in metric tons	Maize and rice exports in metric tons
2003	154059	28236
2004	35143	87835
2005	59179	47220
2006	146318	28521
2007	13763	201172
2008	17208	190651
2009	52515	20343
2010	17147	59623
2011	9263	496357
2012	20616	726987

Note. Author's calculation using FAOSTAT data.

Brigham (2011) defined international grain trade as the combination of imports and exports of grains. The level of exports and imports is also used to measure "trade openness" (p. 731). However, Brigham argues that the effect of imports and export should analyzed separately as each on these components of international trade produces different effects in different circumstances. Key considerations must include food availability, agricultural labor productivity and the importance of agriculture in the

economy. These considerations are important when the dependent variable is food security or food insecurity. The dependent variable for this study is the level of international grain trade. Therefore, the combination of key grain imports and export is appropriate.

Table 5

Zambia's International Grain Trade

Year	Maize and rice imports in metric tons	Maize and rice exports in metric tons	Total international grain trade volumes
2003	154059	28236	182295
2004	35143	87835	122978
2005	59179	47220	106399
2006	146318	28521	174839
2007	13763	201172	214935
2008	17208	190651	207859
2009	52515	20343	72858
2010	17147	59623	76770
2011	9263	496357	505620
2012	20616	726987	747603

Note. Author's calculation using FAOSTAT data.

Porter and Kramer (2011) urged businesses to partner with host communities to create shared value. The creation of shared value depends on the policy environment that must encourage wealth creation rather than redistribution of resources. Therefore, "governments must learn how to regulate in ways that enable shared value rather than working against it" (Porter & Kramer, 2011, p. 64). In fact, the creating shared value theory is paradigm shift in the interaction between businesses, government and society. It

advocates for “moving beyond trade-offs” and zero sum games that assume that providing societal benefits means tempering with companies’ economic success (Porter & Kramer, 2011, p. 65).

The private sector can assist farmers in adopting technologies and practices that increase yields and the quality of produce that business buy and process. The intertwined interest of farmers and agribusiness companies leads to a “bigger pie of revenue and profits that benefits both farmers and companies that buy from them” (Porter & Kramer, 2011, p. 66). However, the government of Zambia invests heavily in grain purchasing. The operations and spending of the Zambian Food Reserve Agency (FRA) have been suspected of crowding out private sector companies that are involved in grain trading (Gilbert, 2011).

Trust Among Policy Stakeholders

Trust is the backbone of market-based economic systems. The state and the perception of public sector fiduciary responsibility can lead to boom or bust in the marketplace. Successful development and implementation of public policies also depend on the trust level between policymakers and stakeholders (Lubell, 2007). In fact, Abbink, Jayne and Moller (2011) argue that the Bretton Woods institutions imposed liberalization policy to African government in 1980s. These policies led to the transfer of “critical marketing functions from state to private traders” and reinforced mistrust between governments and private sector operators (p. 208). Policy trust theories can assist the evaluation of the Zambian grain market performance in the current policy environment. Relevant theoretical frameworks include generalized trust framework, transaction cost

framework, advocacy coalition framework, policy stream framework, and creating shared value theory.

Summary

This review of literature explored what scholars published on the Zambian agricultural policy and its impact. The review showed that the government is involved in both the production and marketing of agricultural commodities. The government of Zambia uses both demand side and supply side policy instruments to influence transactions and activities at the upstream and downstream levels of agricultural supply chains.

Scholars who investigated the impact of the Zambian agricultural policy focused on food security in its strict sense of food availability and the price of food. They did not consider the impact of this policy on grain trade. This study investigated causal relationships between applied policy instruments and the volumes of international grain trade. The next chapter describes the methodology that this study used to collect data and analyze the relationship between input subsidies, government grain purchases, and grain trade in Zambia.

Chapter 3: Research Method

Introduction

This chapter describes the purpose and design of this research, the sampling methods, and the data collection and analysis tools. The selection of any type of research design is informed by the purpose of a study and the research questions (Creswell, 2009). Therefore, this chapter begins with an examination of the purpose of this study.

Purpose of the Study

The purpose of this study was to investigate the impact of Zambian agricultural policy on grain trade. Studies on Zambian agricultural policy have been focused on food production, food prices, and poverty reduction. Studies on how key instruments of the Zambian agricultural policy impact grain trade are lacking.

Abbink, Jayne, and Moller (2011) argued that private-sector involvement in the grain grade and the intervention of the Zambian government in key grain markets had resulted in a "paranoia effect" (p. 226). The fear of losing money due to government intervention reduced the involvement of grain traders in the production and marketing of agricultural commodities. On the other hand, the fear of private sector dominance increased government spending on both upstream and downstream activities of agricultural value chains. However, the effect of Zambian agricultural policy on grain trade has not yet been determined. To fill this gap, I conducted a time-series analysis of existing data on grain trade and government spending on input subsidies as well as grain volumes that the Food Reserve Agency (FRA) bought over a 10-year period. Major sections of this chapter address research design, research questions and hypotheses,

definitions of variables and concepts, assumptions, and the methodology for data collection and analysis.

Research Design and Rationale

This study investigated the relationship between two independent variables and one dependent variable. The independent variables were government spending on input subsidies and grain volumes that the government-run grain reserve agency bought over a 10-year period. It is important to note that the Zambian Food Reserve Agency always buys grain at a price that is above the going market rate (Mulungu & Chilundika, 2016). The dependent variable was the quantity of internationally traded grain. This variable combined both imports and exports of key grains, including maize and rice.

This study employed a quantitative method with a time-series design that "predicts outcomes retrospectively" (Druckman, 2004, p. 398). A time-series design and analysis enable researchers to analyze

> variation in chronological events that occur within cases referred to as diachronic variance, focus on trends that may reveal patterns or shapes of change, compare trends for two or more cases with the same or different number of data points, and use regression and correlational statistics taking into account the correlations that exist among the data points themselves, referred to as autocorrelation. (p. 398)

Wagner et al. (2002) defined a *time series* as "a sequence of values of a particular measure taken at regularly spaced intervals over time" (p. 299). Moreover, Balogun, Awaeyo, and Dawodu (2014) asserted that time series models are used "to obtain an understanding of the underlying forces and structure that produced the observed data, and

to fit a model and proceed to forecasting, monitoring or even feedback and feedforward control" (pp. 1046-1047).

Research Questions and Hypotheses

Research questions influence the design of a study and "focus the purpose of the study," whereas hypotheses show the "predictions the researcher makes about the expected relationships among variables" (Creswell, 2009, p. 132). This study investigated the impact of Zambian agricultural policy on grain trade. It sought to answer and test the following research questions and hypotheses:

Research Question 1 (RQ1): What is the impact of the Zambian food reserve agency's purchases on grain trade?

Null Hypothesis (H_0): The Zambian food reserve agency's purchases do not significantly impact grain trade.

Alternative Hypothesis (H_1): The Zambian food reserve agency's purchases significantly impact grain trade.

Research Question 2 (RQ2): What is the impact of government spending on input subsidies on grain trade?

Null Hypothesis (H_0): Government spending on input subsidies does not significantly impact grain trade.

Alternative Hypothesis (H_1): Government spending on input subsidies significantly impacts grain trade.

Definition of Variables and Concepts

Below are operational definitions of the key variables that I sought to measure and analyze in this research:

Grain Trade

Grain trading is a step in the agricultural value chain that fulfills the function of moving agricultural commodities from areas of surplus to areas of deficit as dictated by the market fundamentals of supply and demand (Odozi, 2015). Using price and volume signals, grain traders "play a central role in the decisions that producers make about what to grow, where and how, in what quantities, and for which markets" (Murphy, Burch, & Clapp, 2012, p. 10). Zambian grain is traded in both domestic and export markets. The government of Zambia controls the supply and demand of grain in the internal market. The government uses both input subsidies and grain purchasing to influence market forces and deal with the dilemma of ensuring that food remains affordable in urban centers while maintaining incentives for rural farmers to continue the production of key grains (Bates & Block, 2013). Agricultural trade flows include both exports and imports (Brigham, 2011).

Zambia adopted two policy choices to influence the international agricultural trade: import substitution and export promotion. It is evident that increased export boosts the growth of the Zambian economy (Chimfwembe & Seshamani, 2014). However, the imperatives of food security have led the government of Zambia to restrict exports of staple crops. This research focused on international grain trade and used data on import and export of key grains, including maize and rice.

Food Reserve

Governments intervene in the grain market through the creation of strategic grain reserve (Mason & Myers, 2013). The main goal of food reserves is to "overcome supply shortage in markets as a result of harvest failures or unavailability of international supply" (Kornher, Kalkuhl, & Mujahid, 2015, p. 6). In addition, food reserves help governments manage price volatility and keep stock that can be distributed to people affected by drought, flood or any event that prevents them from having enough food (Galtier, 2013).

Input Subsidies

Agricultural input subsidies constitute one of the mechanisms for transferring public resources to producers in order to reduce farmers' cost of production and encourage the adoption of productivity-enhancing input such as improved seed and fertilizer (Chirwa & Dorward, 2013). Policy objectives of agricultural input subsidies in developing countries include "short-term private input market development, replenishment of soil fertility, social protection for poor subsidy recipients, and national and household food security" (Chirwa & Dorward, 2013, p. 22).

Assumptions

Agrarian societies engage in export when they produce significant surplus. In fact, Saverimuttu and Rempel (2004) analyzed the determinants of grain imports and found that "a policy that increased the price farmers receive for food crops, relative to the price received for export crops, would reduce the need to import food" (p. 534). This study involved an assumption that grain export and import quantities represent the true image

of grain trade. The government of Zambia restricts grain trade, especially exports; however, it rarely imposes a total ban. From a public policy standpoint, this study reflects policy debates that determine the expected outcome of a specific policy action. An example of a typical policy question is "what will happen if the Federal Funds rate is raised by 25 basis points from its current level, and kept there for two years?" (Christiano, 2012, p. 1098). For this study, the policy question is what will happen to grain trade if the Zambian Government changes its spending on input subsidies and the amount of government grain purchases.

The study also involved an assumption that the linear model met is multiple regression and the linear model not met is bootstrapped multiple regression (Field, 2013). Another key assumption of the model is that there is no autocorrelated errors. This means that residues are not correlated. I used the Durbin Watson test to assess whether autocorrelations of a time series were different from zero. In addition, time series analysis assumes that data are stationary. This means that data have the same mean, variance, and autocorrelation over time (Adhikari & Agrawal, 2013). Heckman (2003) referred to these properties as "the independence and invariance of the mean" (p. 74). I used the Augmented Dickey Fuller (ADF) test to assess the stationarity of each time series.

Scope and Delimitations

The government of Zambia uses public expenditure and trade restrictions to achieve its agriculture-related goals. This study focused on the two public policy instruments that the government uses: spending on agricultural input subsidies and government purchases of grains. This means that the study did not investigate the effect

of agricultural trade restriction in terms of an export ban or export quota. These export bans and quotas are not regular and may only last a few days or a few months, as they depend on lobbyists' efforts to influence "grain import tariffs and export ban for a brief time" (Sitko & Jayne, 2011, p. 16). There may be additional factors that impact the volume of internationally traded grains that are not necessarily in the public policy realm or related to the two predictors of this study. Standard error of estimates account for factors "not explained by the equation of the model" used for statistical analysis or "uncorrelated white-noise disturbances" (Enders, 2010, pp. 5, 297).

Limitations

Grain trading, one of the economic activities that dominate the Zambian formal and informal sector, has employed many Zambians since 2002 (Resnick & Thurlow, 2014). However, available data on import and export of key grain cover the formal sector. This means that the study did not cover occasional or ad hoc, informal grain traders. This may affect the external validity of the study, in that the extrapolation of study results to the whole universe of grain traders may erroneous. However, the study population is implicitly defined by the fact that time-series data assume consistency in grain trading.

This study used quantitative methods; therefore, it did not capture opinions and interpretations of the study population. A "sequential explanatory strategy "of mixed methods would have added qualitative data to explain what the numbers revealed (Creswell, 2009, p. 211). Qualitative data would have enabled the study to afford insights into causal relationships between Zambian agricultural policy instruments and external

trade volumes. A rigorous time-series analysis of data covering a 10-year period addressed these limitations. In addition, a political analysis included in the literature review dissected the reasons behind specific annual budget allocations and grain purchases.

Population and Sampling Strategy

Sampling and Sample Size

To test the impact of Zambian agricultural policy on grain trade, this study used data covering 10 agricultural seasons from 2003 to 2012. The unit of analysis was the country year (Zambian market measured on an annual basis). Thus, *N* was 10 years. I used the entire 10-year time series, which enabled the use of standard estimation techniques such as "linear interpolation" (Rehfeld, Marwan, Heitzig, & Kurths, 2011, p. 390).

Instrumentation

Data Collection

I used secondary data that are available from official publications, including those of the Zambian Central Statistical Office (CSO), Food and Agriculture Organization Corporate Statistical Database (FAOSTAT), and Michigan State University (MSU). Data on the dependent variable, international grain trade volumes, came from FAOSTAT, whereas data on independent variables came from government databases and other publications, including research from Michigan State University that contained time-series data on the Zambian food reserve agency and input subsidies. The FAOSTAT

database is the most comprehensive and widely used for data on agriculture. The Walden Institutional Review Board (IRB) approval number was 06-06-17-0360425.

Variables. Independent variables included government spending on input subsidies and grain volumes that the government-run grain reserve agency bought over a 10-year period. Government spending was measured in monetary terms (Zambian Kwacha), whereas government grain purchases were measured in metric tons. The dependent variable was the quantity of internationally traded grain. This variable combined both imports and exports, and it was measured in metric tons.

Procedures. I used time-series data that spanned 10 agricultural seasons from 2003 to 2012. These procedures were cost effective because data were readily available and I did not need a lot of time and financial resources to collect the data. This time-series design advanced knowledge in the public policy arena by predicting the effect of the Zambian agricultural policy on grain trade retrospectively (Druckman, 2004). SPSS and Excel software could handle the analysis of causal relationship between variables. However, I used Stata because it was required to conduct vector autoregression (VAR) analysis.

Level of measurement. I used ratio variables that had a meaningful zero. These variables were also continuous, in that they "can be measured at any level of precision" (Field, 2013, p. 10). Thus, "ratio level" of measurement required statistical manipulation for analysis (Frankfort-Nachmias & Nachmias, 2008, p. 147). I used computer software such as Stata and Excel "to build a model with several predictors" (Field, 2013, p. 321).

Statistical Analysis

This study used time-series data covering 10 Zambian agricultural seasons from 2003 to 2012. Data on the dependent variable consisted of the volume of internationally traded grains. This variable combined both import and export of the main grains, including maize and rice. The volume of grains was expressed in metric tons. Data on independent variables included volumes that the government of Zambia purchased for its strategic grain reserve expressed in metric tons and the amount of money that the government spent on input subsidies. This money was expressed in the local currency; the Zambian Kwacha.

I conducted a time-series analysis to draw meaningful inferences from these data. Time-series analysis is "the procedure of fitting time series data into a proper model" (Adhikari & Agrawal, 2013, p. 15). In addition, Madsen (2008) stated that "time-series analysis deals with statistical methods for analyzing and modelling and ordered sequence of observations" (p. 1). Analyzing time-series data leads to understanding the underlying structure and function that produce the observations. I used descriptive, predictive, and prescriptive analytics to describe what happened, forecast what could happen, and advise Zambian policy makers on how to achieve their strategic goal of building a private-sector-led agricultural sector (Tembo, Chapoto, Jayne, & Weber, 2009). Even though time-series analysis, also referred to as *time-series econometrics*, was originally used for forecasting, economists have increasingly used it "for the interpretation of economic data and hypothesis testing" (Anders, 2010, p. 42).

There exist two main time-series models: univariate and multivariate (Adhikari & Agrawal, 2013). *Univariate* refers to a time series that consists of one variable, whereas *multivariate* time series have more than one variable. A multivariate time series that has only two variables is termed *bivariate*.

Univariate time-series analysis. A univariate time series is a sequence of measurements of the same variable collected over time at regular intervals. The difference between a univariate time series and standard linear regression is that time-series data are not necessarily independent or similarly distributed.

One of the key principles of data analysis is to visually inspect the data of each variable separately to assess the variation of each variable before ascertaining the covariation of all the variables together (Anders, 2010). I used univariate time series analysis to observe the behavior of each variable to determine if there are any unusual patterns that can inform subsequent analysis. This procedure also allows researchers to distinguish "stochastic and deterministic" trends of a time series (Anders, 2010, p. 248)

Decomposition. I used the Moving Average (MA) technique to describe each time series. MA helped with visual inspection of each variable, determining whether the appropriate decomposition technique is additive or multiplicative, testing the appropriate additive or multiplicative algorithm, and performing statistic tests to verify the correct model. Using the Moving Average technique, an analyst can calculate the following:

1. Trends
2. Seasonal index
3. Regression equation

4. Forecast future value for each of the variables (trade volumes, FRA purchases, and government expenditure on FISP)

I used the following classic multiplicative model to get coefficient, constant and random matrix for each variable: Y123=TCSI where

Y1 = Quantity of internationally traded Zambian grain

Y2 = Government input subsidies

Y3 = government grain purchases of its strategic reserve

T = Trend

C = Cycle

S = Seasonal effect

I = Irregular fact (noise or random variation that is unpredictable)

I used annual data; so, the time series analysis did not include S as annual data do not have seasonal effect.

The linear model was $y = b_0 + b_{1(}x1) + b_2(x2) + b_3(x3) + \ldots + b_k\,(xk)$ where

y = Trend line estimate of y

x = Time period

The applicable regression equation is y = a+bx

$$b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - \left(\sum x^2\right)}$$

$$a = \frac{\sum y}{n} - b\left(\frac{\sum x}{n}\right) \text{ or } a = \bar{y} - b\bar{x}$$

Tests

Stationarity. Time-series analysis assumes that the dataset is stationary. Stationary time series are those whose "mean and variance are constant over a given period of time and the covariance between the two time periods does not depend on the actual time at which it is computed but it depends only on lag amid the two time periods" (Kumar, 2011, p. 10). Stationary series vary around a constant mean level, neither decreasing of increasing systematically over time with constant variance. In fact, "stationarity of a data series is a prerequisite for drawing meaningful inferences in a time series analysis" (Kumar, 2011, p. 10).

Greene (2003) asserted that different forms of "Dickey-Fuller (ADF) tests for unit roots are an indispensable tool for the analyst of time-series data" (p. 661). I used Augmented Dickey-Fuller test to assess the stationarity of the variables because the time series data for this study are parametric as they are ratio data, they assume a normal distribution, homogeneous variance. The ADF null hypothesis is that the t-test is 0, meaning that there is a unit root. When the t-test is equal to zero, the dataset must be transformed to make it stationary. The alternative hypothesis is that the t-test is less than zero; meaning that the dataset is stationary and does not need to be transformed.

Autocorrelation. I used the Durbin-Watson test to assess the presence of autocorrelation. Autocorrelation refers to the relationship between a variable and itself over period intervals, the level of a variable affects its future level.

Multivariate time series. Multivariate time series analysis allows researchers to model and explain the interactions and co-movements among a group of time series variables. Multivariate analysis also enables researchers to test the effect of multiple independent variables on the dependent variable. Multivariate analysis uses "the technique of multiple regression" that helps researchers reflect the realities of the real life where changes depend on many events acting together (Frankfort-Nachmias & Nachmias, 2008, p. 403). Multiple regression analyzes the effects of multiple independent variables on one dependent variable: y=f(x1, x2… xn).

Multivariate analysis also enables researchers to avoid caveats and conduct comprehensive analysis of key phenomenon without conduction multiple and costly studies to look at every angle of a social problem.

Knowing the extent to which each variable drives change or its contribution to the change allows researchers to conduct a "utilization-focused" research and analysis (Patton, 2002, 173-175). This type of analysis helps stakeholders use the findings to take decisions knowing the likely "effect size" attributed to each variable and combination of variables (Creswell, p. 157). I also assessed "the combined effect" of all the independent variables" by "computing the "coefficient of determination" (Frankfort-Nachmias & Nachmias, 2008, p. 403).

Covariation. Frankfort-Nachmias and Nachmias (2008) asserted that covariation exists when two or more variables 'go together' or change together in a systematic way" (p. 53). Covariates are referred to as predictors in time-series analysis. The main variables for the study included a group of independent variables (predicators) consisting of key

agricultural policy instruments such as the amount of money allocated to agricultural input subsidies and the quantity of grains that the government of Zambia bought for the strategic food reserve. The dependent variable consisted the volumes of international grain trade that included both imports and exports. I used time-series data that covered ten agricultural seasons; from 2003 to 2012.

I used "multivariate vector autoregressive model" to test the impact of the Zambian agricultural policy instruments on grain trade (Hood III, Kidd, & Morris, 2008, p. 326). This instrument allows appropriate sequence of time-series datasets. Multivariate time-series are also known as vector autoregressive and the main models include Vector Autoregressive (VAR) and Autoregressive-Moving Average (ARMA).

The basic model for this research was:

$y = f(x1, x2)$ where

y = Quantity of internationally traded Zambian grain

x1 = Government spending on agricultural input subsidies

x2 = Quantity of grain purchased by the government's food reserve agency

I used vector auto regression (VAR) technique to determine whether government spending on input subsidies and the volumes that the food reserve agency buys can be used to forecast the level of imports and exports of key grains. VAR is one of the models for the analysis of multivariate time series. Chaiechi (2014) stated that "in addition to data description and forecasting, the VAR model is also used for structural inference and policy analysis" (p. 139). Stock and Watson (2001) also asserted that econometricians use VAR models for "data description, forecasting, structural inference and policy

analysis" (p. 101). Christopher A. Sims who introduced VAR suggested three purposes of VAR including "forecasting economic time series, designing and evaluating economic models, and evaluating the consequences of alternative policy actions" (Christiano, 2012, p. 1083). VAR models provide a good fit to macroeconomic data. They are also flexible as they "can be conditional on the potential future paths of specified variables in the model" (Ozturk & Agan, 2014, p. 7). It has also been argued that "VAR sticks more closely to the data than other structuralist models" (Heckman, 2000, p. 49).

The primary focus was on investigating whether or not correlation between these two sets of variables existed. However, as Campbell and Stanley (1963) indicated, "correlation does not necessarily indicate causation" (p. 64). Heckman (2000) insisted that "a causal interpretation of an empirical relationship is required to evaluate economic policies within well-specified model" (p. 46). So this study provided preliminary insights that can be used to develop further causal hypotheses between the Zambian agricultural policy and grain trade.

This study used one outcome variable which was continuous. It consisted of internationally traded grain volumes. This variable combined both imports and exports of key grains including maize and rice. I used two predictor variables including government spending on input subsidies and the quantity of grain that the food reserve agency purchased over a ten-year period. Field (2013) defined a continuous variable as "one that can take any value on the measurement scale" (p. 10).

Significance

There has been a lot of research on the impact of agricultural subsidies on the production, productivity and poverty in Zambia. However, the impact of the key instruments of the Zambian agricultural policy on grain trade has not been ascertained. The Zambian government uses input subsidies and price stabilization mechanisms to support the development of its agricultural sector. These two instruments are supposed to increase the volumes of grain traded. Saverimuttu and Rempel (2004) suggested that export parity pricing boosts local production which leads to a surplus. However, Caracciolo, Depalo and Macias (2014) found that Zambian agricultural policy forces the exit of many international grain traders.

The best policy outcome makes "at least one person better off while making no one worse off" (Mikesell, 2013, p. 22). In the grain industry, government policies may affect farmers, traders and consumers. This research on the impact of the Zambian agricultural policy on grain trade provided additional empirical evidence that explain and predict the indirect effects of the theory of trust or the lack of trust embedded in policies regulating the grain industry in Zambia.

This study fills this gap and raises public policy makers' awareness of the need to consider both intended and unintended consequences during the agricultural policy making process. Public and private sectors perform complementary functions to improve people's quality of life. Government policies must strike the right balance between equity and efficiency of the marketplace. This research contributes to the existing literature about the appropriate role of the public sector and the private sector in supporting key

sectors of the economy such as agriculture to create value and sustain social and economic development.

Threats to Validity

Grain traders in Zambia have different forms including farm gate grain collectors, village level grain aggregators, small-scale traders, medium and large size corporations that purchase and process grains. This study focused on formal grain trade as it used import and export data. This focus did not consider informal grain trade and internal markets. This might dilute the external validity of the study as it could be difficult to extrapolate the findings to the entire grain trading industry. To minimize measurement error and measure variables accurately, I used ten-year data on international grain trade.

Ethical Issues

There are no ethical issues that this study caused as it used data from secondary sources. All the data are in the public domain and the study did not collect any views from people who might be affected by the findings or conclusions. However, I have spent almost ten years supporting agribusiness to source raw materials from smallholder farmers and building the capacity of small and medium sized agribusinesses to improve their supply chain management. So, my professional biases could be a source of potential ethical issue. To mitigate this risk, I used rigorous statistical analysis that focused on what the numbers revealed.

Summary

The time-series design that uses multivariate analysis enabled me to test the effects that the two policy instruments of the Zambian agricultural policy had on grain

trade from 2003 to 2012. Vector auto-regression technique allowed me to investigate the causal relationships between multiple variables.

Chapter 4: Results

Introduction

This study was developed to determine the impact of Zambian agricultural policy on international grain trade. The study was designed to answer the following research questions:

1. What is the impact of the Zambian food reserve agency's purchases on grain trade?

The null hypothesis for this question was that the Zambian food reserve agency's grain purchases did not significantly impact grain trade, whereas the alternative hypothesis was that the Zambian food reserve agency's purchases significantly impacted grain trade.

2. What is the impact of government spending on input subsidies on grain trade?

The null hypothesis for this question was that government spending on input subsidies did not significantly impact grain trade. Its alternative hypothesis was that government spending on input subsidies significantly impacted grain trade.

This chapter contains the results of the data analysis and includes sections on data description, assumption testing, and causality inference among variables. Descriptive analysis was conducted to visualize trends and develop forecasting equations for each variable; the augmented Dickey Fuller (ADF) test was used to assess the stationarity of the time-series datasets; and the Durbin-Watson test helped in detecting the presence of autocorrelation in the residuals from a regression analysis. Vector autoregression analysis

was used to analyze causal inferences between one dependent variable and two independent variables and answer the two research questions.

Data

This research and analysis used time-series data covering a 10-year period from 2003 to 2012, as shown in the table below. These are secondary data from publically available sources such as the Food and Agriculture Organization, Michigan State University, and the Government of Zambia.

Table 6

Time-Series Data

Year	FRA purchases in metric tons	FISP in million ZMK	Total international grain trade volumes
2003	54846	98050	182295
2004	105279	139990	122978
2005	78666	184050	106399
2006	389509	204540	174839
2007	396450	492080	214935
2008	73876	565120	207859
2009	198629	589010	72858
2010	883036	895390	76770
2011	1751660	500000	505620
2012	1046000	499970	747603

Note. Author's calculations using data from Sitko and Kuteya (2013) and FAOSTAT.

Data Description

In this analysis, FRA purchases are referred to as *FRA*, FISP spending is referred to as *FISP*, and international grain trade volume is referred to as *Trade*. Each of these variables has 10 observations, as shown in the data summary in Table 7.

Table 7

Data Summary

Variable	Obs	Mean	Std. dev.	Min	Max
FRA	10	497795.1	561571.5	54846	1751660
FISP	10	416820	253347	98050	895390
Trade	10	241215.6	216938.5	72858	747603

The analysis of these data focused on identifying patterns, including trends and periodical variations (descriptive statistics); understanding and modeling the data (explanatory statistics); and predicting trends from previous patterns (forecasting). After summarizing the data, I started plotting observed values for each variable against time to visualize the patterns of the data over time.

Figure 1 shows that FRA purchases almost hit rock bottom in 2008 as the government was increasing its budgetary allocations to the Farmer Input Support Program. Allocations to FISP started to increase more than ever right after 2008. During this year, the country held presidential elections to replace President Levy Mwanawasa, who died in office serving his second term.

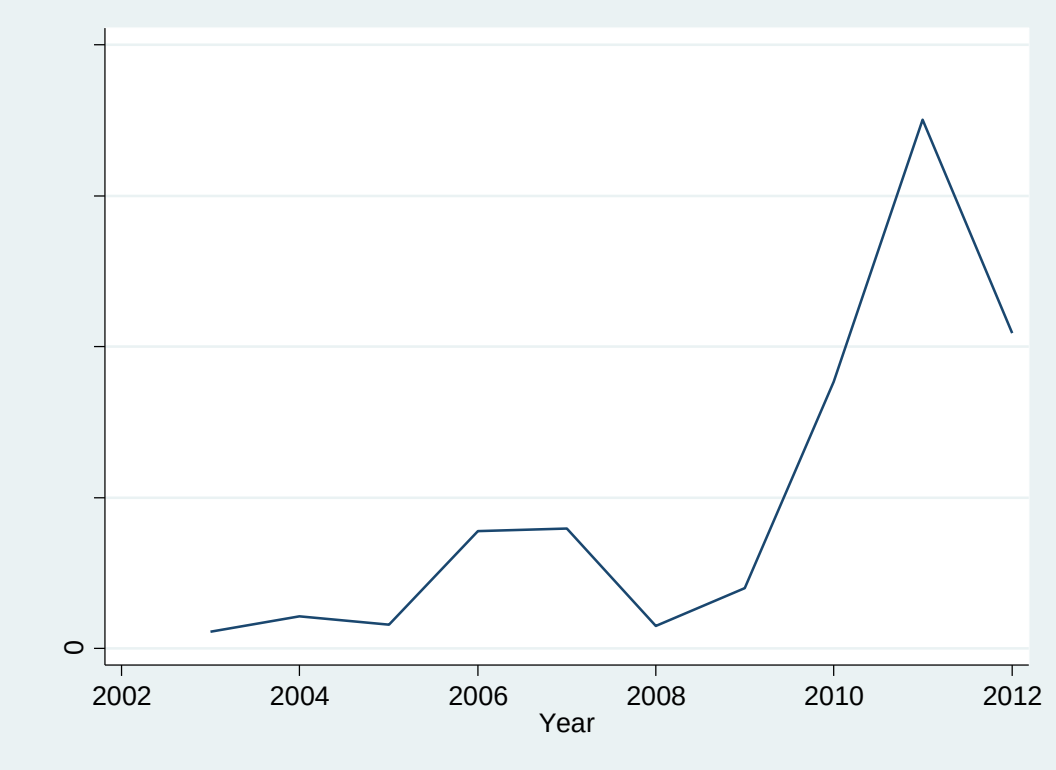

Figure 1. Trends in FRA grain purchases.

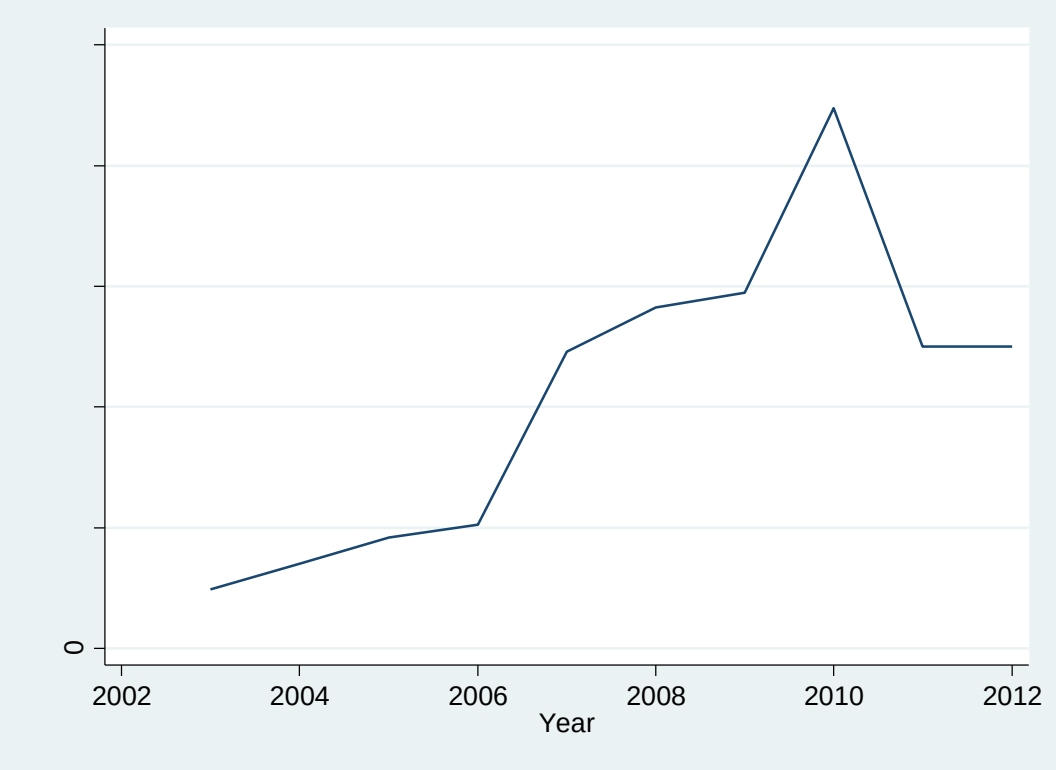

Figure 2. Trends in government spending on FISP.

In 2010, government spending input subsidies for the FISP program skyrocketed as the country headed toward elections. More spending on input subsidies symbolizes government efforts to mobilize rural voters.

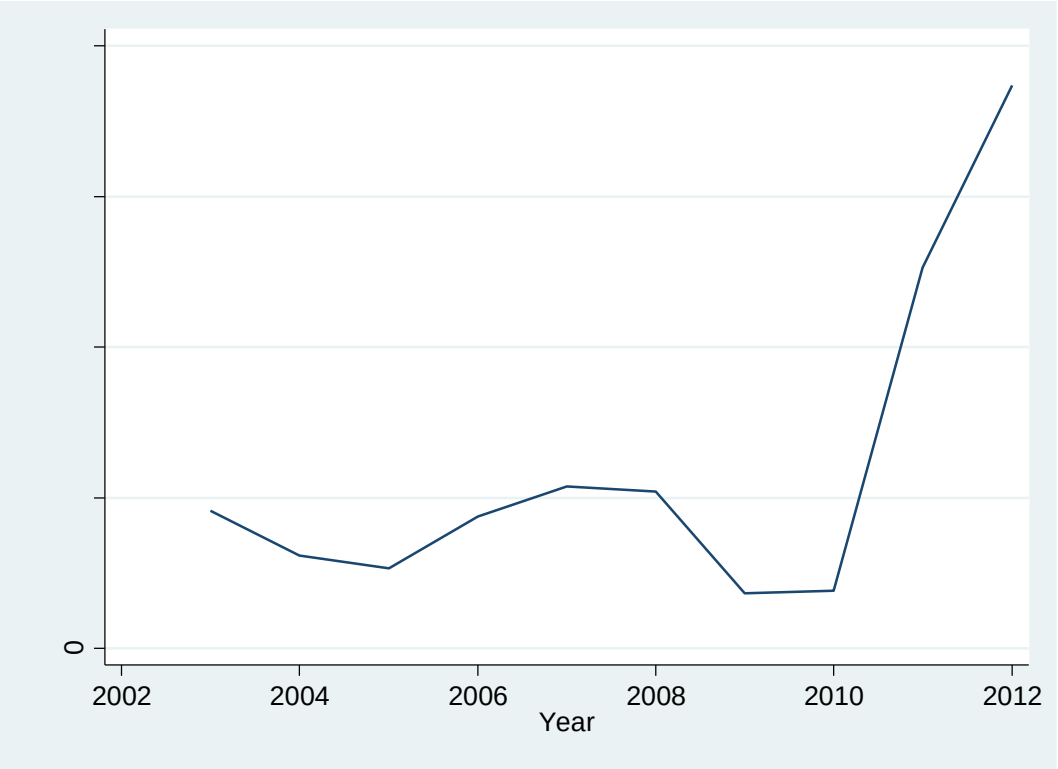

Figure 3. Trends in grain volumes traded internationally.

In 2010, volumes of internationally traded grain bottomed. After that year, they shot straight upward. During the same period, the other two variables experienced an upswing movement.

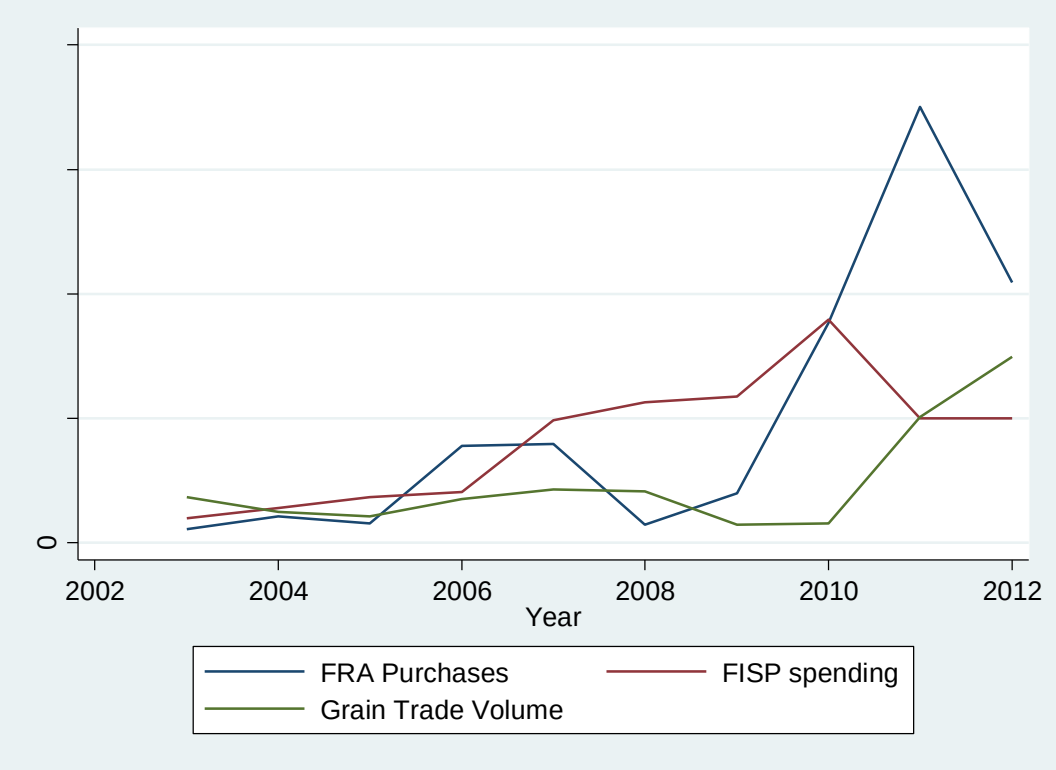

Figure 4. Covariance among variables.

Whereas FRA purchases and FISP spending declined and plateaued after 2011, grain trade volumes continued on an upward trend.

Univariate Time-Series Analysis

After graphic representation of the data, I proceeded with univariate time-series analysis, which is a sequence of measurements of the same variable collected over time at regular intervals. One of the key principles of data analysis is visual inspection of the data for each variable separately to assess the variation of each variable before ascertaining the covariation of all the variables together (Anders, 2010). I used univariate time-series analysis to observe the behavior of each variable to determine if there were any unusual

patterns that could inform subsequent analysis. This procedure also allows researchers to distinguish "stochastic and deterministic" trends of a time series (Anders, 2010, p. 248)

I used a decomposition procedure with the moving average (MA) technique to describe each time series. MA helped with visual inspection of each variable, determining whether the appropriate decomposition technique was additive or multiplicative, testing the appropriate additive or multiplicative algorithm, and performing statistical tests to verify the correct model. Using the MA technique, I was able to calculate the following:

1. Trends
2. Seasonal index
3. Regression equation
4. Future value forecast for each of the variables (trade volumes, FRA purchases, and government expenditure on FISP)

I used the following classic multiplicative model to get coefficient, constant, and random matrix for each variable: y123 = TCSI, where

y1 = Government input subsidies (FISP)

y2 = Government grain purchases of its strategic reserve (FRA)

y3 = Quantity of internationally traded Zambian grain

T = Trend

C = Cycle

S = Seasonal effect

I = Irregular fact (noise or random variation that is unpredictable)

I used annual data, so the time-series analysis did not include S, because annual data do not have seasonal effects.

The linear model was $y = b_0 + b_{1(}x1) + b_2(x2) + b_3(x3) + \ldots + b_k\ (xk)$ where

y = Trend line estimate of y

x = Time period

The applicable regression equation is y = a+bx

$$b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - \left(\sum x^2\right)}$$

$$a = \frac{\sum y}{n} - b\left(\frac{\sum x}{n}\right) \text{ or } a = \bar{y} - b\,\bar{x}$$

Table 8

FISP Expenditure in Millions of Zambian Kwacha

Year	x code	y	2-period moving average	Centered moving average	Ratio to MA	Deseasonalized FISP expenditure
2003	1	98050				82458
2004	2	139990	119020			117728
2005	3	184050	162020	140520	1.31	154782
2006	4	204540	194295	178157.5	1.15	172013
2007	5	492080	348310	271302.5	1.81	413827
2008	6	565120	528600	438455	1.29	475252
2009	7	589010	577065	552832.5	1.07	495343
2010	8	895390	742200	659632.5	1.36	753001
2011	9	500000	697695	719947.5	0.69	420488
2012	10	499970	499985	598840	0.83	420463
				Total	9.51	
				Mean	1.19	

	x code	y	Xy	x2
	1	98050	98050	1
	2	139990	279980	4
	3	184050	552150	9
	4	204540	818160	16
	5	492080	2460400	25
	6	565120	3390720	36
	7	589010	4123070	49
	8	895390	7163120	64
	9	500000	4500000	81
	10	499970	4999700	100
Sum	55	4168200	28385350	385
Mean	5.5	416820		

The applicable equation is y = a+bx

$$b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - \left(\sum x^2\right)} = 41$$

$$a = \frac{\sum y}{n} - b\left(\frac{\sum x}{n}\right) \text{ or } a = \bar{y} - b\bar{x} = 416595$$

Below is the equation that can be used to predict future value of FISP expenditure:

$y1 = 416595 + 41x$; where y1 is projected FISP expenditure and x is the n^{th} year after 2013.

Table 9

FRA Purchases in Metric Tons

Year	x code	Y	2 -period moving average	Centered moving average	Ratio to MA	Deseasonalized FISP expenditure
2003	1	54846				39398
2004	2	105279	80063			75626
2005	3	78666	91973	86018	0.91	56508
2006	4	389509	234088	163030	2.39	279798
2007	5	396450	392980	313534	1.26	284784
2008	6	73876	235163	314071	0.24	53068
2009	7	198629	136253	185708	1.07	142682
2010	8	883036	540833	338543	2.61	634315
2011	9	1751660	1317348	929090	1.89	1258278
2012	10	1046000	1398830	1358089	0.77	751378
				Total	11.14	
				Mean	1.39	

	x code	y	xy	x2
	1	54846	54846	1
	2	105279	210558	4
	3	78666	235998	9
	4	389509	1558036	16
	5	396450	1982250	25
	6	73876	443256	36
	7	198629	1390403	49
	8	883036	7064288	64
	9	1751660	15764940	81
	10	1046000	10460000	100
Sum	55	4977951	39164575	385
Mean	5.5	497795		

The applicable equation is y = a+bx

$$b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - \left(\sum x^2\right)} = 88$$

$$a = \frac{\sum y}{n} - b\left(\frac{\sum x}{n}\right) \text{ or } a = \bar{y} - b\bar{x} = 497309$$

Below is the equation that can be used to predict future value of FRA purchases: y2= 497309+88x; where y2 is projected FRA purchases and x is the n^{th} year after 2013.

Table 10

International Grain Trade (Import and Export of Key Grains)

Year	x code	y	2-period moving average	Centered moving average	Ratio to MA	Deseasonalized trade volumes
2003	1	182295				145983
2004	2	122978	152636.5			98481
2005	3	106399	114688.5	133662.5	0.80	85205
2006	4	174839	140619	127653.75	1.37	140012
2007	5	214935	194887	167753	1.28	172121
2008	6	207859	211397	203142	1.02	166454
2009	7	72858	140358.5	175877.75	0.41	58345
2010	8	76770	74814	107586.25	0.71	61478
2011	9	505620	291195	183004.5	2.76	404903
2012	10	747603	626611.5	458903.25	1.63	598684
				Sum	9.99	Total
				Average	1.25	seasonal index

Adjustment factor = 1.6016

	x code	y	xy	x2
	1	182295	182295	1
	2	122978	245956	4
	3	106399	319197	9
	4	174839	699356	16
	5	214935	1074675	25
	6	207859	1247154	36
	7	72858	510006	49
	8	76770	614160	64
	9	505620	4550580	81
	10	747603	7476030	100
Sum	55	2412156	16919409	385
Mean	5.5	241216		

The applicable equation is y = a+bx

$$b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - \left(\sum x^2\right)} = 18$$

$$a = \frac{\sum y}{n} - b\left(\frac{\sum x}{n}\right) \text{ or } a = \bar{y} - b\bar{x} = 241080$$

Below is the equation that can be used to predict future value of internationally traded grain volumes:

y3=241080+18x; where y3 is projected internationally traded grain volumes and x is the n^{th} year after 2013.

After the above univariate analysis, I conducted an analysis of statistical assumptions for vector autoregration analysis to ensure that this type of analysis is appropriate for each of the variables.

Evaluation of Statistical Assumptions

There are two main assumptions for vector autoregression analysis. These include stationarity of time series and serial correlation. Before running vector autoregressive analysis of time-series data sets, I tested these assumptions using Augmented Dickey-Fuller test for the stationarity of time series and Durbin-Watson test for serial correlation.

Stationarity Test

Drawing inferences from autoregressive models becomes an issue when time-series datasets have a unit root. Augmented Dickey- Fuller (ADF) is one of the most popular test for unit root. The null hypothesis for this test is that the time series has a unit root; and the alternative hypothesis is that the time series does not have a unit root.

The test value is a negative number. When the ADF test statistic is positive, the null hypothesis is automatically accepted and the time series is declared non-stationary (Stadnytska, 2010 & Brooks, 2008). The key characteristic of a stationary time series is that it's "mean, variance, and autocorrelations can usually be well approximated by sufficiently long time averages based on the single set of realizations" as they do not change over time (Enders, 2010, p. 53-54).

Table 11

Augmented Dickey-Fuller

[lags]	DF-GLS tau test statistic	1% critical value	5% critical value	10% critical value
11	-2.925	-3.610	-2.763	-2.489
10	-2.671	-3.610	-2.798	-2.523
9	-2.766	-3.610	-2.832	-2.555
8	-3.259	-3.610	-2.865	-2.587
7	-3.536	-3.610	-2.898	-2.617
6	-3.115	-3.610	-2.929	-2.646
5	-3.054	-3.610	-2.958	-2.674
4	-3.016	-3.610	-2.986	-2.699
3	-2.071	-3.610	-3.012	-2.723
2	-1.675	-3.610	-3.035	-2.744
1	-1.752	-3.610	-3.055	-2.762

Note. Opt Lag (Ng-Perron seq *t*) = 7 with RMSE .0388771. Min SC = -6.169137 at lag 4 with RMSE .0398949. Min MAIC = -6.136371 at lag 1 with RMSE .0440319.

ADF value is normally negative. As shown in Table 11, the null hypothesis that these time-series datasets have a unit root or are non-stationary can be rejected at 11 and 8;7;6,5; and 4 lags as they are all more negative than the DF-GLS test statistic at 5% significance level. However, it is appropriate to use 1 lag as each variable contains annual data.

Variable: Food Reserve Agency (FRA).

Table 12

Augmented Dickey-Fuller Test for Unit Root in FRA Data

Number of obs = 8			
	Interpolated Dickey-Fuller		
Test Statistic	1% critical value	5% critical value	10% critical value
Z(t) 2.264	-4.380	-3.600	-3.240

Note. MacKinnon approximate *p*-value for Z(t) = 1.0000.

Test statistic of 2.264 shows that this time series is not stationary. To make it stationary, I used the following seasonally adjusted data (deseasonalized) for this variable.

Table 13

Deseasonalized Data on FRA Purchases in Metric Tons

Year	x code	Y	2-period moving average	Centered moving average	Ratio to MA	Deseasonalized FISP expenditure
2003	1	54846				39398
2004	2	105279	80063			75626
2005	3	78666	91973	86018	0.91	56508
2006	4	389509	234088	163030	2.39	279798
2007	5	396450	392980	313534	1.26	284784
2008	6	73876	235163	314071	0.24	53068
2009	7	198629	136253	185708	1.07	142682
2010	8	883036	540833	338543	2.61	634315
2011	9	1751660	1317348	929090	1.89	1258278
2012	10	1046000	1398830	1358089	0.77	751378

Table 14

Augmented Dickey-Fuller Test for Unit Root in Deseasonalized FRA Data

Number of obs = 8				
		Interpolated Dickey-Fuller		
	Test statistic	1% critical value	5% critical value	10% critical value
Z(t)	-5.381	-4.380	-3.600	-3.240

Note. MacKinnon approximate *p*-value for Z(t) = 0.0000.

ADF test conducted on deseasonalized data shows that the test statistic is -5.381 which is more negative than the critical value at 5% significance level.

Variable: Farmer Input Support Program (FISP).

Table 15

Augmented Dickey-Fuller Test for Unit Root in FISP Data

Number of obs = 8				
		Interpolated Dickey-Fuller		
	Test statistic	1% critical value	5% critical value	10% critical value
Z(t)	-4.717	-4.380	-3.600	-3.240

MacKinnon approximate p-value for Z(t) = 0.0007

The test statistic is lower or more negative than the critical value. So, this time series is stationary.

Variable: International grain trade.

Table 16

Augmented Dickey-Fuller Test for Unit root in International Grain Trade Data

Number of obs = 8				
		Interpolated Dickey-Fuller		
	Test	1% critical	5% critical	10% critical

	statistic	value	value	value
Z(t)	-1.631	-4.380	-3.600	-3.240

MacKinnon approximate p-value for Z(t) = 0.7800

This time series is not stationary as the test statistic is higher or less negative than the critical value. To make it stationary, I deseasonalized the dataset.

Table 17

Deseasonalized Data on International Grain Trade

Year	X code	Y	2-period moving average	Centered moving average	Ratio to MA	Deseasonalized trade volumes
2003	1	182295				145983
2004	2	122978	152636.5			98481
2005	3	106399	114688.5	133662.5	0.80	85205
2006	4	174839	140619	127653.75	1.37	140012
2007	5	214935	194887	167753	1.28	172121
2008	6	207859	211397	203142	1.02	166454
2009	7	72858	140358.5	175877.75	0.41	58345
2010	8	76770	74814	107586.25	0.71	61478
2011	9	505620	291195	183004.5	2.76	404903
2012	10	747603	626611.5	458903.25	1.63	598684

Table 18

Augmented Dickey-Fuller Test for Unit Root in Deseasonalized International Grain Trade Data

Number of obs = 8

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-4.975	-4.380	-3.600	-3.240

MacKinnon approximate p-value for Z(t) = 0.0002

This time-series variable has become stationary as the test statistic value is more than critical value at 1%, 5% and 10% significance level.

Serial Correlation Test

Serial correlation occurs in time-series when the errors associated with a given time period carry over into future time periods. Vector autoregression analysis assumes the absence of autocorrelation. Durbin – Watson test helps detect the presence of autocorrelation in the residuals from a regression analysis. This test "has been found to be quite powerful when compared to others for AR (1) processes" (Greene, 1990, p. 452).

Table 19

Durbin-Watson statistic

Source	SS	df	MS	Number of obs = 10
				F (2, 7) = 3.89
Model	1.4293e+11	2	7.1465e+10	Prob > F = 0.0732
Residual	1.2869e+11	7	1.8385e+10	R-squared = 0.5262
				Adj R-squared = 0.3908
Total	2.7162e+11	9	3.0181e+10	Root MSE = 1.4e+05

Trade	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
FRA	.3478672	.1258216	2.76	0.028	.0503465	.645388
FISP	-.1876164	.2003416	-0.94	0.380	-.661349	.2861162
_cons	146977.3	86121.33	1.71	0.132	-56667.31	350621.9

. estat dwatson

Durbin-Watson d-statistic (3, 10) = 1.461809

The null hypothesis is that there is zero autocorrelation in the residuals and the alternative hypothesis is that the residuals are positively autocorrelated. "The Durbin-

Watson statistic has a distribution of $0 \leq d \leq 4$ with value vary close to 2 indicating no serial correlation" (Carson & Munroe, 2005, p.606). A value toward 0 indicates positive autocorrelation, while a value toward 4 indicates negative autocorrelation. The Durbin-Watson statistic of 1.462 suggests that there is zero autocorrelation in the residuals. Therefore, at 95% level of significance, we can accept hypothesis that there is no autocorrelation. Moreover, a regression without the intercept term shows $d = 1.275$.

Table 20

Durbin-Watson test in a Regression without Intercept Term

Source	SS	df	MS	Number of obs = 10
				F (1, 8) = 3.92
Model	8.9383e+10	1	8.9383e+10	Prob > F = 0.0829
Residual	1.8224e+11	8	2.2780e+10	R-squared = 0.3291
				Adj R-squared = 0.2452
Total	2.7162e+11	9	3.0181e+10	Root MSE = 1.5e+05

Trade	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
FRA	.3653054	.139594	2.62	0.031	.043401	.6872098
FISP	.0626333	.1519555	0.41	0.691	-.2877767	.4130434

. estat dwatson

Durbin-Watson d-statistic (2, 10) = 1.275174

The Durbin Watson significance table for 2 variables and 10 observations shows dl: 0.466 and du: 1.333. Since 1.275 is more than the tabulated lower bound of 0.466, we can accept the null hypothesis that there are no autocorrelated errors and conclude that there is no first-order correlation. Even though Kmenta (1986) recommended the following decision rules:

1. Reject if $d < d_L$

2. Do not reject if $d > d_U$

3. The test in inconclusive if $d_L \leq d \leq d_U$

Banerjee et al. (1993) asserted that when R^2 is more than the Durbin-Watson statistic, it is an indication that there is "strong autocorrelation in the regression residuals" (p.81). In our case, the R^2 value 0.3291 which is less than the *d* value of 1.275. As there are still concerns that the residuals may be serially correlated, I used Prais-Winsten estimator to reinforce the conclusion that there is no autocorrelation.

Table 21

Prais-Winsten AR (1) regression - iterated estimates

prais Trade FRA FISP, rhotype (regress)

Iteration 0: rho = 0.0000
Iteration 1: rho = -0.1197
Iteration 2: rho = -0.1639
Iteration 3: rho = -0.1753
Iteration 4: rho = -0.1779
Iteration 5: rho = -0.1785
Iteration 6: rho = -0.1786
Iteration 7: rho = -0.1787
Iteration 8: rho = -0.1787
Iteration 9: rho = -0.1787
Iteration 10: rho = -0.1787

Source	SS	df	MS
Model	1.8735e+11	2	9.3673e+10
Residual	1.2760e+11	7	1.8228e+10
Total	3.1494e+11	9	3.4993e+10

Number of obs = 10
F (2, 7) = 5.14
Prob > F = 0.0423
R-squared = 0.5949
Adj R-squared = 0.4791
Root MSE = 1.4e+05

Trade	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
FRA	.3629159	.1163524	3.12	0.017	.0877861	.6380457
FISP	-.1985358	.1842873	-1.08	0.317	-.634306	.2372344

_cons	141705.9	76465.46	1.85	0.106	-39106.16	322518
rho	-.1786781					

Durbin-Watson statistic (original) 1.461809
Durbin-Watson statistic (transformed) 1.595201

The value of the transformed Durbin-Watson is now d=1.595 which is more that the upper limit of *dU*: 1.333 and close of 2. I can now conclude that there is no serial correlation.

Even though time series analysis, also referred to as time series econometrics, was originally used for forecasting, economists have increasingly used it "for the interpretation of economic data and hypothesis testing" (Anders, 2010, p. 42). I used vector autoregression analysis to test the hypothesis underlying each research question of this study. I used deseasonalized data for the two variables (FRA and Trade) who time-series data had to be transformed to meet stationarity conditions.

Vector Autoregression

Vector autoregressive models are used to perform four macro-economic tasks including "data description, forecasting structural inference, and policy analysis" (Stock and Watson, 2001, p. 101). I used vector autogressive analysis to answer research questions.

Table 22

Modified Data for VAR Analysis

Year	FRA	FISP	Trade
2003	39398	98050	145983
2004	75626	139990	98481

2005	56508	184050	85205
2006	279798	204540	140012
2007	284784	492080	172121
2008	53068	565120	166454
2009	142682	589010	58345
2010	634315	895390	61478
2011	1258278	500000	404903
2012	751378	499970	598684

Note. FRA and Trade datasets have been seasonally adjusted to meet stationarity conditions.

Research Question 1

Research Question 1 was the following: What is the impact of the Zambian food reserve agency's purchases on grain trade? The Null hypothesis for this question is that the Zambian food reserve agency's purchases do not significantly impact grain trade. The alternative hypothesis is that the Zambian food reserve agency's purchases significantly impact grain trade.

Table 23

Vector Autoregression for Research Question 1

Sample: 2004 - 2012				No. of obs =	9
Log likelihood	= -110.9971			AIC	= 25.33268
FPE	= 6.04e+09			HQIC	= 25.19081
Det (Sigma_ml)	= 3.02e+09			SBIC	= 25.39842

Equation	Parms	RMSE	R-sq	chi2	P>chi2
Trade	3	67292.3	0.8991	80.15732	0.0000

Trade	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
Trade					

Trade						
L1.	1.137868	.1843163	6.17	0.000	.7766148	1.499121
FRA	.2996418	.0472647	6.34	0.000	.2070046	.3922789
_cons	-87859.87	37444.76	-2.35	0.019	-161250.2	-14469.49

The goodness of fit between observed expected values is significant as the *p* value of chi square is below 0.05. The *p* value is 0.0000. The result is significant at $p < 0.05$. This means that the FRA purchases significantly impacts grain trade. So, null hypothesis is rejected and the alternative hypothesis accepted.

Research Question 2

Research Question 2 was the following: What is the impact of government spending on input subsidies on grain trade? The null hypothesis for this question is that government spending on input subsidies does not significantly impact grain trade; and the alternative hypothesis is that government spending on input subsidies significantly impacts grain trade.

Table 24

Vector Autoregression for Research Question 2

Sample: 2004 - 2012			No. of obs	=	9
Log likelihood = -118.6208			AIC	=	27.02685
FPE	= 3.29e+10		HQIC	=	26.88498
Det (Sigma_ml) = 1.64e+10			SBIC	=	27.09259
Equation	Parms	RMSE	R-sq	chi2	P>chi2

Trade	3	156982	0.4506	7.382846	0.0249

Trade	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Trade						
Trade						
L1.	1.163747	.4299047	2.71	0.007	.3211496	2.006345
FISP	.0371238	.1880317	0.20	0.843	-.3314116	.4056592
_cons	9258.806	113850.3	0.08	0.935	-213883.8	232401.4

The goodness of fit between observed expected values is significant as the *p* value of chi square is below 0.05. However, the value of R2 shows that the model describes only 45% of the variances in trade volumes.

The *p* value is 0.841 which is more than the critical value of 0.05. The hypothesis that government spending on input subsidies does not significantly impact grain trade is accepted.

Overall Research Question

The overall research question was the following: What is the impact the Zambian agricultural policy on grain trade? The null hypothesis was that the key policy instruments (FRA and FISP) do not significantly impact grain trade; whereas the alternative hypothesis was that these instruments significantly impact grain trade. Below is the analysis of the combine impact of the key policy instruments.

Table 25

Vector Autoregression for the Overall Research Question

Sample: 2004 - 2012		No. of obs	= 9
Log likelihood = -107.7513		AIC	= 24.83363
FPE	= 3.82e+09	HQIC	= 24.64447
Det(Sigma_ml)	= 1.47e+09	SBIC	= 24.92128

Equation	Parms	RMSE	R-sq	chi2	P>chi2
Trade	4	51396.4	0.9509	174.4016	0.0000

Trade	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Trade						
Trade						
L1.	1.139934	.1285129	8.87	0.000	.8880531	1.391814
FRA	.3421253	.0357171	9.58	0.000	.2721211	.4121295
FISP	-.1878696	.0609097	-3.08	0.002	-.3072503	-.0684888
_cons	-19897.25	34163.17	-0.58	0.560	-86855.82	47061.33

Equation	Parms	RMSE	R-sq	chi2	P>chi2
Trade	4	105855	0.7918	34.23584	0.0000

Trade	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Trade						
Trade						
L1.	1.113002	.2665227	4.18	0.000	.5906273	1.635377
logFISP	-161231.3	68616.15	-2.35	0.019	-295716.5	-26746.14
logFRA_FISP	103226.8	27396.03	3.77	0.000	49531.59	156922
_cons	-492861.2	568451.3	-0.87	0.386	-1607005	621283

The goodness of fit between observed expected values is significant as the *p* value of chi square is below 0.05. The model also describes 95% of data as the $R^2 = 0.951$ which is higher than the one assigned to any of the two independent variable when analyzed alone. This means that combined both variables improved the model.

Testing for the statistical significance of each independent variable (testing if the unstandardized coefficients are equal to 0 in the population) shows that FRA variable coefficient is statistically significant (its *p* value is 0.000 which is less than the critical value of 0.05). The test also shows that FISP variable coefficient have become statistically significant as its *p* value changed from 0.843 to 0.002 which is less than the critical value of 0.05. FRA dominated the combine effect as the *p* value for the combine effect is 0.000.

The analysis of combined effect of these two policy instruments suggests that there are both significant. Unstandardized coefficients indicate how much the dependent variable varies with an independent variable. Calculated coefficients show that for every 1 MT purchased by FRA, international grain trade increases by 0.342 MT. For every 1 Kwacha spent on Farmer Input Subsidy Program, international grain trade decreases by 0.187 MT.

Therefore, the general form of the equation to predict Zambia's international grain trade from the grain reserve and input subsidy programs is as follows:

Predicted grain trade (Trade) = -19897.25 + (0.342 x FRA) – (0.187 x FISP)

Forecasting Horizon

The Zambian long-term vision is to become "a prosperous middle-income nation by 2030" with an agriculture-related goal of "an efficient, competitive, sustainable and export led agriculture sector that assures food security and increased income by 2030" (Weitz et al., 2015, p.9). Therefore, the forecast from 2013 to 2030 will cover 18 years.

Figure 5 shows that grain trade volumes continue to grow if the trends and FRA purchases and FISP spending continue.

Table 26

Forecast Levels of Grain Trade

Year	FRA	FISP	Trade	varTrade
2003	39398	98050	145983	
2004	75626	139990	98481	
2005	56508	184050	85205	
2006	279798	204540	140012	
2007	284784	492080	172121	
2008	53068	565120	166454	
2009	142682	589010	58345	
2010	634315	895390	61478	
2011	1258278	500000	404903	
2012	751378	499970	598684	598684
2013				723289.8
2014				868444.8
2015				1037538
2016				1234516
2017				1463979
2018				1731284
2019				2042670
2020				2405408
2021				2827967
2022				3320210
2023				3893632
2024				4561618
2025				5339763
2026				6246235
2027				7302197
2028				8532300
2029				9965263
2030				11634541

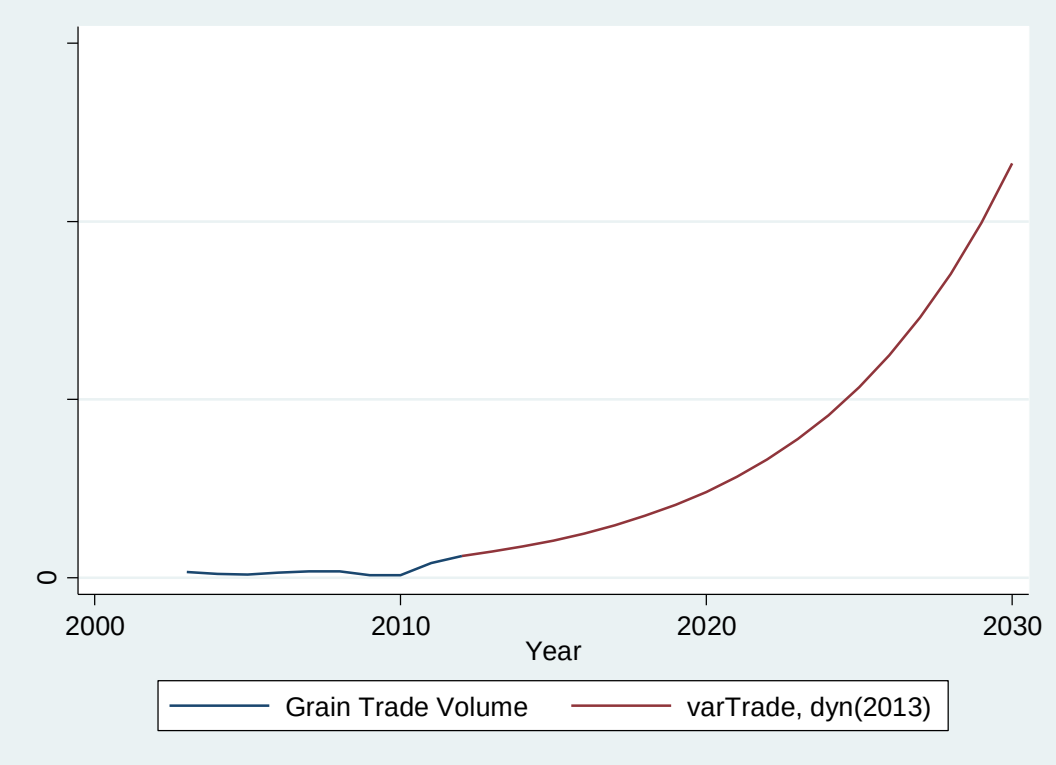

Figure 5. Forecast grain trade volumes.

Summary

This analysis has shown that the combined effect of the two main agricultural policy instruments (Food Reserve Agency and Farmer Input Support Program) significantly impact grain trade. However, the analysis of individual independent variables showed that only the purchases of the Food Reserve Agency significantly impact grain trade and that government spending on the Farmer Input Support Program does not significantly impact grain trade.

The next chapter contains a discussion on the above-mentioned findings, conclusions that can be drawn from this research and policy recommendations. The chapter also discusses areas that need further research.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this study was to determine the impact of the Zambian agricultural policy on grain trade. The key policy instruments that served as independent variables included the volume of grain that the Zambian Grain Reserve Agency (FRA) purchased from the 2002-2003 agricultural season to the 2012-2013 season and government spending on the Farmer Input Support Program (FISP) over the same period. The dependent variable consisted on volumes of grain imported in and exported out of Zambia from 2003 to 2013.

This study found out that a combination of these two agricultural policy instruments significantly impacted grain trade. The analysis also showed that for every 1 MT purchased by FRA, international grain trade increases by 0.342 MT, and that for every 1 Zambian Kwacha spent on FISP, international grain trade decreases by 0.187 MT. However, when the impact of these variables is analyzed separately, it becomes clear that only FRA purchases significantly impact grain trade.

Interpretation of Key Findings

The findings of this study confirm that strong coordination and cooperation between "policy games" is crucial to the achievement of policy objectives (Lubell et al., 2010, p. 289). Policy games are defined as "arenas of competition and cooperation structured by a set of rules and assumptions about how to act in order to achieve a particular set of objectives" (p. 289). The findings revealed that the combined impact of the two policy games (i.e., FRA and FISP) on grain trade is significant; however, when

these instruments are analyzed individually, only FRA has a significant impact. This is because FRA sells its stocks to grain traders in preparation for new harvest seasons. These traders export the grain purchased from FRA; hence, the grain reserve becomes a transitional storage facility. Sometimes, FRA is also involved in government-to-government grain export when there is a food crisis in the southern Africa region (Kuteya & Jayne, 2012).

It is also important to note that the analysis showed that FISP has a negative impact on grain trade as it reduces trade volumes. This finding may be further evidence that most of the input subsidies in southern Africa are targeted to farmers who can afford them and disfranchise smallholder farmers (Burke, Jayne, & Sitko, 2012). This targeting may not result in the production of new stocks of grains and may displace private investments in agriculture. In fact, Chirwa (2014) asserted that "some FISP inputs are diverted or stolen before they reach farmers and some that farmers receive may displace unsubsidized purchases that they would have made anyway without FISP" (p. 1). It has also been established that "the productivity of subsidized inputs that farmers receive depends upon the timing of input receipt, on rainfall, and on the overall management of the crop they are applied to" (Chirwa, 2014, p. 1).

Moreover, the impact ratio for each of the two variables is < 1. According to the input-output model, "a small change in important coefficients should have a large impact on the output of a related sector" (Aroche & Marquez, 2012, p. 87). Therefore, these two instruments still have a long way to go to support Zambia's vision of having "an efficient,

competitive, sustainable and export led agriculture sector that assures food security and increased income by 2030" (Weitz et al., 2015, p. 9).

Political vs. Economic Equilibrium

FRA as a price stabilization instrument is aimed at rural voters. This policy instrument is also aimed at urban voters as FRA offloads its stock to millers at lower than its procurement cost to reduce the price of maize flour for urban consumers (Kuteya & Jayne, 2012). FISP is also aimed at rural voters to reduce their cost of production and sustain the adoption of improved inputs. Public spending on these two programs tends to increase during an election year.

FRA uses price signaling to ensure that farmers focus on the type of crops the government want to promote. Price mechanisms act as a signal for market-system actors to decide on what to produce or purchase. However, in markets that are not competitive, this signal becomes artificial because it does not take into consideration the market fundamentals of supply and demand. The cost of production and consumer's willingness to pay become out of sync. In this situation, the farming household "separation hypothesis" does not hold as farmers fail to use price signaling to increase their specialization, hence ending up investing in multiple crops, including those with low or negative return on their investments (Kien, 2010, p. 1429). However, when FRA refrains from announcing the indicative price and quantities, private sector grain traders increase their involvement in purchasing grain from farmers, sometimes at a higher price than that of FRA (Cuts, 2016). In addition, grain traders pay cash to farmers immediately, whereas FRA does not pay farmers for months (Lair, 2012).

Limitations of the Study

The study used official grain export and import data; therefore, the flow of grain through informal cross-border channels was not captured. This could affect the ability to extrapolate the results to the general population of study. However, informal trade is difficult to detect, even though it is estimated to be between 10% and 30% of the total agricultural trade in Zambia (World Bank, 2014).

The study is valid because I used tests of stationarity and serial correlation to ensure that the data and variables were appropriate for vector autoregression analysis, which can also be reliably applied to other time-series datasets. Only one variable was stationary, so I had to use deseasonalized data for the other two variables and ran the augmented Dickey-Fuller test to enhance the analysis of stationarity. I also used Durbin Watson to detect serial correlation.

Recommendations

Export bans and export quotas are increasingly becoming important tools in agricultural policy for many countries in eastern and southern Africa. However, they are applied in ad hoc fashion and last a few days or some months, given that they depend on lobbyists' efforts to influence "grain import tariffs and export bans for a brief time" (Sitko & Jayne, 2011, p. 16).

To supplement this study and close other gaps in the existing literature on the impact of agricultural policies on integrational grain trade, I recommend further research on the optimal policy mix that promotes grain export while assuring that producers sell their crops at or below import parity price. This recommended research would also

determine the level of Zambian grain farmers' competitiveness and provide a market-related basis for FRA pricing policy. Saverimuttu and Rempel (2004) analyzed the determinants of grain imports and found that "a policy that increased the price farmers receive for food crops, relative to the price received for export crops, would reduce the need to import food" (p. 534). Import parity pricing is referred to as "a pricing policy adopted by suppliers of a good for their sales to domestic customers according to which price is set at the opportunity cost of a unit of an imported substitute good;" and "export parity pricing is applied when the "price is set at the net proceeds per unit from export sales" (Parr, 2005, p. 2).

Commenting on the calculation of parity prices, Holden (2005) suggested that "import parity price includes the world price plus transport costs, insurance and tariffs," whereas "the export parity price … would be the FOB would price at the port of exit" (p. 357). This means that when domestic prices are above import parity, traders have incentives to import. If the target good is more expensive abroad, traders have an incentive to export.

Implications

This study has the potential to generate impact on the governance of the Zambian agricultural sector. Using the findings of this study, government officials can rethink the current policy mix and redesign it in a way that can lead to the vision of having "an efficient, competitive, sustainable and export led agriculture sector that assures food security and increased income by 2030" (Weitz et al., 2015, p. 9). An efficient and competitive agricultural sector will not only positively impact the livelihood of the

majority of the Zambian people, but also enhance the profitability of agribusinesses operating in Zambia.

In practice, the ministry of agriculture can use this study and its methodology to run multivariate time-series analysis on Zambian investments in different agriculture-related programs. A constant use of such an analysis will inform the ministry's allocation of resources and ensure that more resources are channeled to high-impact areas such postharvest management and extension.

Conclusion

Using time-series data on FISP and FRA, which constitute key agricultural policy instruments in Zambia, this study has shown that only FRA significantly impacts grain trade, FISP does not significantly impact grain trade, and the combined effect of these two instruments on grain trade is significant. The study supported a recommendation that investment in these instruments be preceded by an empirical analysis of how to positively influence the performance of the agricultural sector and achieve its long-term vision. Zambian agricultural leaders should use data to decide on the optimal mix of agricultural policy that achieves political and economic equilibria.

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Appendix: Stata Syntax

1. **Data summary**

summarize FRA FISP Trade, separator(0)

2. **Trends**

twoway (tsline FRA)

twoway (tsline FISP)

twoway (tsline Trade)

twoway (tsline FRA) (tsline FISP) (tsline Trade)

3. **Test for stationarity**

dfuller FRA, trend lags(1)

dfuller FISP, trend lags(1)

dfuller Trade, trend lags(1)

4. **Test for serial correlation**

tsset Year
regress Trade FRA FISP
estat dwatson
regress Trade FRA FISP, noconstant tsscons
prais Trade FRA FISP, rhotype (regress)

5. **Vector autoregression analysis**

var Trade, lags(1/1) exog(FRA)

var Trade, lags(1/1) exog(FISP)

var Trade, lags(1/1) exog(FRA FISP)

var Trade, lags(1/1) exog(logFRA logFISP logFRA_FISP)

6. Forecasting

var Trade, lags(1/1) exog(FRA FISP)

fcast compute y1_FRA y1_FISP, step(18)

fcast graph