Structural Characteristics of Zambia's Agricultural Sector and the Role for Agricultural Policy: Insights from SAM based Modelling

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Declaration

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Summary

Structural development economists believe that for an economy to develop, it must structurally transform. It is therefore understood that developing countries must transform their economies for them to see development. This study used sectoral contributions to employment and total output in the economy from the 1980s to 2017, to understand the structure of the Zambian economy. Social accounting matrix (SAM) multiplier analysis and analysis using a computable general equilibrium (CGE) model were combined to shed more light on this topic.

This study finds that the transformation of the Zambian economy does not follow standard literature. Although we find that agriculture's share in the total output declined between 1983-2017, the decline corresponds to an increase in the share of services and not manufacturing. In 2017 the service sector contributed 56.33% to gross domestic product (GDP). The economy seems to transform from agriculture to services. In addition, it was found that the agricultural sector is the right sector to kick-start transformation in the Zambian economy. Our results indicate that in general primary agriculture has the largest output multipliers compared to the industry and service sectors. The livestock commodity, for instance, was found to have the largest output multiplier of 3.60. Within the industry, agricultural processing commodities had larger multipliers as they had more backward linkages in the economy.

Further, the literature on structural transformation has concentrated on the role played by capital in the process of structural transformation. There is limited literature on the role played by transaction costs on structural transformation. Therefore, this study further sought to establish the relevance of transaction costs in structural transformation by drawing from a CGE model insights. The study also sought to find out the impact of increasing capital in Zambian agriculture.

Using a static CGE model calibrated to the Zambia SAM for 2007, it is found that transaction costs played a significant role in aiding structural transformation. Reducing transaction costs in Zambian agriculture by 30% increased value-added for all the agricultural processing activities in the economy. The "sugar refining" activity, for example, had its quantity of value-added increase by 2.00%. Increasing agricultural capital by 30% also increased the value-added of all agricultural processing activities. , The "meats, fish and dairy" activity had its quantity of value-added increase by 3.94%.

Economists have highlighted the importance of complementing production policies with market policies to achieve optimal development results. To assess this synergy, transaction costs in Zambia's primary agriculture were reduced simultaneously with an increase in agriculture capital. It is found that the impact on the quantity of value-added per agriculture processing activity was higher than the sum of two individual scenarios, indicating the presence of multiplier effects.

It was also found that in the combined simulation, in general, labour moved out of agriculture to industry. Within the industry, the quantity of labour employed increased more for the agricultural processing subsector. The quantity of labour employed in tobacco curing and processing, sugar refining and “meat, fish and dairy” activities increased by 20.80%, 17.06% and 13.01% respectively.

Opsomming

Ekonome van struktuurontwikkeling glo dat ‘n ekonomie struktureel moet transformeer om te ontwikkel. Dit word dus verstaan dat ontwikkelende lande hul ekonomieë moet transformeer sodat hulle kan ontwikkel. Ekonome het bewyse gevind dat die Zambiese ekonomie nie struktureel verander nie. In hierdie studie is sektorale bydraes tot indiensneming en totale produksie in die ekonomie vanaf die tagtigerjare tot 2017 gebruik om die struktuur van die Zambiese ekonomie te verstaan. Sosiale rekeninge matriks (SAM) vermenigvuldigeranalise sowel as analise met ‘n berekenbare ewewigsmodel (CGE) is gebruik om meer lig te werp op die onderwerp.

Hierdie studie bevind dat die transformasie van die Zambiese ekonomie nie die standaardliteratuur volg nie. Alhoewel ons vind dat die landbou se aandeel in die totale produksie tussen 1983-2017 gedaal het, stem die daling ooreen met 'n toename in die aandeel van dienste en nie vervaardiging nie. In 2017 het die dienstesektor 56.33% tot die bruto binnelandse produk (BBP) bygedra. Dit lyk asof die ekonomie van landbou na dienste verander. Verder is gevind dat die landbousektor die regte sektor is om transformasie in die Zambiese ekonomie te stimuleer. Ons resultate dui daarop dat die primêre landbou in die algemeen die grootste uitsetvermenigvuldigers het in vergelyking met die industrie- en dienstesektor. Daar is byvoorbeeld gevind dat vee die grootste uitsetvermenigvuldiger van 3.60 het. Binne die industrie het verwekte landbou-kommoditeite groter vermenigvuldigers gehad, aangesien dit meer rugwaartse skakeling in die ekonomie gehad het.

Voorts het die literatuur oor strukturele transformasie gekonsentreer op die rol wat kapitaal speel in die proses van strukturele transformasie. Daar is weinig literatuur oor die rol wat transaksiekoste in strukturele transformasie speel. Dus poog die studie om die relevantheid van transaksiekoste in strukturele transformasie te vestig deur insig te verky met algemene ewewigsmodelle.

Daarbenewens het die studie gepoog om uit te vind wat die impak van die verhoging van landboukapitaal in die Zambiese landbou is.

Met die hulp van 'n statiese berekenbare algemene ewewigsmodel wat met die 2007 Zambia SAM gekalibreer is, word gevind dat transaksiekoste 'n belangrike rol gespeel het in die ondersteuning van strukturele transformasie. Die vermindering van transaksiekoste in die Zambiese landbou met 30% het toegevoegde waarde verhoog vir al die landbouverwekringsaktiwiteite in die ekonomie. Die aktiwiteit “suikerraffinering” het byvoorbeeld toegeneem met 'n toename in toegevoegde waarde met 2.00%. Die verhoging van landboukapitaal met 30% het ook die toegevoegde waarde van alle landbouverwerkingsaktiwiteite verhoog. Die aktiwiteit “vleis, vis en suiwel” het byvoorbeeld 'n toename in toegevoegde waarde van 3.94% getoon.

Ekonome het die belangrikheid daarvan benadruk om produksiebeleid met markbeleid aan te vul om optimale ontwikkelingsresultate te behaal. Om hierdie sinergie te beoordeel, is transaksiekoste in die primêre landbou van Zambië terselfdertyd verminder met 'n toename in landboukapitaal. Daar

is gevind dat die impak op die hoeveelheid toegevoegde waarde per landbouverwerkingsaktiwiteit groter was as die som van twee individuele scenario's, wat 'n aanduiding is van die vermenigvuldigingseffekte.

Daar is ook gevind dat arbeid in die gesamentlike simulasie oor die algemeen uit die landbou na die industrie beweeg het. Binne die industrie het die hoeveelheid arbeid wat in diens geneem is meer toegeneem vir die subsektor van landbouprosessering. Die hoeveelheid arbeid wat gebruik word vir die verwerking van tabak, suikerraffinering en “vleis, vis en suiwel” -aktiwiteite het byvoorbeeld onderskeidelik met 20.80%, 17.06% en 13.01% gestyg.

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Table of Contents

Declaration i
Summary ii
Opsomming iv
Acknowledgements vi
Table of Contents vii
Abbreviations...x
Chapter 1 1
Background of The Study 1
1.1 Introduction 1
1.2 Statement of the Problem 2
1.3 Objectives of the Study 4
1.4 Research Question 4
1.5 Research Hypothesis 4
1.6 Methodology and Data 5
1.7 Limitations/Scope of the Research 6
1.8 Thesis Outline 6
Chapter 2 7
Review of Theory and Empirical Literature 7
2.1 Introduction 7
2.2 Review of Theory 7
2.2.1 Theories of Structural Transformation 7
2.2.2 Transaction Cost Economics Theory 12
2.3 Empirical Literature on Structural Transformation 18
2.3.1 Empirical Literature on Structural Transformation in Zambia 18
2.4 Methodological Theories 20
2.4.1 Theory of Social Accounting Matrices (SAM) 20
2.4.2 Notes on SAM Data 24
2.4.3 Notes on SAM Accounts 24
2.4.4 Theory of Multipliers 27
2.4.5 Theory of Computable General Equilibrium (CGE) Models...................................28
2.5 Summary 31
Chapter 3 32
Background Information 32
3.1 Introduction 32
3.2 Sectoral Contribution to Total Output 32
3.3 Employment Share by Sector in the Economy 35
3.4 Sectoral Labour Productivity 37
3.5 Agricultural Capital in Zambia 39
3.6 Summary 41
Chapter 4 42

Methodological Framework 42
4.1 Introduction 42
4.2 The 2007 Zambia SAM 42
4.2.1 Data Changes 46
4.3 Social Accounting Matrix Multipliers 47
4.4 The Computable General Equilibrium (CGE) Model 48
4.4.1 Price Relationships in the Model 48
4.4.2 Quantity Relationships in the Model 51
4.4.3 CES and CET Elasticities in the Model 54
4.4.4 Modelling Transaction Costs 55
4.4.5 Modelling Agricultural Capital 56
4.5 Summary 56
Chapter 5 57
Presentation of Results and Insights 57
5.1 Introduction 57
5.2 SAM Multipliers 57
5.3 CGE Model Results 60
5.3.1 Scenarios 60
5.3.2 Model Closures 61
5.3.3 Results 62
5.4 Sensitivity Analysis 84
5.5 Summary 89
Chapter 6 92
Conclusions and Recommendations 92
References 97
Appendices 101

List of Figures

Figure 1: Institutional Change and Transactions Costs 17
Figure 2: The Circular Flow of Funds 21
Figure 3: Zambia Sectoral Shares 1983-2017 34
Figure 4: Employment Share by Sector in the Economy 36
Figure 5: Value-added Productivity per Worker (constant 2010 US$) 38
Figure 6: Zambia Agricultural Gross Capital Formation (current Million US$) 40
Figure 7: Price relationships in the Model 49
Figure 8: Quantity diagram based on IFPRI model 52
Figure 9: Output Effects on Industry (SIM1 %change) 64
Figure 10: Output Effects on Services (SIM1 %change) 65
Figure 11: Price Effects on Industry (SIM1 %change) 67
Figure 12: Price Effects on Services (SIM1 %change) 67
Figure 13: Output Effects on Industry (SIM2 %change) 69
Figure 14: Output Effects on Services (SIM2 %change) 70
Figure 15: Price Effects on Industry (SIM2 %change) 72
Figure 16: Price Effects on Services (SIM2 %change) 72
Figure 17: Output Effects on Industry (SIM3 %change) 74
Figure 18: Output Effects on Services (SIM3 %change) 75

Figure 19: Price Effects on Industry (SIM3 %change) 77
Figure 20: Price Effects on Services (SIM3 %change) 77
Figure 21: Effects on Quantity of Labour Employed (SIM3 % change) 79
Figure 22: Income Effects (All SIM %change) 80
Figure 23: Macro-Economic Effects (All SIM %change) 82
Figure 24: Macro-Economic Effects Primary Agriculture (All SIM %change)........ 83
Figure 25: Macro-Economic Effects Industry (All SIM %change) 83
Figure 26: Macro-Economic Effects Services (All SIM %change) 84
Figure 27: Sensitivity Analysis CES at Lower Level (SIM2 %change)........ 85
Figure 28: Armington Elasticity (SIM1 QM %change)........ 87
Figure 29: Comparison Between PDD and PM (SIM1 %change)........ 88
Figure 30: Armington Import Elasticity (SIM1 PM %change)........ 89

List of Tables

Table 1: Structure of a SAM........ 23
Table 2: Sector Growth Rate in Employment Share (1995-2016) 37
Table 3: Sector Value-added Productivity Growth Rate (1991-2017)........ 39
Table 4: Zambia Growth Rate in Agricultural Capital/Compared to South Africa (1995-2016)........ 40
Table 5: Zambia 2007 Macro SAM (Billions of Kwacha)........ 43
Table 6: CET and CES Elasticities for International Trade 55
Table 7: Structural Characteristics (SAM Multipliers) 58
Table 8: Output Effects on Primary Agriculture (SIM1)........ 62
Table 9: Price Effects on Primary Agriculture (SIM1) 66
Table 10: Output Effects on Primary Agriculture (SIM2)........ 68
Table 11: Price Effects on Primary Agriculture (SIM2) 71
Table 12: Output Effects on Primary Agriculture (SIM3)........ 73
Table 13: Price Effects on Primary Agriculture (SIM3) 76
Table 14: Price of Factor $\boldsymbol{F}$ in activity $\boldsymbol{A}$ (SIM2 %change) 86

Abbreviations

CBPP	Contagious Bovine Pleuropneumonia
CGE	Computable General Equilibrium
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
FMD	Foot-and-Mouth Disease
GAMS	General Algebraic Modelling System
GDP	Gross Domestic Product
GRZ	Government Republic of Zambia
GTAP	Global Trade Analysis Project
IFPRI	International Food Policy Research Institute
LES	Linear Expenditure System
MPC	Marginal Propensity to Consume
PROVIDE	Provincial Decision-Making Enabling Project
SAM	Social Accounting Matrix
SNA	System of National Accounts
TCE	Transaction Cost Economics
UN	United Nations
UNU-WIDER	United Nations University’s World Institute for Development Economics Research
ZIPAR	Zambia Institute for Policy Analysis and Research
ZMW	Zambian Kwacha Rebased

Chapter 1

Background of The Study

1.1 Introduction

In the words of Gregory Mankiw, those who have travelled the world over are often dumbfounded by one common insight; the large disparity in income and quality of life between rich countries and the poor ones (Mankiw, 1995: 275). Understanding the cause of this disparity and how it can be addressed is at the core of economics. This paper is an attempt to contribute to the “how” question above, using a strand of modern economic growth theory called structural transformation. We focus on Zambia because the country has immense potential in agriculture but has got little to show for it.

On the importance of agriculture in development, Nobel laureate in economics Gunnar Myrdal, once remarked that “it is in the agricultural sector that the battle for long term economic development will be won or lost”. Indeed, this is more so in most developing countries where agriculture remains the main fluid that oils up the engine of the economy (Todaro & Smith, 2012: 416).

In traditional development economics, there is a wide body of literature to the effect that the role of agriculture in development was a passive one, mainly a supportive role for the industrial sector in the form of low-priced food, labour, provision of intermediate inputs for processing and capital contribution (Todaro & Smith, 2012: 417). The literature draws mainly from Lewis’s much celebrated dual-sector model of growth.

The theory argues that, in the early stages of development, agriculture contributes the largest share in the total output of the economy and employs most of the economy’s labour force. Although most people are employed in agriculture, there exists “disguised unemployment” because agriculture productivity is still too low, so that, the marginal product is nearly zero. As productivity in agriculture increases, often through improvement in technology, it provides the savings and capital required by industry, often manufacturing’s share in the economy rises and that of agriculture diminishes, while labour moves from low productive agriculture to the more productive industry which is fructified by capital (Lewis, 1954; Kirsten & Liebenberg, 2017: 6).

Eventually, services start to increase its share in value-added and in the labour force. By moving workers from lower to higher productivity activities, this change in structure accelerates economic growth, as during this transformation, productivity in agriculture slowly increases as labour leaves the sector (McMillan & Rodrik, 2011: 10).

McMillan and Rodrik (2011) indicate that the above structural transformation has not taken place in Zambia, in fact, the structural transformation of the Zambian economy has been in the opposite direction so that the employment share of agriculture has increased significantly, while that of manufacturing has declined. Resnick and Thurlow (2014: 1-5) describe how structural adjustment policies caused manufacturing job losses resulting in most people seeking survival in subsistence agriculture in the rural areas and informal trading in the sprawls of urban areas, resulting in the reduction of national labour productivity. The growth in the Zambian economy that started in 2002, did not result from an increase in manufacturing. On the contrary, the sector that increased its share of employment in the economy was now trade services, high-value construction, finance and communication, while agricultural productivity remained constant.

Although there was a small improvement in manufacturing that accompanied the growth resurgence of 2002, this “new manufacturing” was not that of the old industries of for example textile and clothing which were labour intensive. The “new manufacturing” was now mainly food processing of things such as meats and wheat milling albeit they are not labour intensive. What is clear is that “aggregate services” became the leading sector in the economy after primary agriculture (Resnick & Thurlow, 2014: 9-10). The standard structural transformation described in the literature is not the one that had been taking place in Zambia.

Thus, we are convinced that the situation in Zambia presents a special environment for agricultural policy, using a SAM based analysis, we seek to provide a more coherent understanding of the agricultural policy environment and development strategy in Zambia, including sectoral linkages in the economy with a special focus on the agriculture sector.

1.2 Statement of the Problem

In the words of Simon Kuznets (1973), the take-off to structural transformation and thus economic development is improvement in technology in agriculture. He however hastens to caution that, the improvement in technology must be complemented by a similar change in institutions and human knowledge. The complementarity ensures that technology is widely and efficiently utilised.

That structural transformation as described in the literature has not taken place in Zambia and thus makes economic development elusive, speaks to what Kuznets highlights regarding the role of technology in agriculture, institutions and human knowledge. Govereh et al (2009) indicate that agricultural productivity in Zambia regressed between 1990 and 2005, and otherwise stagnated in general. This situation is attributed to little or no technological use in smallholder agriculture since most smallholders still rely on rudimentary methods of production and the fact that agriculture in Zambia is still rainfed. In addition, Deininger and Olinto (2000) indicate that in Zambia agricultural productivity had been constrained by lack of capital (labour saving) which is supposed to fructify the labour and land in production.

Recent evidence however suggest that Zambia's agricultural sector could start to experience productivity improvement through increases in technology. Jayne et al (2016) speak of the emergence of the "investor farmer" in Zambia and the increasing farm size. The new "investor farmer" represent mainly the urban dwellers, civil servants and rural elite. These new farmers have the working capital and are investing in capital equipment, i.e. they transfer urban savings into agriculture; they also emerge as having superior human knowledge. The situation that Kuznets (1973) describes may soon take place in Zambia.

A historic look at the changes in agricultural capital in Zambian agriculture shows that agricultural capital increased significantly from 2007. Further, significant labour reallocation also took place starting from 2007. These significant changes after 2007 are the particular interest of this study.

We quickly note however that Kuznets cautions that there must exist appropriate institutions for structural transformation to take off. Accordingly, Kirsten et al (2009) indicate that development is a two-step process, first an outward shift and increasing elasticity of the producer supply curve, this is the essence of improvement in technology; and second a reduction in the transport, communication, transaction costs and risk per unit of supply to consumers. Thus, in their words, "development research and policy analysis should be concerned with both processes, the relationship between them and the means of promoting them".

The second part that requires a reduction in transaction costs is the essence of improvement in institutions. In Zambia transaction costs in agriculture are constraining. Bwalya et al (2013) indicate that despite smallholder farmers producing most of the agriculture output, only a small proportion of this output is marketed. They further attribute this to high transaction costs associated with searching for buyers, screening partners, negotiating, enforcement and product transfer. In the maize market, around 8% of smallholder farmers supply 50% of all marketed maize in the country (Chamberlin et al, 2014: 16).

Thus, in its 7th national development plan, Zambia has identified high transaction costs and market coordination failures as one of the challenges toward its development, thus plans and strategies have been outlined to muzzle these challenges. Strategies include actions towards: bettering the market environment, secure land rights and adequate provision of public goods

(GRZ, 2017: 64-68). In the agricultural sector, the country is implementing the warehouse receipt system to improve agricultural market performance (Coulter & Onumah, 2002: 320).

We are convinced that our study is novel in the following ways; first, the empirical literature on structural transformation has mostly focused on the role of capital and labour productivity in agriculture on structural transformation. There is limited literature on the role played by transaction costs on structural transformation in developing countries (Arndt[a], 2000; Pingali et al, 2005; Rum, 2011 and Kuhn, 2005). Second, most of the literature on this topic uses either linear or non-linear models separately. This study combines both linear and non-linear models to provide more insight.

1.3 Objectives of the Study

The main objective of this study is to establish the structural characteristics of Zambia's agriculture sector and to assess the economy-wide impact of the relevant structural transformation policy options.

Specific objectives that will help to achieve the main objective include:

1) To conduct a SAM multiplier analysis for Zambia.
2) To assess the economy-wide impact of increasing capital in agriculture using a computable general equilibrium (CGE) model.
3) To analyse the impact of reducing transaction costs in agriculture on the economy in the CGE model.
4) To evaluate synergies by simultaneously increasing capital in agriculture and reducing transaction costs in agriculture.

1.4 Research Question

What is the relationship between transaction costs, capital and household income? How does this relationship affect structural transformation?

1.5 Research Hypothesis

The Zambian economy is not structurally transformed. Therefore, an increase in agricultural capital is expected to increase value-added for agricultural processing; however, this would be more effective in circumstances where transaction costs were minimal. Further, household income is expected to increase, especially for the rural poor. It is the increase in household incomes that is expected to help transform the economy.

1.6 Methodology and Data

In order to answer the first objective of this, we employ SAM based multiplier analysis to help illuminate the structural characteristics of the Zambian economy, what we do here is a basic analysis of the Zambia SAM for 2007. The focus is on assessing which sectors are prominent, inter alia the agriculture, industry and services sectors. In order to conduct the above analysis, SAM multipliers were developed, following Miller and Blair (2009) based on the *commodity-by-industry* submatrix.

Given that the primary focus of this study is structural transformation, a detailed description of sectoral contributions over time was conducted and presented in chapter three. The analysis was based on world development indicators dataset.

Further, the rest of the objectives of the study were met by using a CGE model to aid simulations of structural transformation agricultural policy options in the generalised algebraic modelling system (GAMS). This is because, first, just like the SAM multiplier price and quantity models, the CGE model captures the direct and indirect impacts of a policy change. Second, the CGE model is superior to SAM multiplier models because it allows for flexible relative prices and it is a non-linear model.

The first simulation is the reduction in transaction costs. This required data changes to our SAM, because the Zambian SAM does not allocate transaction costs in terms of marketing of imports, exports and domestically marketed production, so that the SAM transaction costs will have to be allocated to imports, exports and domestically marketed production following Nhlane (2016). The simulation entails a percentage decrease in the transaction cost parameter representing marketing costs incurred in moving agricultural commodities from production industries to domestic consumers (Arndt[a] et al, 2000: 126).

The second agricultural policy simulation was an increase in the capital used in agriculture, hence this is a percentage increase in the stock of capital used in agriculture. Given that capital is scarce in Zambian agriculture, its increase is expected to increase the marginal product of labour, since labour is already abundant.

Further, a third simulation which combines the first two simulations was conducted. The essence was to examine the synergies of the two policy options. This paper employed the static computable general equilibrium model developed by Lofgren et al (2002) which was calibrated to the 2007 Zambia SAM by Chikuba et al (2013).

This study used a CGE modelling framework to understand a real economic phenomenon. It is observed that a notable movement of labour out of agriculture in Zambia occurred after

2007. It is also observed that after 2007 agricultural capital also increased significantly. Hence the relevance of the use of the pre-change 2007 SAM to shed light on the relationship between the policies and economic changes.

1.7 Limitations/Scope of the Research

This study was limited through the general weakness associated with most CGE models, which is to do with the fact that production, trade and household elasticities that have been used were not econometrically determined but based on a survey of literature on CGE models on Zambia and similar countries. Unfortunately, estimating elasticities is an expensive and time-intensive process which puts it beyond the scope of this study. However, an extensive model sensitivity analysis was conducted to validate the model results.

1.8 Thesis Outline

The structure of the thesis is as follows: in chapter two a detailed review of the theory of structural transformation and transaction cost economics (TCE) is provided. The essence is to provide a theoretical basis of how our agricultural policy options, i.e. agricultural capital and transaction costs aid structural transformation and thus economic development. Further, a review of the theory on social accounting matrices (SAM) and computable general equilibrium models (CGE) is provided in this chapter, as a basis and background for the methodology.

In chapter three a background on structural transformation in Zambia is provided, this involves a detailed analysis of changes in sectoral contributions covering the period from the 1980s to 2017. This chapter also gives a background on the variables of interest, i.e. agricultural capital and transaction costs in the Zambian economy.

Chapter four, provides the methodological framework, i.e. a detailed description of the data set, SAM multiplier model and the CGE model, including a discussion of the functional forms of the constant elasticity of substitution (CES), constant elasticity of transformation (CET) and other behavioural relationships in consumption and production in the economy. This chapter provides an explicit explanation of how the simulations are implemented in the CGE model.

Chapter five provides a report on the structure of the Zambian economy based on SAM multipliers, as well as a report of the simulation results from the CGE model, including the insights acquired as well as a summary thereof. The study ends with chapter six which provides conclusions and recommendations.

Chapter 2

Review of Theory and Empirical Literature

2.1 Introduction

This chapter provides a theoretical basis for this study. Therefore, the chapter first provides an overview of developments in the theory of structural transformation. The focus however is on the new institutional economics theory, particularly the strand of transaction cost economics theory.

We do not see the need to go into detail with respect to the theories of structural transformation such as Rostow's linear stages of growth, Harrod-Domar model and Arthur Lewis's dual sector model of growth. The reason is that these theories have been extensively analysed by other writers (e.g. Ramigo, 2017; Greyling, 2012 & Chitonge, 2016) and thus, only summaries will be provided for the purpose of establishing relationships with respect to our variables of interest such as agricultural capital.

Further, the chapter analyses empirical literature on the topic, and finally concludes with theories related to social accounting matrix (SAM), multiplier models and CGE models.

2.2 Review of Theory

2.2.1 Theories of Structural Transformation

The term "structural transformation" is key to this study, thus we provide its definition here. Structural transformation is a concept within the so called "modern economic growth" theory and refers to the reallocation of economic activity across the general sectors of agriculture, industry and services (Herrendorf et al, 2013: 1). This reallocation of economic activity is seen by structural change theorists as one that accompanies the process of economic development.

Although the increase and decrease of the share of the broad sectors of agriculture, manufacturing and services find their early writings in the works of the German historical school writers, such as Freidrich List, these were not up to standard in terms of economic empirics. Therefore, it is Ernest Engel who is credited for a first more detailed contribution to structural change theory (Katouzian, 1970: 362-363). In his work, Engel established the relationship between income and demand for food, which later became known as Engel's law. The law states that the proportion of income spent on food reduces as the income level rises (Houthakker, 1957: 532). It is clear how this law is an important contribution to the theories of sectoral contribution since these theories have originally been demand-driven.

Perhaps what can be considered as a complete theoretical attempt at structural transformation is the theory developed by Allen Fisher and Colin Clark. This theory later came to be known as the Clark-Fisher development theory or Fisher-Clark model (Katouzian, 1970: 363). In a seminal contribution in the Economic Journal “Capital and the Growth of Knowledge”, Fisher (1933) highlights what he calls “stages of development” which included primary, secondary and tertiary sectors. The central feature of this model is that economic growth would eventually result in the development of a large service sector which would be preceded by the development of the primary and secondary sectors respectively (Fisher, 1933: 380).

The economics of these sectoral shifts is explained in relation to Engel’s law as well as changes in sectoral comparative advantage, i.e. differences in sectoral productivity (Katouzian, 1970: 363). For example, the marginal propensity to consume (MPC) is lower in high-income countries but higher in low-income countries. In other words, the income elasticity of demand for food is more elastic in low-income countries than in rich countries. In the case of manufactures and services, the income elasticity of demand is more elastic in high-income countries than in low-income countries. Thus, high incomes support the industrial and service sectors.

However, the impact of the level of income on consumption of services remains contested (Katouzian, 1970: 364). This disagreement comes from the fact that researchers frequently find that the difference in the share of services in output and employment between rich countries and poor countries is less than those in other sectors of industry and primary (Katouzian, 1970: 364). For example, in most African countries the small decline in the share of agriculture in value-added that they have recorded previously has often resulted in a corresponding increase in the share of services and not manufacturing (Binswanger et al, 2010: 124). McMillan et al (2014) find this same situation in the case of South Africa and Ghana.

The distortion in the relationship between the service sector and income has been attributed to the problem of aggregation. Sub-sectors that are often aggregated to form the services sector tend to be very different in terms of structure and income elasticities (Katouzian, 1970: 364). Katouzian (1970) finds that it is more appropriate to divide the service sector into three sub-sectors.

First, is a service sector which he calls “new service sector”, this sector includes leisure related services like restaurants, hotels, holiday resorts, education, modern medical services and general entertainment. These services are the ones that increase with the level of per capita income and thus form a large proportion of the large service sectors observed in developed countries.

Second, is the service sector he calls “complementary services”, this includes banking, finance, transportation, construction, wholesale and retail trade. These services complement industrialization hence they may form a large part of the service sectors for industrializing countries.

Finally, is the “old services”, this includes mainly services related to for example domestic workers. These services may form a large part in the primary stage, but as per capita incomes rise they are substituted by labour-saving manufactures like modern kitchen appliances and restaurants and are thus expanded in the tertiary stage. Therefore, before conclusions can be made that the structural transformation for African countries is different because of the presence of a relatively large service sector before manufacturing has fully developed, it is important to analyse what kind of services these are.

It is the criticism about the Fisher-Clark development theory that led to the birth of Rostow’s stages of economic growth theory. In summary, the leading sector growth stage approach identifies five stages of development namely: the traditional society, the preconditions for take-off, the take-off, the drive to maturity and the stage of high mass consumption (Rostow, 1968: 4-11). The theory itself is rooted in what Rostow calls a dynamic theory of production.

What is important to note however is that the theory is the first to provide a dynamic role for agriculture in the transition process especially in the early stages. It states that agriculture would be critical in the provision of food, as a market for new industries and savings for new leading sectors (Ruttan, 1965: 22).

The theory has faced criticism for among other things, for its analytical criteria in identifying the stages, its leading sector hypothesis and the concept of take-off itself. More importantly, the theory does not provide an explanation of why countries such as India that experienced greater economic growth in the late 19th century did not experience a successful take-off (Ruttan, 1965: 22-23). In fact, Ruttan (1965) highlights this point better when he indicates an article that reached a surprising conclusion that, “after entering the take-off stage in 1957, the Philippian economy immediately slipped back into the preconditions stage”.

The emphasis of the stages theory on the important role played by agriculture in the “traditional stage” provided insight to agricultural economists. Based on the same theory, extensions have been made to provide a theory of how agriculture can be transformed from subsistence to emergent sector and later commercial sector (e.g. Johnston & Mellor, 1961; Mellor, 1962; Mellor, 1963). The transformation of agriculture from small scale to commercial is referred to as “agricultural transformation” and is a subject of extensive research in developing countries mainly in Africa. These theories emphasise technology in the form of biological innovations and mechanisation to achieve intensification. The theories also draw heavily from Arthur Lewis's dual sector model of growth, a theory that we now turn our attention to.

It is generally accepted within economics literature that the Lewis model is a seminal contribution. In fact, Lewis himself believed this to be true (Gollin, 2014: 71). The model itself combines several concepts within economics, including growth theory, structural transformation, wage determination, income distribution and inequality as well as population (Gollin, 2014: 71). It basically makes the following assumptions.

First, there exists the "traditional" sector. In this sector, there is an unlimited supply of labour relative to other scares resources like capital and land. Therefore, the marginal product of labour is seen to be nearly zero, zero or even negative. The un-limitedness of the labour reflects "disguised" unemployment in the form of excess labour in agriculture, casual workers and petty trading. Second, there exists a "modern" sector. In this sector, productivity is high and thus there are higher wages. Third, the wage rate in the "modern" sector is constant and is determined based on the "conventional standard of living" or average farmer production in the subsistence sector. Finally, a critical assumption within the model is that the subsistence sector cannot make use of reproducible capital; this is a preserve of the capitalist sector (Lewis, 1954: 401-407).

The central issue in the Lewis model is the importance of capital in achieving economic growth. This element is highly pronounced in the model and is perhaps the most important. The mechanism of growth in this model relies on the fact that labour can be transferred from the subsistence sector to the modern sector. This movement of labour does not result in any increase in wages in the modern sector. Therefore, this aspect increases the profitability of capitalist investment and creates what is called "capitalist surplus". The resulting profits are saved and reinvested and combined with further additional labour to make more profit. This process is self-reinforcing and results in further expansion until all surplus labour is exhausted, food prices start to rise, or land rents rise (Lewis, 1954: 412-417). It is important to note at this stage that, the Lewis model emphasizes structural transformation as its growth process involves reallocation of economic activities between sectors of the economy.

The main fly in the ointment of the Lewis model is that it fails to recognise the role of agricultural productivity in the general transformation of the economy. On the contrary, researchers frequently find that removing labour from agriculture also reduces output in this sector, thus the need for increasing agricultural productivity (Mellor, 1963: 517). More importantly, the model also fails to recognise the use of reproducible capital in the subsistence sector.

Ranis and Fei (1961) made extensions to the Lewis model by applying it to the agricultural sector. So that the capitalist sector was the non-agricultural or industrial sector while the subsistence sector was the agricultural sector. This model thus recognises the role of the agricultural sector in ensuring that the capitalist sector expansion does not come to an immediate stop (Ranis & Fei, 1961: 534).

In this model, the transfer of labour from agriculture to Industry results in the commercialisation of the agricultural sector. This transfer of labour to industry occurs in phases. The first phase is the transfer of redundant labour, this process has no impact on agricultural output. The second phase is the transfer of disguised unemployed labour, this process also doesn't impact agriculture output. It is the third phase which involves the transfer of labour whose marginal product becomes greater than the "conventional standard of living", that reduce agricultural output. Hence market forces set in because farmers must competitively bid for agricultural labour. The agricultural sector is effectively transformed and commercialised (Ranis & Fei, 1961: 537).

The main point in this model, however, is that the transfer of the so called "redundant" labour initially results in "agricultural surplus". This surplus is the part of total agricultural output in excess of the consumption requirements of the remaining agriculture labour force since wages are constant in the industry. The essence of this surplus is that it becomes a source of surplus that can be invested by landlords and farmers into agricultural capital (Ranis & Fei, 1961: 538).

The investment in "agricultural capital" is the source of productivity in agriculture, which ensures that more food is produced with fewer workers. This aspect accomplishes two important things; first, it ensures that more workers are released to the industry so that capitalist expansion does not come to a halt due to the shortage of labour and rising wages. Second, it ensures that more food is produced and hence food prices do not rise and cause a halt to industrial expansion. In summary, therefore, investment must occur in both sectors to ensure this mutual support (Ranis & Fei, 1961: 538-544).

The important point to note at this stage is how our variables of interest in our model, i.e. agricultural capital, which is financed through investment of agricultural surplus, contributes to structural transformation through the linkages explained above. This capital is also financed through household savings in our model, based on literature and developments in the Zambian economy.

The above theories have led to a lot of emphasis on the development of agricultural technologies and investment in order to increase productivity. However, emphasising improvements on the production side without addressing challenges on the market side creates bottlenecks in the development process (Arndt[a] et al, 2000: 121). Improvement in agricultural technology is therefore a necessary but is not a sufficient condition for achieving structural transformation. In order to have the desired impact on structural transformation, technological investment in agriculture must be complemented by improvement in institutions and human knowledge (Kuznets, 1973: 247).

The aspect of institutions is a subject of discussion for our section below, as it provides us with a framework to discuss how the market side can be improved. The focus is on transaction cost economics theory. In this study, we give a more detailed account of this theory, because it has not received enough attention in the literature of structural transformation.

2.2.2 Transaction Cost Economics Theory

The economics of transaction cost (TCE) finds its origins in the works of Ronald Coase, particularly his paper on "the nature of the firm" (1937) and his seminal contribution on "the problem of social cost" (1960). In the first paper, Coase attempted to find out why the firm emerges even though there is a price system that coordinates economic activity (Coase, 1937: 386-390). A conclusion is then reached that the firm emerges because there is a cost incurred in running the price system. There are costs because people must search for price information and negotiate as well as contract. Therefore, firms will emerge to internalise these marketing costs (Coase, 1937: 390-391).

The work of Coase alongside the work of other economists like Oliver Williamson and Douglas North is credited by Kaufman for originating the New Institutional Economics (NIE) (Kaufman, 2007: 8). Coase's work on the nature of the firm clearly illustrates how a firm as an institution emerges and what its role should be (Coase, 1998: 72). The term "institution" in this context refers to society's rules of the game that provide constraints in order to structure human interaction (North, 1995).

In the second paper about the problem of the social cost, Coase further elaborates on the relationship between transaction costs and institutions. What Coase said is that, irrespective of how property rights are defined, economic agents can internalise an externality through bargaining and the outcome would be efficient. However, this solution rests on the assumption that no costs would be incurred in the process of bargaining (Coase, 1960: 9-15). It is obvious that this assumption is a theoretical construct and does not exist in real situations. As Coase stated:

> " In order to carry out a market transaction it is necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on. These operations are often extremely costly, sufficiently costly at any rate to prevent many transactions that would be carried out in a world in which the pricing system worked without cost" (Coase, 1960: 15).

In general, these transaction-related costs increase with the number of interested economic agents. Therefore, in order to ensure that bargaining takes place at a reduced cost and that an efficient economic outcome is achieved, institutions such as firms will naturally emerge. These institutions provide a platform for carrying out the bargain in a vertically integrated system, hence minimizing transaction costs. In the case where the administrative costs of a vertical integration solution are prohibitive, the government as a special institution will come in to regulate the externality (Coase, 1960: 16-17). Theoretically the winners in the vertically integrated system could compensate the losers in order to ensure an efficient system, through what is called the Hicks-Kaldor equivalence (Griffiths & Wall, 2000: 446-447).

The above analysis gives a clear perspective on what constitutes transaction costs. They are the costs of searching for market information, negotiating, screening, and monitoring or enforcement of transactions (Kirsten et al, 2009: 44). From a neo-classical economics perspective, most of the above costs fall under trade costs. In the SAM used in this study, trade cost is one of the main components for the transaction cost account, making the SAM suitable for analysing transaction cost.

The economics of transaction costs has become an integral part of neoclassical economics. This has been achieved by relaxing the assumption of perfect information within the perfect competition model (Kirsten et al, 2009: 38). For the price system to efficiently allocate society's scares resources, the perfect competition model posits that this can only happen under the following assumptions:

First, there must exist many buyers and sellers in the market. This means that each seller can supply only a small proportion of the total market supply and each buyer constitutes only an insignificant proportion of total demand in the market. In short, both sellers and buyers are price takers in the market. Second, there must exist homogenous products, i.e. the technical attributes of the products and the service attributes accompanying its sell must be identical. In short, the buyer can not differentiate between products offered by each firm in the market. Third, there must be free entry and exit of firms in the market. This assumption supplements the assumption of many sellers because, without it, firms could gain market power and influence prices by setting barriers to entry. Fourth, the objective of firms is to maximize profits while that of the buyers is to maximize utility. Finally, it is assumed that economic agents have perfect information about the conditions of the market, including prices, quantity and quality of products. Markets are considered frictionless.

It is clear at this point that the above conditions of perfect competition are a theoretical construct that does not hold in the real world. Therefore, economists have identified conditions under which the price system may fail to allocate resources efficiently, a situation commonly referred to as market failure. These conditions include the case of public goods and common resources, externalities, monopolies and imperfect information. In these conditions, government intervention or other forms of institutional arrangements could improve market outcomes (Cowen & Crampton, 2002).

As indicated, it is the relaxing of the assumption of perfect information that ensures that transaction cost economics (TCE) finds a theoretical and methodological basis in neoclassical economics. The detail of imperfect information economics and how it links with transaction costs is a subject of the following discussion.

Information is considered imperfect whenever it is incomplete or asymmetrically distributed and therefore presents risk and uncertainty in transactions (Kirsten et al, 2009: 38). Therefore, in order to reduce risk and uncertainty, economic agents must search for information, monitor the transaction and ensure that it is enforced. These transaction costs reduce exchange and result in suboptimal multiple equilibria in an economy; this aspect has serious implications for resource allocation and development policy (Kirsten et al, 2009: 40). The problems associated with asymmetric information manifest in two ways namely: adverse selection and moral hazard. We discuss these theories below.

Information asymmetry occurs whenever one economic agent has more information to a market transaction than the other. George Akerlof (1970) "the market for "lemons": quality uncertainty and the market mechanism" is a notable contribution to this topic. In the paper, Akerlof uses the market for second-hand cars to make his point clear. In summary, he said the following:

In the market for second-hand cars, sellers have more information about the quality of the car they are offering for sale but the buyers do not have this information. The reason is that, after owning the car for a period, the seller develops an accurate estimate of the quality of the car. The problem is that, because buyers can not differentiate between a good used car and a bad one, the two types of cars must sell at the same price (Akerlof, 1970: 489). Therefore, the market price will reflect the average quality of the used cars and will thus lie in between the price of a good used car and that of bad used cars. Clearly, this market price discourages sellers of good cars from offering them on the market as it does not reflect their true value. However, the price encourages more bad cars to be sold because the price is above the true value of these cars. The bad cars will chase the good cars out of the market (Akerlof, 1970: 490).

The above market condition is what constitutes adverse selection, i.e. "the tendency for the mix of unobserved attributes to become undesirable from the standpoint of an uninformed party" (Mankiw, 2008: 485). Intuitively, we could say that the probability of purchasing a bad used car keeps on rising in the market until eventually, this market collapses.

In the agricultural sectors of developing countries, adverse selection has serious implications for transaction costs. The presence of people who wish to pawn bad wares as good wares tend to drive good business out of the market and thus increase the extent of the problem. In India "Indian housewives must carefully glean the rice of the local bazaar to sort out stones of the same colour and shape which have been intentionally added to the rice" (Akerlof, 1970: 496). This aspect alone means that screening becomes important when engaging in transactions of this nature and thus calls for institutional arrangements such as branding and signalling to solve the problem often at extra cost.

Transaction costs also manifest in terms of the impact on access to credit. In most rural economies there is limited access to credit. Banks often practice credit rationing and therefore do not extend credit to large sections of the population especially in agriculture. The rationale is to limit the cost of screening borrowers and monitoring (Stiglitz¸1990: 354). This illustrates how transaction costs impact rural development.

Solutions to market problems caused by adverse selection rest on the development of institutions that reduce information uncertainty in the market. Including screening, signalling, guarantees and licencing. Unfortunately, most of these institutional arrangements in developing countries are either weak or do not exist. Therefore, the extent of transaction costs tends to be high in these countries (Akerlof, 1970: 499-500).

Another important aspect of transaction cost economics (TCE) is the concept of moral hazard. Moral hazard finds its origin in insurance markets. What moral hazard means is that the provision of insurance for a particular risk will increase the occurrence of the insured against risk (Baker, 1996: 239). The implication of moral hazard is that it increases the cost of monitoring once the deal has been struck. In agriculture, this concept finds application in institutional arrangements such as sharecropping, contract farming and many other principal-agent problems (e.g. see Stiglitz & Braverman, 1982; Braverman & Guasch, 1984).

The problems relating to moral hazard have resulted in the emergence of institutional arrangements such as interlinkage of factor markets. In most contract farming involving agribusiness firms and farmers, for example, the firm provides inputs such as fertilizers, credit and purchases the output of the farmers. These institutions have in the past been seen as the exploitation of the farmers by firms, however, it has become clear that these institutions provide the principal firms with devices to control "shirking" by the farmers and therefore control moral hazard in general (Stiglitz & Braverman, 1982: 695-696). Hence, the institutions of sharecropping and contract farming emerge to economise on transaction costs.

Transaction cost also manifests in asset specificity. This aspect relates to special purpose investments that cannot be easily used in other activities, i.e. they are activity-specific. Asset specificity presents a form of risk whereby long-term contracts become necessary. These long-term contracts require negotiating and monitoring and thus are an important source of transaction costs (Williamson, 1985: 55-56). In agriculture, asset specificity presents substantial transaction costs. Suppliers of inputs such as fertilizer and seeds rely on farmer demand that occurs in narrow farming season windows. This same demand is unreliable as it depends on incomes of the farmers and their vulnerability to shocks and risk. Therefore, in periods when the demand is not enough, inventories of supplier inputs such as seeds must go to waste, this is a transaction-related cost (Kirsten et al, 2009: 8).

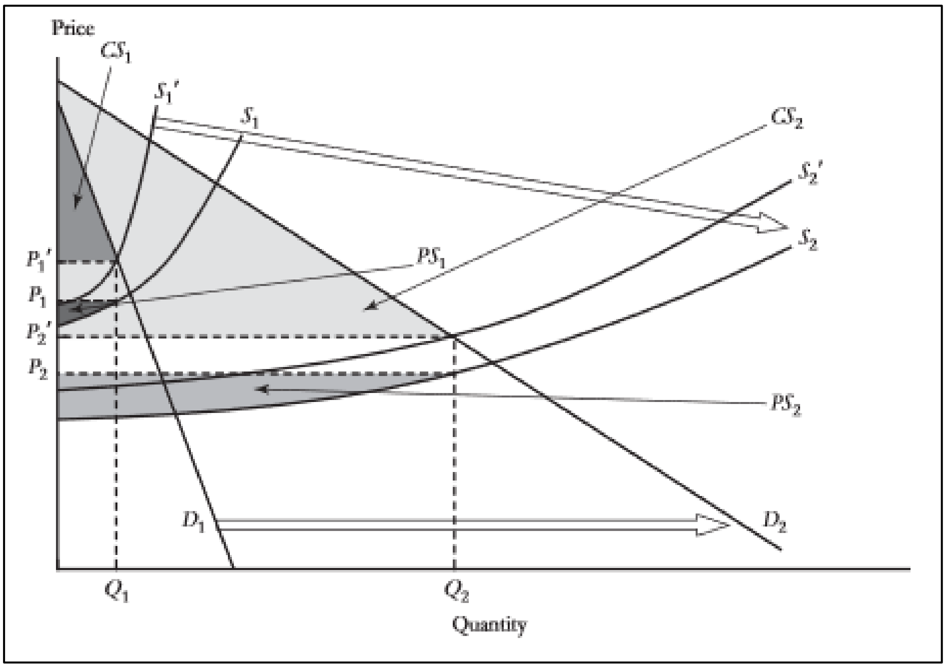
The economics of transaction cost has been criticised mainly for its inability to lend itself to measurement. Given that transaction costs are the economics equivalent of friction in physical systems; given also that Kenneth Arrow (1969) quoted in Williamson (1985: 18) defines transaction costs as the “costs of running the economic system”. Therefore, in measuring transaction costs, economists sometimes consider transport costs as a part of transaction costs (Hobbs, 1997: 1085). In neoclassical economics transport costs are among the major components of transaction costs. Indeed, it is impossible to facilitate market exchange if goods are not transported to the buyer or the buyer does not travel to purchase the goods from the seller. In the SAM used in this study transport costs are a major account for transaction costs.

Further, in measuring transaction costs two aspects are particularly important in rural agricultural markets. These costs include an element of the search for information, i.e. communication and transport costs. These costs are significant because a lot of places in these areas have no cell phone network and have poor road networks, hence coordinating transactions can be very costly. The second one is the cost of waiting; this cost is important because farmers often must wait for many days in order to sell their output at the market as well as wait for payment.

Therefore, the importance of transaction costs in rural agricultural markets and economic development cannot be overemphasized. In these rural areas, agricultural production occurs on small areas of land and output is often very small. This aspect alone means that small scale farmers lack the economies of scale to reduce transaction costs in input purchase and output marketing. In short, transaction costs tend to be too high for each individual farmer (Kirsten et al, 2009: 8). Therefore, on one hand, high transaction costs in input acquisition present a serious impediment to technology adoption, on the other hand, high transaction costs affect market access and output incomes. These two production and market problems are self-reinforcing and result in low level equilibrium trap.

The following graph illustrates how reducing transaction costs by improving institutional arrangements facilitates economic development. In this study, we posit that this economic development comes through structural transformation which is facilitated first by improvement in technology (capital) in agriculture as indicated earlier, and second by reducing transaction costs as shown below.

Figure 1: Institutional Change and Transactions Costs



Source: Kirsten et al (2009)

In figure 1 we have two sets of supply curves. The first set of supply curves (S_1, S_2) reflect the cost of production up to the farm gate, i.e. standard producer supply. The second set (S_1', S_2') reflect the cost of production up to the farm gate as well as of taking the commodities up to the consumer. Therefore, the difference between (S_1 and S_1') is what constitutes transaction costs including transport costs. The same can be said of the difference between (S_2 and S_2') (Kirsten et al, 2009: 21).

In standard microeconomic theory, the shift in the supply curve from (S_1 to S_2) is usually considered the essence of change in technology, price of inputs and government devices such as taxes and subsidies. In terms of transaction costs, what is relevant is the shift in the supply curve from (S_1 to S_1') or that from (S_2 to S_2'). It is clear at this stage that supply in agriculture can be improved by increasing technology (capital) in the sector or reducing transaction costs.

When transaction costs are reduced, the supply curve S_1' shifts to S_1 because the cost per unit of output delivered to the consumer has reduced, producers can supply more output. The quantity supplied at S_1' is higher, thus the price falls from P_1' to P_1. The producer surplus increases by the area bound by P_1 and S_1, i.e. PS_1. The consumer surplus increases by the area bound by P_1', the demand curve D_1 and supply curve S_1, i.e. CS_1. The same analysis applies to the shift in the producer supply curve from S_2' to S_2.

In summary, therefore, we see that the process of structural transformation hinges on increased output in the agriculture sector and that this process can effectively be achieved by increasing capital in agriculture and reducing transaction costs. In the next section, therefore, we analyse empirical literature on these concepts.

2.3 Empirical Literature on Structural Transformation

The purpose of this section is to provide an analysis of the empirical literature on structural transformation in Zambia. The summary of this literature will however include papers in southern Africa and elsewhere in Africa, this inclusion is necessitated by the realisation of limited nature of the literature on structural transformation in Zambia. The conclusion of this section highlights the contribution that this study attempts to make.

2.3.1 Empirical Literature on Structural Transformation in Zambia

Structural transformation in Zambia has been a subject of several empirical studies. The literature on this topic focus on the historical aspect of it; mainly on the reallocation of labour and economic activity across the broad sectors of agriculture, manufacturing and services over time. Notable contribution on the topic includes Resnick and Thurlow (2014), Chitonge (2016), Thurlow and Wobst (2006), Sitko and Jayne (2014) and Brautigam and Tang (2013).

Perhaps what can be considered a comprehensive assessment of structural transformation in Zambia is Resnick and Thurlow (2014). This paper primarily investigates the impact of structural transformation on poverty and social welfare. Further, the paper goes on to describe how structural adjustment programs had a significant effect on Zambia's structural transformation.

The paper employs shift-share analysis to determine if the country experienced structural transformation during the structural adjustment program 1991-2002 and the economic recovery period 2002-2010. The paper finds that, during the adjustment period 1991-2002, the country experienced negative structural change, i.e. labour moved out of high productive industry and services into low productive agriculture (Resnick and Thurlow, 2014: 4). This situation is attributed to the collapse of mining, of manufacturing in things like textile and clothing as well as of other industrial manufacturing, caused by the structural adjustment programs. Workers moved out of productive employment into low productive agriculture in rural areas. In the so called "recovery period" 2002-2010, this paper highlights that there was positive structural change, which contributed to value-added per worker increasing. Labour moved from low productive agriculture into the relatively more productive informal services as well as the more productive high-value construction, finance and communication. There was movement of labour into manufacturing, mainly food processing, although the employment created in this sector was small (Resnick and Thurlow, 2014: 5).

The important point to note is that this paper makes it clear that a significant proportion of the productivity increase associated with the new growth was due to within sector productivity increase. The productivity increase from labour reallocation across sectors was small because most of the employment was created in the not so productive informal services. Thus, growth had very little impact on poverty.

Chitonge (2016) is a more extensive study describing structural transformation in Zambia from the time of independence in 1964 to 2010. This study describes what Resnick and Thurlow (2014) already explained above, however, the paper concludes that the country has not experienced structural transformation in general as evidenced by large sectoral productivity gaps and the fact that changes in sectoral contribution and labour reallocation are not consistent (Chitonge, 2016: 797).

What stands out in this paper is its emphasis that Zambia must focus on improving productivity in agriculture in order to achieve structural transformation. That, the diversification song in Zambia has been sung for too long a time, but agriculture is only prioritised when the mining sector is not performing well (Chitonge, 2016: 801). The paper indicates that this lack of emphasis on agriculture could be due to a misunderstanding of the two-sector model of growth theories (Chitonge, 2016: 801).

Thurlow and Wobst (2006) employ a computable general equilibrium (CGE) model to assess the impact of growth led by different sectors on poverty reduction. They find that in Zambia mining led growth does not have a strong impact on poverty, mainly because the sector has limited linkages to the whole economy and has low employment multiplier (Thurlow & Wobst, 2006: 619). More importantly, the paper establishes that there exists a tendency for mining growth to crowd-out growth in agriculture, as though the sectors were competing, and is reminiscent of the “Dutch disease”.

Further, they implement their simulation in the CGE model by increasing total factor productivity (TFP) across all sectors in agriculture. This paper finds that agriculture-led growth is more poverty-reducing. This is because of its extensive linkages to the economy and the fact that the sector generates more employment for the poor. Even more importantly growth through the agriculture sector changes the structure of the Zambian economy more effectively (Thurlow & Wobst, 2006: 620).

As already indicated in this study, theories of structural transformation have been applied to agricultural transformation by agricultural economists. Indeed, the development of agriculture from small scale to more productive and commercial is seen as the start point for structural transformation. Sitko and Jayne (2014) assess the transformation of small-scale agriculture to emergent farming in Zambia. They find that the change from small scale to emergent farming is a result of civil servants and other middle-income earners investing in agricultural land and farming and hence the farm size has been increasing in the country (Sitko & Jayne, 2014: 201). This development is important for structural transformation in Zambia because the “new” farmers are engaging in agriculture that is fructified by capital hence making agriculture more productive. Even so, the writers indicate that there is underutilisation of the acquired landholdings, which on the other hand could limit the prospects for agricultural transformation.

Finally, in this section, Brautigam and Tang (2013) assessed the influence of China’s special economic Zones in fostering structural transformation in Africa. Among other countries assessed in this paper is Zambia. The Chambishi multi-facility economic zone in Zambia is a big facility involved mainly in copper value addition and is envisioned to create huge industrial employment. The important point to note however is the writer’s observation that, although the multi-facility economic zones was a good model to ensure structural transformation, its impact would be limited because of a lack of technology transfer and the employment of a number of Chinese in the zones as opposed to locals (Brautigam & Tang, 2013: 86).

In summary, this study takes a different path away from the general historic descriptions of structural transformation in Zambia to assess how factors, like increasing agricultural capital and reducing transaction costs, can aid structural transformation and hence economic development in the country.

2.4 Methodological Theories

The purpose of this section is to provide a theoretical basis for the type of methodology that will be employed in this study. The section analyses the theory of social accounting matrices (SAM) and its accompanying extensions of multipliers and linkages. Further, the section explores the theory of general equilibrium models (CGE) and ends with a summary of selected literature on SAMs and CGE models in Zambia.

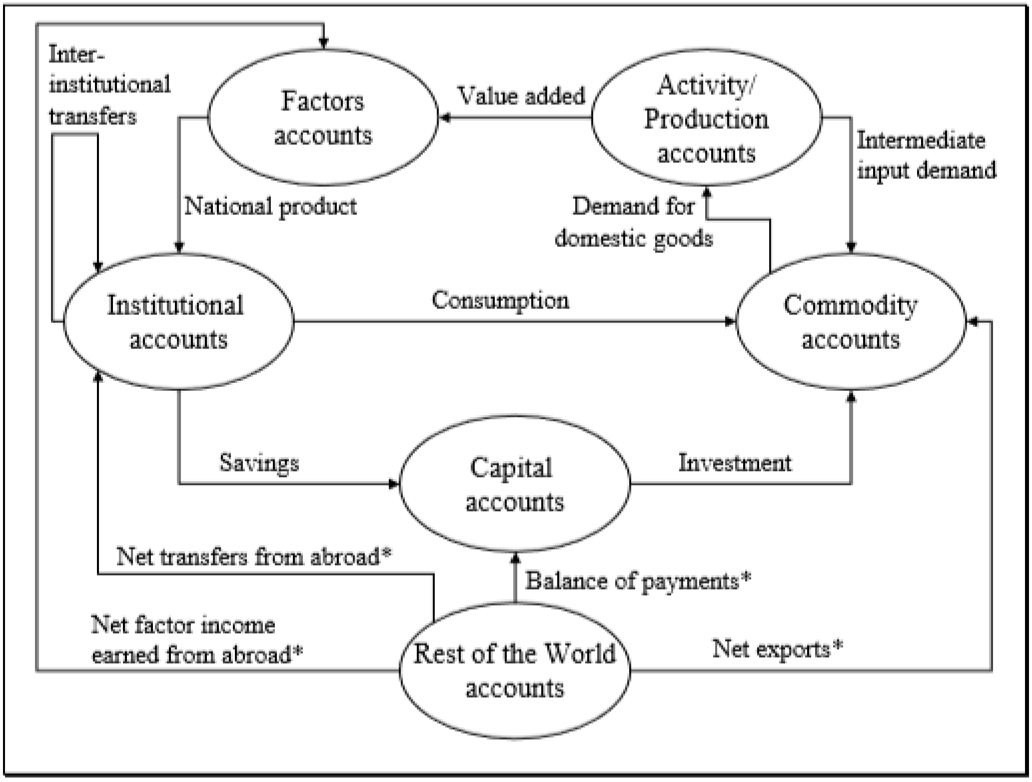
2.4.1 Theory of Social Accounting Matrices (SAM)

Social accounting matrix (SAM) is defined as an accounting framework which captures the flow of funds and the use of these funds in the circular flow model of the economy. It is basically an economy’s circular flow of income and expenditure expressed in a matrix format (Breisinger et al, 2009: 1).

The matrix itself has two main objectives; first is to provide an organised format of social and economic data of a country, region or any economic unit of interest. Usually, the time of reference of the data captured in SAM is one year (Pyatt & Round, 1985: 17). The SAM is not a model as it just presents a static image of the economy at a point in time. Therefore, the second objective is to provide a statistical foundation for economy-wide model development. The models that are developed based on the SAM will now be able to explain how the economy works and predict the impacts of various policy simulations (Pyatt & Round, 1985: 17). We explain the circular flow model of an economy and later show how a SAM captures this circular flow in a matrix format.

The economy consists of many economic agents who are engaged in a wide range of economic activities. The circular flow model simplifies the economic relationships of the agents in the economy. The activities include buying, selling, manufacturing, farming and more. The agents include industries, decision makers such as governments, households, enterprises and the rest of the world. The buying and selling or exchange of goods and services takes place in markets which are the commodity markets and factor markets (Mankiw, 2009: 24). Figure 2 shows the circular flow model.

Figure 2: The Circular Flow of Funds



Source: (PROVIDE Project, 2003)

The figure above (figure 2) shows a circular flow of goods and services in the direction opposite to the arrows and expenditure on these goods and services in the direction of the arrows. The productive activities or industries purchase land, labour and capital in the factor markets. These primary factors of production, i.e. land, labour and capital are owned by the institutional agents, thus, the income from their sell eventually ends up in the institutional accounts (households, corporations, government). The industries combine the primary factors of production with intermediate inputs in the production process of final goods and services. Industries purchase these intermediate inputs in the commodity market. The commodity market is also called the product market.

The final goods and services from industries are complemented by imports and sold through the commodity market to households, government, for investment (inventories) and to the rest of the world as exports. The combination of final goods and services and imports constitute total supply in the economy.

In the circular flow, each economic agent’s expenditure becomes income for another agent. Clearly, the diagram illustrates the “circular process of demand leading to production, leading to income which in turn leads back to demand” (Pyatt & Round, 1985: 19).

The circular flow diagram is a more simplified version of what happens in the economy, because for instance production in industries is conducted by several industries in the economy, using different types of labour and capital as well as various intermediate inputs. Therefore, in order to capture the above circular flow in more detail and to add data to the flows, the process is usually appropriately captured in a SAM as shown below.

Table 1: Structure of a SAM

	Products	Industries	Factors	Households	Corporations	Government	Capital	Rest of World	Totals
Products	Marketing margins	Use matrix		Household consumption		Central government expenditure	Investment expenditure and stock changes	Exports of goods and services	Product demand
Industries	Supply matrix								Production
Factors		Remuneration of factors						Factor income from RoW	Incomes to factors
Households			Distribution of factor incomes	Inter household transfers	Distribution of corporation income	Transfers to households		Remittances from RoW	Household income
Corporations			Distribution of factor incomes			Transfers to corporations		Corporation income from RoW	Corporation income
Government	Taxes less subsidies on products	Taxes less subsidies on production	Factor taxes	Hhold income tax & transfers to government	Ent income tax & transfers to government			Current transfers from RoW	Government income
Capital			Depreciation	Household savings	Corporation savings	Government savings	Total stock changes	Capital account balance	Savings
Rest of World	Imports of goods and services		Factor payments to RoW	Remittances to RoW	Corporation payments to RoW	Government transfers to RoW		Re-exports	Imports of g&s from RoW and transfers to RoW
Totals	Product supply	Cost of production	Expenditure on factors	Household expenditure	Corporation expenditure	Government expenditure	Investment expenditure	Exports of g&s to RoW and transfers from ROW	

Source: Own table based on Punt (2013)

2.4.2 Notes on SAM Data

The way in which data are entered in the SAM like the one in table 1 above, follows the double-entry bookkeeping in traditional accounting. Each cell in the table is an account, hence the incomings and outgoings in this account must balance. However, the double entries in the traditional national accounts are transformed into single entries in the SAM. Therefore, an entry in an account is a simultaneous entry of expenditure from the perspective of column account (j) and income for the row account (i) (Pyatt & Round, 1985: 17).

The size of the matrix can be as large as possible and depends on the main objective for which it is being constructed. The limitation, however, is on the availability of data and the amount of effort required to construct a SAM. As it will be shown in the next section, data for the SAM accounts are acquired from various sources, hence its availability, collection effort and reconciliation can impose serious limitations on the amount of detail that can be captured.

2.4.3 Notes on SAM Accounts

Social accounting matrices have six broad accounts namely; the activity or industry accounts, commodity accounts, factor accounts, institutional accounts (current), institutional accounts (capital or accumulation) and the rest of the world accounts. Each broad account in the SAM can have many sub-accounts, for example; the industry account can have sub-accounts for agriculture, forestry, livestock and so on. The general accounts are explained below.

Activity/ Industry Account

In a sense, the activity account captures the production function of the economy through its expenditure side which is the column accounts. The columns of the activity account show what industries must spend on in order to produce output in the economy. The columns of activity account capture expenditure by industries on intermediate inputs and on factors of production, i.e. labour, capital and land. The payments to factors of production are commonly referred to as value-added while the expenditure on intermediate inputs is usually called intermediate consumption.

In the production process, some production activities receive subsidies on production and incur taxes on production like a land tax. The columns of the activity account record this kind of expenditure as net taxes on production. The value-added and this net production taxes are important in determining GDP from the income side.

The rows of the activity accounts record income from the sale of final output in the economy, this output is sold in the commodity markets. Only output that is produced with the intention to sell on the market is included in product supply, hence the output is captured even if it is not sold but given in kind (Punt, 2013: 29). The value of total supply captured in the rows of the activity accounts in connection with the intermediate demand is important for determining the GDP based on the production side.

Commodity/ Product Account

The commodity accounts record the total value of goods and services supplied in the economy in a period, usually one year. The columns of the commodity accounts record the value of supply of goods and services and imports. Since product supply is valued at purchaser's prices, net taxes on products must be accounted for in this valuation (Pyatt, 1988: 335). Hence commodity accounts also record net product tax expenditure in its column.

The rows of the commodity accounts record income from the sale of intermediate inputs to the industries, the sale of final commodities to households, government, investment institutions and to the rest of the world (exports). All the industries and institutions buy the goods and services in the commodity market at purchaser's prices. The purchase by industries is called intermediate demand while that by the institutions is called final demand.

The commodity accounts also record transaction costs or trade and transport margins. The transaction costs reflect the costs incurred in the marketing of commodities and delivering them from the activity site to the consumers in the commodity market. Given that total supply is valued at purchaser's prices, the transaction costs must be included in the value of total supply in the economy. There are transaction costs in marketing and delivering domestic goods and services, imports and exports. This is of particular importance in the current study.

Factor Account

The columns of the factor account indicate the distribution of factor incomes to institutions, as indicated earlier, factors of production are owned by institutions, hence whatever income they earn ends up being distributed to the institutions. Households are known to own labour, hence they receive the income earned as wages, corporations are known to own capital and therefore receive profits on the use of capital, while the government receives income through direct taxes. Some of the factor income is transferred to the rest of the world as remittances.

The rows of the factor account record receipt of income by the factors from industries and from the rest of the world. The income from industries comes in the form of wages to labour, profits to capital and rents to land. These payments constitute value-added. Factors also receive income from abroad as remittances.

The data on activity, product and factor accounts are usually acquired from the country input-output tables or supply-use tables which are usually published by country statistical bodies.

Institutional Account (Domestic)

The institutional units are those that can legally engage in transactions and can own assets or accrue liabilities. When grouped, these units form institutional sectors (SNA, 2008: 17). Institutions can either be domestic or foreign, in the SAM domestic institutions include households, government and corporations. Further, institutions can either engage in current expenditure or accumulation. Households and government engage in current expenditure, while corporations engage in accumulation.

The rows of the institutional account record income from factors and inter-institutional transfers, while the columns record current expenditure on goods and services by households and government. The consumption expenditure of the households and government on goods and services constitutes part of final consumption and is also a part of final demand. The data on these accounts are acquired from national accounts, household surveys and public sector budgets. Hence, this is an important account for policy and development planning.

Capital Account

As indicated earlier, the corporations engage in accumulation and in this case, they act as investment institutions. Investment is of two kinds, the first is expenditure on assets, i.e. goods and services from which economic benefits can be drawn over an extended period. The second is the accumulation of inventories that add to stocks, i.e. purchased goods that do not get used up within the accounting period.

The columns of the capital account, therefore, record expenditure on the assets and inventories, while the rows record the income that is used for investment. The sources of this income include household savings, government savings, corporation savings, savings for the depreciation of capital and the capital account balance if it is positive. The capital account balance is the difference between foreign exchange receipts and foreign exchange expenditure. This information can be found on the balance of payments which is usually published by central banks.

Rest of the World Account

The rest of the world is an account that records transactions between institutions that are resident in the economy and those that are non-resident. An institution is resident in an economy if its major centre of economic activity occurs within the boundaries of the economy for a period, usually one or more years (SNA, 2008: 17).

The columns of the rest of the world account record expenditure on goods and services, i.e. exports, as well as transfer income from foreign households, corporations and government.

The expenditure on goods and services constitute a part of final demand in the economy. The rows of the account record income from imports and transfer payments to foreign institutions.

2.4.4 Theory of Multipliers

This study employs SAM multiplier analysis to achieve one of its objectives, i.e. development of SAM multipliers for the Zambian economy, in order to assess the structural characteristics of the Zambian economy. Therefore, this section is dedicated to explaining the theory of SAM multipliers.

The theory of multipliers is generally accepted to have been developed by R.F. Khan in his 1931 paper "The Relation of Home Investment to Unemployment". There exists literature however to the effect that the theory of multipliers existed much earlier before Khan (Kent, 2007: 529).

Multipliers are a numerical expression that explains the effect on an economy when there is a change in exogenous variables in an established model of an economy. When there is a change in an exogenous variable in the economy, there will be a direct effect on the appropriate sector. However, this sector is linked to other sectors in the economy either through inputs that it buys or as an input itself to upstream sectors, hence there will also be indirect effects. The direct and indirect effects when combined constitute what is called simple multipliers or input-output multipliers. In determining these multipliers, the households are made exogenous. When households are endogenous in the model, we get combined direct, indirect and induced effects, in this case, the multipliers are called total multipliers or the SAM multipliers (Miller & Blair, 2009: 244). The SAM multipliers are therefore bigger than the input-output multipliers.

Common types of multipliers include output multipliers, income multipliers and value-added multipliers. The output multiplier for an activity (j) measures the change in total production in the economy when the demand for the output of sector (j) increases by one unit. When the demand of sector (j)'s output increase by a unit and increases production in the economy and households are endogenous to the model, the increased production means that more people must be employed to support it. When more people are employed it also means more payments to labour, and because labour is owned by households it implies more income for households. This increase in household income when demand for the sector (j)'s output increases by a unit is what is called income multipliers, while the increase in payments to factors is what is called value-added multipliers (Miller & Blair, 2009: 244-253).

The output multipliers are also a measure of a sector's backward linkage, i.e. how much a sector's output is dependent on the intermediate inputs from other sectors (Miller & Blair, 2009:

556). This is an important measure of “economic connectedness” and helps in identifying important sectors in an economy. The larger the multiplier or backward linkage the more important a sector. In the case where there is data for an economy that refers to different years, it is possible to compare how the multiplier or economic importance of a sector has changed over time. In this way, it is possible to assess which sectors are prominent (Miller & Blair, 2009: 555).

Traditionally the multipliers have been used to determine in which sectors governments should invest more, sectors with larger multipliers are attractive to invest in because the impact on production in the rest of the economy would be higher. However maximum output is usually not the only objective of governments, but governments often have other objectives like reducing inequality (Miller & Blair, 2009: 246). In addition, multipliers work on the assumption that there are unlimited inputs to the production process, hence production is unconstrained. Multipliers also assume that relative prices are fixed so that the change in demand only increases output and not prices. Therefore, the simple SAM multipliers have a weakness of overstating the size of multipliers, to address this problem the literature mentions the use of constrained multipliers (Breisinger et al, 2009: 23). In this study, unconstrained multipliers are used.

In summary, an important element in the size of a SAM multiplier is the structural characteristics of the economy, more importantly, the proportion of imports in total household consumption. If this proportion is high, then when an increase in demand results in increased production and household incomes in the economy, a large proportion of this income will be spent on imports and benefit foreigners. This reduces the size of a multiplier and thus constitutes a “leakage” in the economy. Sales taxes levied by the government is also a leakage to the circular flow of income and reduces the size of multipliers in the same way (Breisinger et al, 2009: 15).

Irrespective of their weakness, SAM multipliers have been used as a methodology in a few studies in Zambia. Notable contributions include Nokkala (2001), who used a SAM based quantity model to study the income distributional impact a Zambian agricultural project. Elsewhere, Arndt[b] et al (2000) conducted a similar study on the Mozambique economy.

2.4.5 Theory of Computable General Equilibrium (CGE) Models

The development of computable general equilibrium (CGE) models is credited to Johansen (1960), it is however understood that other forms of general equilibrium models had existed before this. Mainly the Leontief input-output system and the programming models were the earlier models of this sort (Dixon & Rimmer, 2010: 3).

The computable general equilibrium (CGE) models belong to a class of economy-wide models. These models acknowledge the interdependence of markets and are therefore based on the theory that a set of prices can be obtained such that all markets, i.e. product and factor markets can be in equilibrium simultaneously. It is an extension of partial equilibrium analysis, which on the contrary focuses on resource allocation in a single market such as product market or factor market in isolation. In other words, “it is *mutatis mutandis* rather than a *ceteris paribus* approach” (James, 1984: 231).

As indicated earlier, the other economy-wide models are the Leontief input-output system and linear programming models (Dixon & Rimmer, 2010: 3). What distinguishes the CGE models from these other general equilibrium models is that the Leontief input-output models and the programming models do not have an explicit description of behavioural relationships among economic agents in the economy (Dixon & Rimmer, 2010: 3). For example, “in input-output modelling, the *economy* organises production of each commodity (the vector X) to satisfy a vector of final demands (the vector Y) with given technology specified by the input-output coefficient matrix (A). In programming models, the *economy* organises production to maximize a welfare function subject to Leontief’s technology specification and subject to constraints on the availability of primary factors” (Dixon & Rimmer, 2010: 3). Thus, in these models, relative prices are assumed fixed and the production structure per industry remains constant regardless the level of production. These assumptions are made in order to isolate relative changes in production quantities because the interest is to capture real changes in the economy.

In a CGE model, however, the demand behaviour of consumers and the structural behaviour of production are modelled in a set of simultaneous equations based on economic theory. Consumers are modelled as maximizing utility while producers maximize profits. Usually, the model is calibrated to initial values in a SAM for which the economy is assumed to be in equilibrium, the system of simultaneous equations is solved through price and quantity adjustments until a new comparative static equilibrium is achieved for which demand and supply is equalized in all markets (James, 1984: 232). Prices and quantities in a CGE model are endogenous to the model, what is captured however is the change in relative prices and not changes in nominal prices as would be obtained in the real economy. Therefore, the objective of a CGE model is not to determine the exact outcome of policy intervention but to merely indicate the direction and the size of the changes.

The types of CGE models include those that are differentiated by time dimension, i.e. comparative static, dynamic or recursive dynamic models, as well as those that are differentiated by coverage, i.e. single country, regional, multi-regional or global models. The comparative static models have got no time dimension, they only compare the existing equilibrium to the equilibrium achieved after policy simulation. In short, they indicate what the equilibrium would have been with a different set of parameters or exogenous variables. Although the model can refer to either short run or long run depending on model closures chosen, for example with respect to capital mobility. The dynamic models have a time dimension, parameters obtained when solving for the previous year are used as starting points for the new year. The recursive dynamic models are solved for one year at a time while the fully dynamic models solve simultaneously for all years (Punt, 2013: 49). In terms of coverage, the single country CGE models are built for a country, regional ones are for a region within a country and global CGE models such as GTAP attempt to cover all countries or regions of the world (Punt, 2013: 49). In this study, a comparative static CGE model is employed as it is sufficient to meet the objectives of the study.

CGE models use SAMs as their main dataset, hence variables and parameters are usually calibrated to an existing social accounting matrix to establish the base situation after which shocks using exogenous factors or parameters are introduced in the model to get a new equilibrium. However very often the SAM data is complemented with elasticities that are econometrically determined or guessed based on the good judgement of the modeller (Lofgren, 1994: 2). The elasticities usually relate to the functional forms for the constant elasticity of substitution (CES) for the aggregation of imports and domestic output to get domestic supply, the constant elasticity of substitution (CES) for aggregation of primary factors, the constant elasticity of transformation (CET) for the domestic output exported and sold at home, and the linear expenditure system (LES) for household consumption behaviour (Lofgren, 1994: 3-4). A more detailed discussion on the CGE, SAM data and functional forms will be provided in chapter four of this study.

CGE models have been criticised first for the problems relating to the development of elasticities for various functional forms. What is recommended is that elasticities for functional forms must be determined econometrically based on recent country data, the problem is that this process is data intensive and sometimes the data may not be readily available. Therefore, it is frequently found that researchers resort to guesstimates of elasticities based on their knowledge of the economy or based on elasticities of similar countries surveyed. Consequently, the absence of econometrically determined elasticities puts the validity of most CGE model results in question (Lofgren, 1994: 2-3). Modellers hence frequently use sensitivity analysis to assess the robustness of results and to identify important assumptions and parameters that are crucial to the results (James, 1984: 235).

In addition, although CGE models are favoured for their ability to capture direct and indirect effects as well as the endogeneity of relative prices and quantities, this is also their weakness. The complex interactions in the model leaves no room for intuition in evaluating results, it is therefore difficult to intuitively unravel the forces driving the results (James, 1984: 235).

CGE models have however been extensively used in many studies in Zambia, notable contributions include Jung and Thorbecke, (2003); Clausen and Schürenberg-Frosch, (2012); Thurlow and Wobst, (2004 and 2006); Hartley et al (2018); Gronau et al (2018) and Nhlane (2016).

2.5 Summary

This chapter contains a detailed description of how improving capital and reducing transaction costs in agriculture could help transform an economy and spur economic development, from a theoretical perspective. Although there is empirical literature demonstrating this same phenomenon in other countries, this study adds a dimension of assessing the impact of increasing agricultural capital and reducing transaction costs in the case of a closed economy and an open economy.

Furthermore, the empirical literature surveyed for SAM multipliers reviews that aggregated SAMs have been used for determining multipliers. This study uses a more disaggregated SAM in order to more accurately capture the indirect effects. More importantly, this study discusses the multipliers with respects to structural characteristics of the Zambian economy, we find that this is an important contribution as the literature on multipliers for Zambia does not address this aspect in detail and not with respect to the agricultural sector.

Chapter 3

Background Information

3.1 Introduction

The purpose of this chapter is to provide background information on structural transformation in Zambia. Therefore, a historic perspective on sectoral contribution to total output as well as to employment in the economy will be discussed. Further, trends in sectoral productivity will be presented and the chapter ends with a discussion on agricultural capital. The transaction costs will only be discussed in the conclusion as this topic has been extensively discussed in chapter two and partly in chapter one.

3.2 Sectoral Contribution to Total Output

The sectoral contributions give insight into the nature and extent of structural transformation in an economy. It illustrates the contribution of the broad categories of agriculture, manufacturing and services to the total output in the economy. As mentioned in this study, the essence of structural transformation is to move labour from less productive agriculture to more productive manufacturing. This process is expected to increase overall national productivity and therefore result in economic development.

Therefore, a large contribution to total output by manufacturing indicates positive structural transformation, while a large contribution by agriculture to GDP indicates that an economy is not yet transformed. The expectation in literature is that services must only increase its share after the transformation from agriculture to manufacturing has taken place.

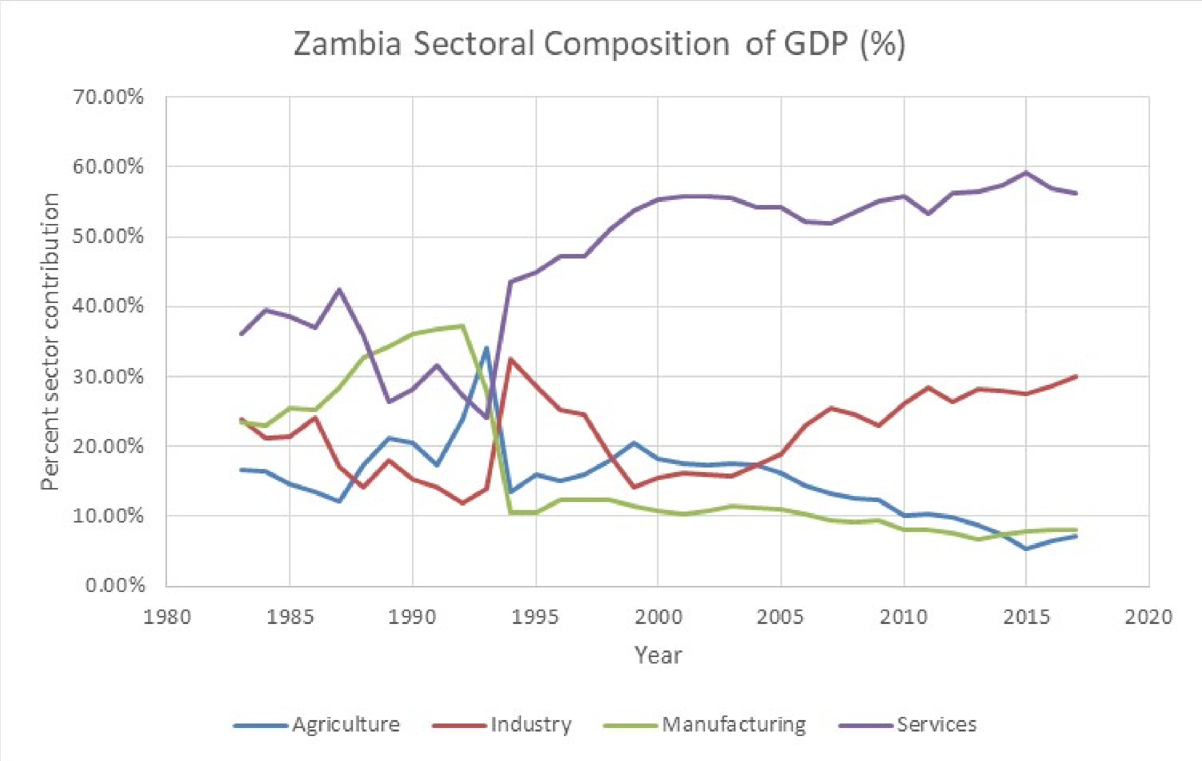
In figure 3 is a graphical representation of sectoral contribution to total output in the Zambian economy from 1983-2017. Total output in the source data is valued at producer prices. It is clear in figure 3 that the 1980s going to about 1994 was a period of significant sectoral shifts. Industry whose main component is mining during this period had been declining while agriculture was on the rise. The decline in industry during this period is attributed to the copper price shock that occurred in 1974 as well as the oil shocks of 1973, so that by the 1980s the country was in an economic crisis as a result of the declining mining sector, a lifeblood of the economy (Seshamani, 1992: 116-117). The crises that originated in the 1970s had their full effect felt in the 1980s, hence the 1980s was a period of changes in policy regime aimed at restructuring the economy.

In restructuring the economy in the 1980s, a strong emphasis was placed on diversifying the economy toward agriculture, which was accorded the highest priority. Therefore, the increase in agriculture sectoral contribution can be attributed to this policy change, as well as to the fact that during the crisis period there was retrenchment of workers who had to relocate to rural agricultural areas (Seshamani, 1992: 117-119). This indicates occurrence of negative structural transformation since workers moved from a relatively high productive to a low productive sector in the economy.

In the same period services also fell, mainly because government services which are a significant proportion of the service sector declined due to the large government budget deficit during this period. Informal trade was also adversely affected because of its dependence on the purchasing power of the formal sector employees whose income was adversely affected, a consequence of high inflation (Seshamani, 1992: 119). Manufacturing increased its share during this period, mainly because the sector was composed of state enterprises under infant industry protection which were privatised only after 1991 (Chitonge, 2016: 776).

In fact, Chitonge quoting Bates (1981) indicates that: “By the 1980s Zambia had established a relatively diversified production base with a wide range of light industries such as manufacturing of bicycles, batteries, textiles and clothing, metal products, a wide range of food products, copper and leather products including shoes, wood and related goods, and the assembling of tractors and light vehicles” (Chitonge, 2016: 775). The Zambian economy was slowly transforming under the arm of infant enterprises protected by the state. This kind of import substitution industrialisation (ISI) was a classic strategy of post-colonial states in the global south of Africa (Chitonge, 2016: 734).

Figure 3: Zambia Sectoral Shares 1983-2017



Sources: Own graph based on World Development Indicators Data, World Bank (2019)

However, as shown in figure 3, around 1993 Zambia's manufacturing took a nosedive, this was because state-owned enterprises were privatised and the economy got liberalised, hence they failed to compete against imports (Chitonge, 2016: 776). The manufacturing sector in Zambia has since failed to pick up from the policy change of the 1990s. In terms of the industry sector, since the 2000s going forward after the privatisation of mines of the 1990s and structural adjustment programs were successfully implemented, the industry sector started increasing its share in the GDP. In addition, Resnick and Thurlow (2014) indicate that rising construction also contributed to the increase in the share of industry, mainly it's the increase in building of new roads and rehabilitation of existing ones, building of schools, and shopping malls, as well as housing (Resnick & Thurlow, 2014: 12). The agricultural sector's share to the contrary has generally been declining, this is as expected as an economy transforms, however instead of manufacturing increasing when agriculture declines, what is increasing is services. The Zambian economy is transforming from agriculture to services, which in 2017 accounted for 56.33% of GDP.

The liberalisation reforms of the 1990s are responsible for much of the growth in the service sector, mainly because people who lost employment in the formal sector found a safety net in informal trading. In addition, liberalisation removed controls on the exchange rate, imports and prices, this opened entry into informal trading (Resnick & Thurlow, 2014: 12). In addition, formal trade, transport, communication, tourism, finance and business services contributed significantly to the growth of the services sector. For instance, between 2000 and 2010 the number of mobile phone subscribers in Zambia increased from 98,000 to 5 million. There is also an extensive provision of financial services through mobile banking, which allows financial transactions to be conducted through the mobile phone even when the owner does not own a bank account (Resnick & Thurlow, 2014: 12). In terms of poverty reduction, however, the effect has been minimal. The growth in the service sector has mainly been through value-added per worker and less through employment and has benefited mainly skilled labour. In fact, the World Bank (2012) indicates that between 2006 and 2010 for instance, poverty incidence only dropped from 62.3% to 60.5%.

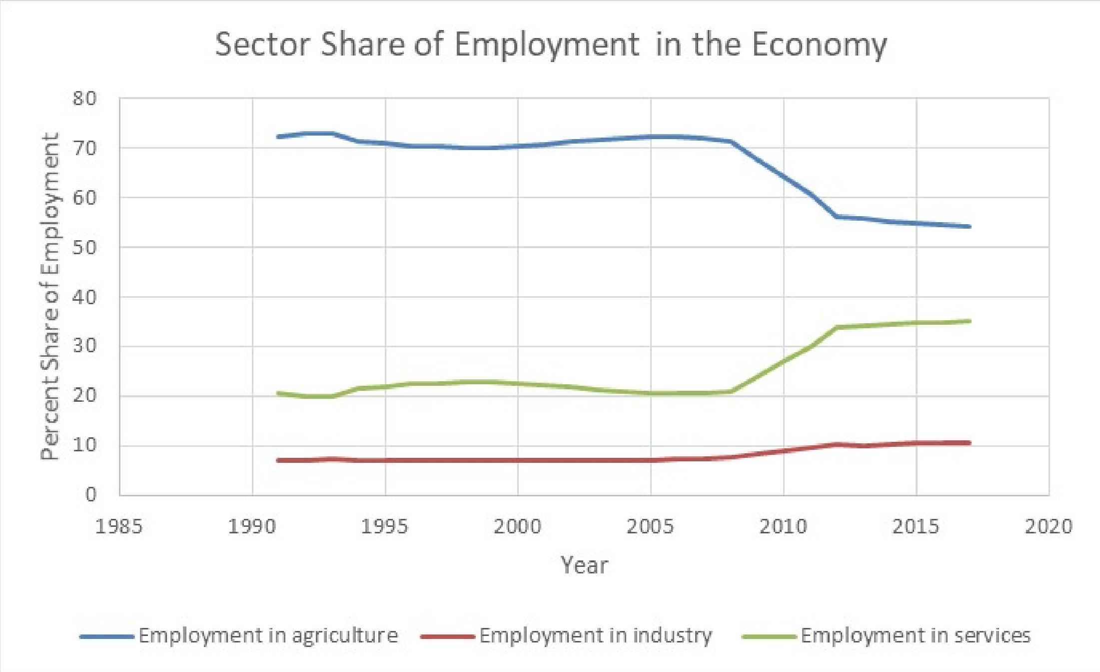
3.3 Employment Share by Sector in the Economy

The share of employment of each sector in the economy is an important measure of structural transformation. In a positively structurally transforming economy, it is expected that manufacturing should be increasing as well as be having a large share of employment in the economy. It is an indication that labour is moving from declining agriculture into the expanding manufacturing where productivity is high. The literature indicates that the share of services in employment must only become large when the economy has successfully industrialised and hence economically developed. Figure 4 shows the trend in the sector share of employment in the Zambian economy from 1991-2017.

In figure 4 it is clear that agriculture has been contributing the most in terms of employment in the Zambian economy. Although in Figure 3 we saw that the agricultural contribution to GDP was small and decreasing, the sector still employed most of the labour force in the country. Resnick and Thurlow (2014) indicate that the importance of agriculture in Zambia is not because of its sectoral contribution in the total output, but because at least two-thirds of Zambians leave on or work on the farms.

It is clear that the employment share of agriculture has been declining, although it is still large. It is the economic recovery in the 2000s that attracted labour out of agriculture in search of employment in the urban areas that is responsible for the decline in the share of agricultural employment. Most of these rural migrants ended up in informal trade, mainly selling merchandise to an emerging middle class in urban areas (Resnick & Thurlow, 2014: 12-13). This sheds light on the rise in the employment share of services observed in figure 4 from 2005 and significantly from 2007.

Figure 4: Employment Share by Sector in the Economy



Sources: Own graph based on World Development Indicators Data, World Bank (2019)

Interestingly, although services have been contributing the largest share to the GDP from the early 1990s, its employment share is low but increasing, this indicates that the major components of services such as tourism, formal trade services, finance, transport and communication are not labour intensive. Growth in these components has been mainly through increasing value-added per worker and less through employment (Resnick & Thurlow, 2014: 12). Since the collapse of manufacturing in the 1990s, industry employment which includes manufacturing in figure 4, has generally been low and stagnant, until after about 2005 when mining picked up and the economy was recovering due to private sector investment after the successful implementation of the structural adjustment program. Thus, from about 2005 the employment share of industry marginally increased. This employment has been in mining as well as in food processing, both these activities are not labour intensive (Resnick & Thurlow, 2014: 12).

An important point to note in figure 4 is that, in order to reduce poverty in Zambia, emphasis must be placed on making the agricultural sector more productive, because it employs more labour compared to other sectors. Therefore, an agricultural led growth would be more poverty reducing (Thurlow & Wobst, 2006: 620). Table 2 shows the growth rates in sector employment from 1995 to 2016.

Table 2: Sector Growth Rate in Employment Share (1995-2016)

VARIABLES	(1) OLSESAGR LESAGR	(2) OLSESIND LESIND	(3) OLSESSEV LESSEV
Year	-0.0134***	0.0223***	0.0236***
	(0.00224)	(0.00255)	(0.00450)
Constant	31.05***	-42.70***	-44.11***
	(4.493)	(5.107)	(9.027)
Observations	22	22	22
R-squared	0.641	0.794	0.579

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Sources: Own calculations based on World Development Indicators Data, World Bank (2019)

We specified the following regression model in order to determine the rate of growth in the employment share of each sector: $SAGR = \beta_0 + \beta_1 Year + \varepsilon$; where LESAGR is the natural log of the employment share of agriculture in each year. The same equation was used for industry and services by replacing the LESAGR with LESIND and LESSEV, where LESIND is the natural log of the employment share of industry in each year and LESSEV is the natural log of the employment share of services in each year.

We find that over the period 1995-2016, growth in the employment share of agriculture declined by 1.34%, while that of industry and services increased by 2.23% and 2.36% respectively. The decline in the growth rate of employment share of agriculture is too small to have the required impact on structural transformation. further, industry must have increased its share of employment growth more than services if there was evidence of structural transformation, as opposed to what is depicted in table 2.

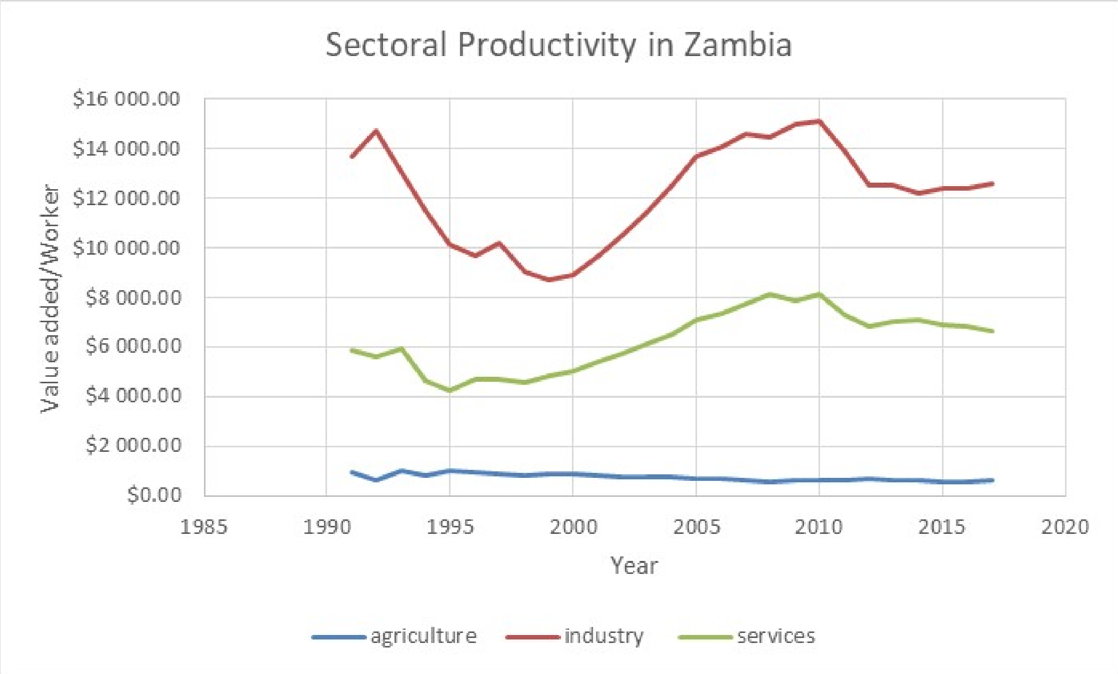
3.4 Sectoral Labour Productivity

Sectoral labour productivity is one of the variables that is of interest when assessing structural transformation in an economy. Large gaps in sectoral productivity indicate that an economy is not economically transformed, what is expected is that, once structural transformation is successful there must be convergence in sectoral productivity. Figure 5 shows the trend in sectoral productivity in the Zambian economy from 1991-2017.

In figure 5, it is clear that the Zambian economy has been characterised by large gaps in labour productivity. As McMillan and Rodrik (2011:1) indicate "this is indicative of the allocative inefficiencies that reduce overall labour productivity". Since the 1990s agricultural labour productivity has been declining, although the change is not much, showing stagnation. This illuminates on the observed situation in figure 4 that the dominant employer in the economy is still agriculture, labour has not moved to more productive industry and services.

If labour had moved to either services or industry where productivity is higher, then productivity in agriculture would have been increasing. The growth in industry and services observed in figure 5 was a result of an increase in valued-added per worker and only very little through employment.

Figure 5: Value-added Productivity per Worker (constant 2010 US$)



Sources: Own graph based on World Development Indicators Data, World Bank (2019)

In general, the labour value-added productivity in the industry and service sectors had been increasing since around 1998, and continued to rise, only to taper off a little from 2010 onwards. The rise in value-added per worker in industry is attributed to large inflows of capital through foreign direct investment (FDI) in the mining sector, this was after successful privatisation of the mining sector (Resnick & Thurlow, 2014: 8). The growth in value-added is a result of the capital-intensive nature for the components that were responsible for much of the growth in this sector i.e. communication and financial sectors (Resnick & Thurlow, 2014: 12). Table 3 shows the growth rates in sectoral productivity from 1991-2017.

Table 3: Sector Value-added Productivity Growth Rate (1991-2017)

VARIABLES	(1) OLSAgri LAgri	(2) OLSIndus LIndus	(3) OLSServ LServ
Year	-0.0184***	0.00775*	0.0184***
	(0.00285)	(0.00400)	(0.00336)
Constant	43.36***	-6.138	-28.08***
	(5.705)	(8.026)	(6.726)
Observations	27	27	27
R-squared	0.624	0.130	0.545

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

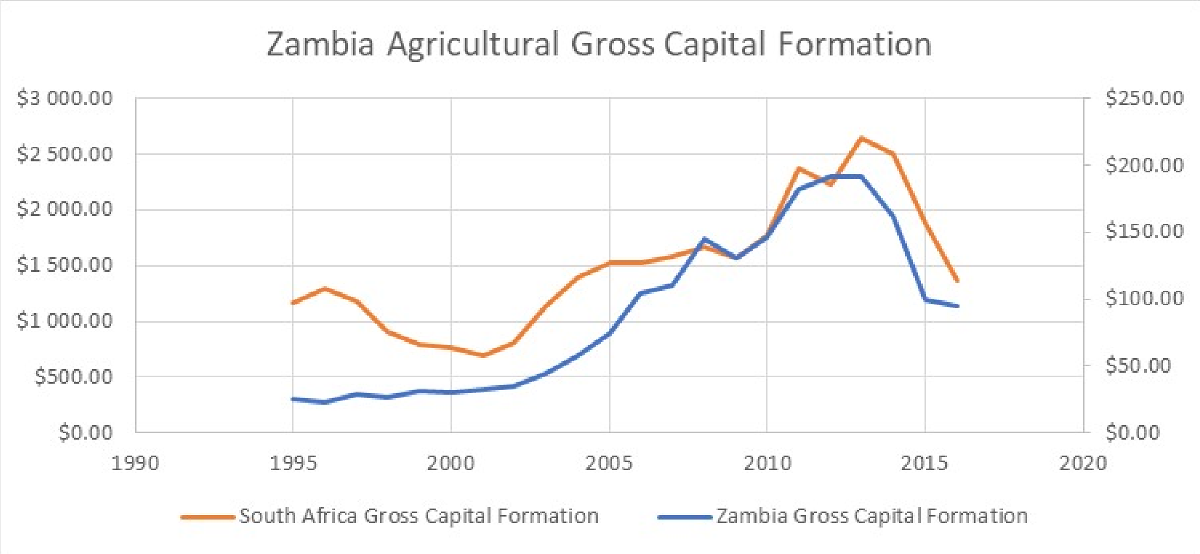
Sources: Own calculations based on World Development Indicators Data, World Bank (2019)

We determined the growth rate in sector labour productivity for agriculture using the regression equation: $gri = \beta_0 + \beta_1 Year + \varepsilon$; where LAgri is the natural log of agriculture labour productivity for each year. The same equation was used in the case of industry and services labour productivities, by replacing LAgri with LIndus and LServ respectively. We find that agricultural value-added productivity declined by 1.84% while industry and services productivity increased by 0.78% and 1.84% respectively. For structural transformation to take place, agricultural productivity must be increasing until it converges with other sector productivities, as opposed to the situation reflected in table 5.

3.5 Agricultural Capital in Zambia

The accumulation of agricultural capital is an important element in transforming the Zambian economy. This is in the light of literature to the effect that agricultural productivity in Zambia is constrained by a lack of capital (Deininger & Olinto,2000; Govereh et al, 2009). Therefore, the trend in agricultural capital is analysed in this section, this will be done in comparison to South Africa where the economy is more transformed.

Figure 6: Zambia Agricultural Gross Capital Formation (current Million US$)



Sources: Own graph based on FAOSTAT data, FAO (2019)

In figure 6, Zambia's gross capital formation has been stagnant from 1995 and only started rising after 2000; this corresponds with the recovery of the Zambian economy which started around 2000. Although gross capital formation had been rising since 2000 and more significantly from 2007, the magnitude remained very small compared to countries with more productive agricultural sectors like South Africa. For example, at its pick in 2013, Zambia's gross capital formation was only $192.12 (right hand axis) while that of South Africa was $2 640.21 (left hand axis). Table 4 below shows the growth rate in gross capital formation for Zambia compared to that of South Africa. Despite that large difference in value, the gross capital formation in agriculture in Zambia and South Africa follow vaguely similar trends after 2002.

Table 4: Zambia Growth Rate in Agricultural Capital/Compared to South Africa (1995-2016)

VARIABLES	(1) OLSZMGCF LZMGCF	(2) OLSSAGCF LSAGCF
Year	0.107***	0.0455***
	(0.0114)	(0.00888)
Constant	-209.7***	-84.03***
	(22.91)	(17.82)
Observations	22	22
R-squared	0.813	0.567

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Own calculations based on FAO stats data (2019)

In order to determine the growth rate in gross capital formation in the Zambian agricultural sector, we specified a regression model: $LZMGCF = \beta_0 + \beta_1 Year + \varepsilon$; where LZMGCF is the natural log of gross capital formation in Zambia. The same was done for South Africa, by replacing LZMGCF with LSAGCF, where LSAGCF is the natural log of South Africa's gross capital formation for each year. We find that agricultural gross capital formation grew by 10.70% between 1995 and 2017 in Zambia, while in South Africa it grew 4.55% over the same period. The annual growth rate in South Africa is slow because the country is reaching its expansion space in this area and the rate is calculated off a larger base.

3.6 Summary

This chapter contains a detailed description of indicators on structural transformation in Zambia. The conclusion is drawn that, standard structural transformation as we know it in literature has not taken place in Zambia. Although the sector and employment shares of agriculture have been declining, the rate is too small. Further, the decline in the output and employment share of agriculture is corresponding to an increase in the output and employment share of services, with only minimal changes in industry. In addition, labour value-added productivity in agriculture is declining, while agricultural capital is small and only growing slowly to have the necessary impact on productivity.

More importantly, the share of agricultural employment in total employment in the economy only started declining significantly from 2007. From 2007, there were also generally major increases in agricultural capital, which reached its maximum around 2013. Hence the use of the 2007 SAM for Zambia as a pre-change base to understand the impact that certain policies had on the economic situation that occurred after 2007. The significant changes that started from 2007, could have been spurred by the positive effects of the debt relief of 2005 under the enhanced framework of the Heavily Indebted Poor Countries (HIPC) initiative (World Bank, 2012: 14).

Therefore, it is relevant that we understand the impact of growing agricultural capital at levels higher than obtained. This was done in conjunction with reducing transaction costs based on the economic theory already explained in chapter two of this study.

Chapter 4

Methodological Framework

4.1 Introduction

In this chapter, a description of the dataset is provided first, this entails a discussion of the Zambia SAM for 2007 that has been used to develop multipliers for the Zambian economy. The same dataset is used as base data for the CGE model in the study.

Further, the chapter provides an overview of the method that has been employed to develop the SAM multipliers for the Zambian economy. The multipliers illuminate the agricultural policy environment in Zambia and thus provides insight in discussing the structural characteristics of Zambia's agricultural sector. The chapter ends with a section relating to the methodology of the CGE model as well as a detailed description of how simulations are implemented in the model.

4.2 The 2007 Zambia SAM

This study relies on the Zambia 2007 SAM as its dataset. The SAM was developed by the Zambia Institute for Policy Analysis and Research (ZIPAR), the International Food Policy Research Institute (IFPRI) and the United Nations University's World Institute for Development Economics Research (UNU-WIDER). A discussion of the SAM which draws on Chikuba et al (2013) is provided below.

The SAM is a square matrix in structure, with each row representing income having a corresponding column representing expenditure. The macro SAM is an aggregation of the micro SAM, for lack of space, only the macro SAM is presented in table 5 and the description of the submatrices provided below.

Table 5: Zambia 2007 Macro SAM (Billions of Kwacha)

	Activities	Commodities	Transaction costs	Factors	Households	Enterprises	Government	Savings/Invest	Row	Total
Activities	0	97 636	0	0	0	0	0	0	0	97 636
Commodities	53 031	0	13 243	0	32 868	0	5 537	10 293	17 818	132 790
Transaction costs	0	13 243	0	0	0	0	0	0	0	13 243
Factors	44 604	0	0	0	0	0	0	0	0	44 604
Households	0	0	0	27 186	0	8 094	1 830	0	940	38 050
Enterprises	0	0	0	17 418	0	0	455	0	142	18 016
Government	0	4 083	0	0	2 139	2 589	7 844	0	1 771	18 427
Saving/Invest	0	0	0	0	3 043	1 830	2 284	291	3 136	10 583
RoW	0	17 828	0	0	0	5 502	476	0	0	23 807
Total	97 636	132 790	13 243	44 604	38 050	18 016	18 427	10 583	23 807	0

Source: Own table based on Zambia SAM 2007, Chikuba et al (2013)

Supply and Demand in the Economy

Productive activities i.e. industries, purchase land, labour, and capital inputs from the factor markets. The inputs are purchased to help in the production of final goods and services. The actual payment in the SAM from productive activities to factors is ZMW44,604 billion indicated in the *factors-by-activities* submatrix. This amount is also called valued added or GDP at factor cost. The primary factors are combined with intermediate inputs purchased from commodity markets to complete the production of final goods and services. The actual payment in the SAM from productive activities to the commodity market for the supply of intermediate goods is ZMW53,031 billion as depicted in the *commodities-by-activities* submatrix.

The first row in the SAM shows the total domestic supply in the economy is equal to ZMW97,636 billion, as depicted in the *activities-by-commodities* submatrix. In the SAM each activity only produces one commodity, thus there is no secondary production. The total domestic output is combined with imports from the rest of the world to make final supply of goods and services in the economy. The actual payments for imports to the rest of the world is ZMW17,828 billion, as shown in the *row-by-commodities* submatrix.

The final goods and services and the imports are sold through commodity markets to households, the government, investors, and exported to foreigners. In the SAM, the payment from households, government, investment and exports to the commodity markets for the supply of final goods and services is ZMW32,868 billion, ZMW5,537 billion, ZMW10,293 and ZMW17,818 billion respectively. This component constitutes final demand. These transactions are indicated in the *commodities-by-household; commodities-by-government; commodities-by-investment* and *commodities-by-row* respectively.

Household Income and Expenditure

The households are usually the ultimate owners of the factors of production, and so they receive the incomes earned by factors during the production process. The amount distributed by factors to households is ZMW27,186 billion this is captured in the *household-by-factors* submatrix. Households are the shareholders in incorporated enterprises; hence they receive income from enterprises in the form of dividends. The distribution of income from enterprises to households is captured in the *household-by-enterprise* submatrix and is equal to ZMW8,094 billion. Households also receive transfer payments from the government (for example, social security and pensions) and from the rest of the world (such as remittances received from family members working abroad). In the SAM the transfer payments from government to households is ZMW1,830 billion as shown in the *household-by-government* submatrix. Transfers from the rest of the world to households is ZMW940 billion in the *household-by-row* submatrix.

Households then use the income they receive to pay taxes directly to the government amounting to ZMW2,139 billion in the *taxes-by-household* submatrix. They also purchase commodities worth ZMW 32,868 billion as indicated earlier in the *commodities-by-household* submatrix. The remaining income is then saved (or dis-saved if expenditures exceed incomes). The amount of household savings is ZMW3,043 billion in the *savings-by-household* submatrix.

Enterprises Income and Expenditure

The enterprises are treated as separate institutional units and can separately engage in production or accumulation but not final consumption. Enterprises receive incomes from factors, as returns to capital or gross operating surplus. The actual amount is ZMW17,418 billion shown in the *enterprise-by-factors* submatrix. They also receive transfers from the government and from the rest of the world. The actual amounts being ZMW455 billion reflected in the *enterprise-by-government* and ZMW142 billion in the *enterprise-by-row* submatrices respectively.

A part of the income received by enterprises is distributed to households in the form of payments such as dividends ZMW8,094 billion shown in the *household-by-enterprise* submatrix. The other share of the income is paid to the government as taxes, such as corporate taxes and transfers, in the SAM these amounts are ZMW1,622 billion in the *taxes-by-enterprise* and ZMW968 billion in the *government-by-enterprises* submatrices respectively. Another amount is transferred to the rest of the world ZMW5,502 billion in the *row-by-enterprises* submatrix. The remaining income is then saved (or dis-saved if expenditures exceed incomes). The amount of enterprise savings is ZMW1,830 billion indicated in the *savings-by-enterprises* submatrix.

Government Income and Expenditure

The government receives transfer payments from the rest of the world (such as foreign grants and development assistance). In the SAM this figure is ZMW1,771 billion reflected in the *government-by-row* submatrix. This amount is added to all the various tax incomes including ZMW4,083 billion product taxes in *taxes-by-commodities*, ZMW2,139 billion household income tax in *taxes-by-household*, ZMW1,622 billion tax from enterprises (corporate tax) in *taxes-by-enterprises*, ZMW 968 billion transfers from enterprises in *government-by-enterprises* submatrices and ZMW 7,844 other government income.

The government uses the above revenue to pay for recurrent consumption spending as earlier indicated ZMW5,537 billion in *commodities-by-government*, transfers to households ZMW1,830 billion in *households-by-government,* transfers to enterprises ZMW455 billion in *enterprises-by-government,* Other government expenditure ZMW7,844 billion, and transfers to the rest of the world ZMW476 billion in *row-by-government* submatrices. The difference between total revenues and expenditures is the fiscal surplus (or deficit, if expenditures exceed revenues) worth ZMW2,284 billion in the *savings-by-government* submatrix.

Investment Income and Expenditure

Investment institutions receive investment income in the form of savings from households ZMW3,043 billion in *Investment-by-household,* from enterprises ZMW1,830 billion in *investment-by-enterprises,* from government ZMW2,284 billion in *investment-by-government* submatrices and changes in stocks ZMW291 billion. The income that is received is used to pay for investment goods and services from the commodity markets ZMW10,293 billion in the *commodities-by-investment* submatrix and changes in stocks ZMW291 billion.

Current Account Balance

The ex-post accounting identity requires that investment must equal total savings. So far, we have accounted for household savings, enterprise savings and government savings. The difference between total domestic savings and total investment demand is total capital inflows from abroad, or what is called the current account balance which is ZMW3,136 billion. This is also equal to the difference between foreign exchange receipts [export receipts ZMW17,818 billion, transfers from the rest of the world to households (remittances from abroad) ZMW940 billion, transfers from abroad to enterprises ZMW142 billion and transfers to government ZMW1,771 billion] and foreign exchange payments [expenditures on imports ZMW17,828 billion, transfers from enterprises to the rest of the world ZMW5,502 billion and transfers from the government to the rest of the world ZMW476 billion].

Transaction Costs

The transaction costs which are captured as trade costs incurred in the marketing of each commodity, and thus are reflected as payment of commodities to transaction cost accounts in the SAM. In the SAM the transaction costs are captured as aggregated trade margins, therefore in this study, they were disaggregated to capture transaction costs in the marketing of imports, exports and commodities that are domestically marketed. The condensed figure for these transaction costs is ZMW13,243 billion as shown in the *transaction costs-by-commodities* submatrix.

4.2.1 Data Changes

In CGE modelling an important step is that of ensuring that the dataset fits the model requirements. In this study, the CGE model used required that transaction cost be in a disaggregated format comprising domestic transaction costs, import transaction costs and export transaction costs. The problem is that the Zambia SAM for 2007 has condensed all the transaction costs in a single row, therefore this row of total transaction costs had to be disaggregated into three rows of domestic, import and export transaction costs.

The disaggregation of transaction costs is based on the production shares of domestic, imports and exports in total marketed output in the economy. It is this share that is used to allocate total transaction costs to domestic, imports and export transaction costs. In some instances further adjustments were made to avoid reexports and negative prices.

Further, it was discovered that commodities such as mining*,* other export crops, chemicals, non-metals, metals, machinery and vehicles and other manufacturing had export values that exceeded the sum of domestic production, export transaction costs and export taxes. This situation indicates that the Zambian economy re-exports these commodities after importing them. This aspect is not accommodated in the model. Thus, changes were made to ensure that the export values of these commodities were less than the sum of domestic production, export transaction costs and export taxes. This was achieved by transferring the excess exports to inventories until the SAM was balanced.

4.3 Social Accounting Matrix Multipliers

This study has one of its objectives as determining the multipliers for the Zambian economy, with a focus on the agricultural sector. This aspect provides insight in discussing the structural characteristics of Zambia's agricultural sector. Therefore, it is the methodology for calculating the SAM multipliers that are presented in this section.

A sector's output multiplier measures the economy-wide effect on production of a change in exogenous demand. In this study we used the *activity-by-commodity* submatrix; hence the column totals of the *activity-by-commodity* submatrix of the Leontief shows the total effect on industry output of a one-unit change in specific commodity exogenous demand. The output multiplier combines all direct, indirect and induced effects of a one-unit increase in specific commodity exogenous demand across multiple rounds and reports the final increase in gross output of all production activities. In this study, a closed SAM multiplier model is used, meaning that households have been made endogenous in the computation of the multipliers.

The output multipliers are also a measure of backward linkages, i.e. they indicate how much a sector is linked to downstream sectors in the economy in terms of inputs. It shows the importance or prominence of a sector in the economy. Thus, the structure of the Zambian economy is discussed in this respect in the study. Following Miller and Blair (2009) the backward linkages or output multipliers are given by the column sum totals of the total requirement matrix of the Leontief inverse = $[l_{ij}]$. Formally, for sector *j* the backward linkage or output multiplier is given by:

$$m = BL(t)_j = \sum_{i=1}^{n} l_{ij}$$

Where *m* is sector j's multiplier which is the same as its backward linkage $BL(t)_j$ and is equal to the column sum of the Leontief elements l_{ij} for each sector *j*. The larger the multiplier or backward linkage, the more integrated the sector is in the economy, i.e. the sectors that use a lot of intermediate inputs from other sectors within the economy. By computing the multipliers, the study was able to determine sectors that are key to Zambia's economy.-

4.4 The Computable General Equilibrium (CGE) Model

This section presents a discussion of the methodology that has been employed to meet the objectives of this study that relate to simulations in the CGE model. Therefore, quantity and price relationships in the CGE model from a modelling perspective are discussed. The Standard IFPRI CGE model developed by Lofgren et al (2002) is used to aid simulations in this study.

4.4.1 Price Relationships in the Model

In figure 7, is a diagram showing price relationships in the base CGE model for IFPRI. The drawing and discussion draw mainly from Punt (2013) and Lofgren et al (2002). In the top right-hand corner, the price of the composite good (PQ_c) is an aggregation of the weighted average of the domestically produced goods that are sold on the domestic market (PDD_c) and the price of imports on the domestic market (PM_c). PDD_c is inclusive of domestic transaction costs (icd_c) prior to aggregation. The price of imports (PM_c) is a product of world import prices (PWM_c) and the exchange rate (EXR) and is inclusive of import tariff (TM_c) and import transaction costs $icm_{CT,C}$. where *CT* is the transaction service commodity accounts. Formally, PM_c is given by:

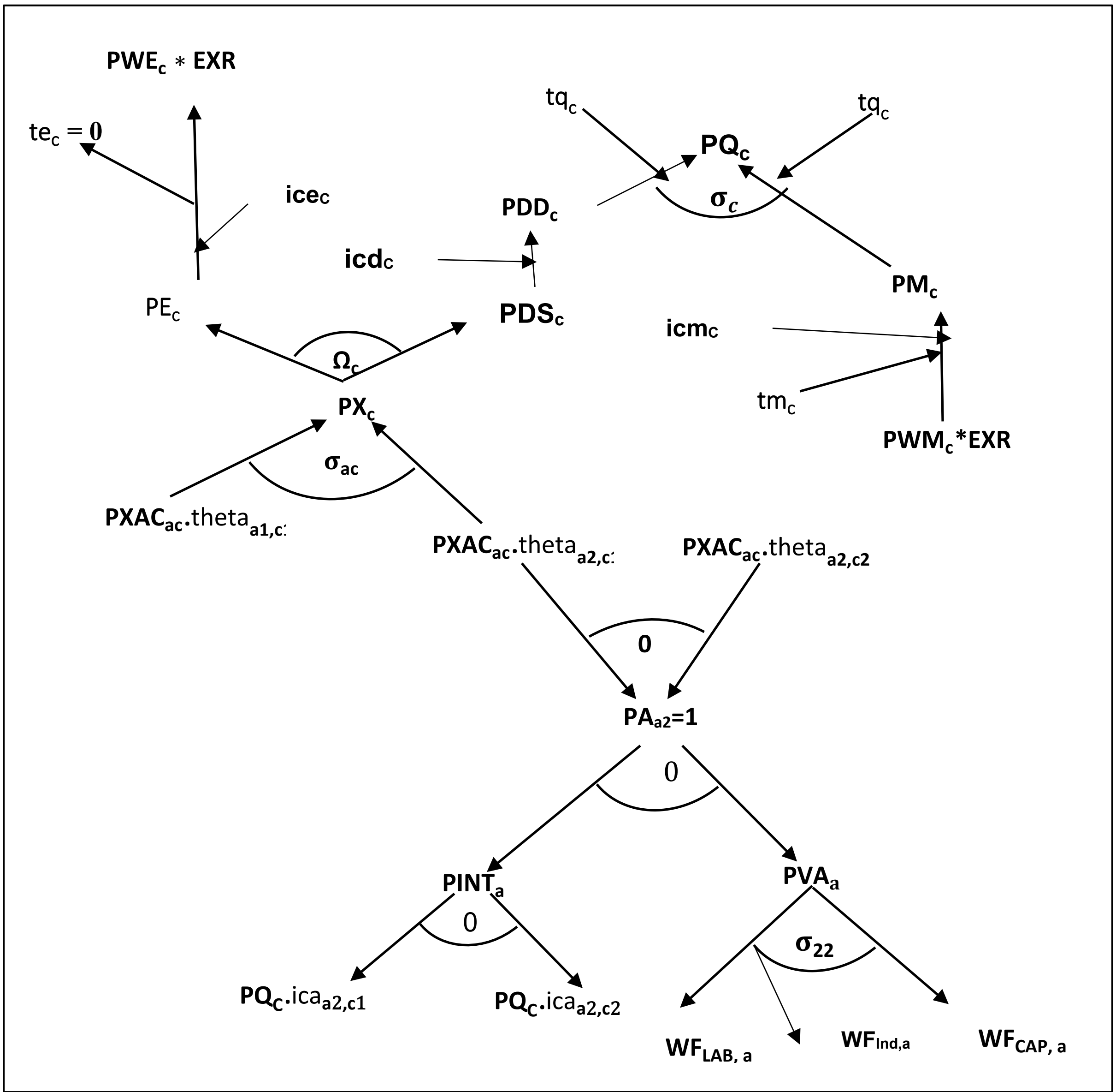
$$PMc = pwm_c.(1 + tm_c).EXR + \sum_{CT} PQ_{CT}\,.icm_{CT,C}$$

Given that the composite product is a constant elasticity of substitution (CES, σ) aggregate of the domestic goods and imports, thus both products must sell at the same price. The composite price (PQ_c) is valued at purchaser's price because it is inclusive of product taxes, transport costs and margins.

The producer price (PX_c) is an aggregation of the weighted average of supply prices of domestically produced products sold on the domestic market (PDS_c) and price of domestically produced products sold in the export market (PE_c). The weights are determined through constant elasticity of transformation (CET, Ω) function and its first-order condition in determining products destined either for the export market or local market. The domestic export price (PE_c) is a product of the world price of exports (PWE_c) and the prevailing exchange rate (EXR) less export taxes (te_c) and export transaction cost ($ice_{CT,C}$). Formally, the price of domestically produced products sold in the export market (PE_c) is given by:

$$PE_c = pwe_c.(1 - te_c).EXR - \sum_{CT} PQ_{CT}.ice_{CT,C}$$

Figure 7: Price relationships in the Model



Source: Adapted from Punt (2013)

The average price per unit of output received by an industry (PA_a) is given by the weighted average of the producer prices per product as produced by each industry ($PXAC_{ac}.\theta_{ac}$), where the weight of the product (θ_{ac}) in the industry output mix is fixed. The mathematical formulation for PA_a is given by:

$$PA_a = \sum_C PXAC_{ac} \,.\, \theta_{ac}$$

After accounting for indirect production taxes, the average price received per unit of output by an industry (PA_a) is composed of the price of value-added (PVA_a) and the price of aggregate intermediate inputs ($PINT_a$). The price of value-added (PVA_a) is the amount payable to labour ($WF_{lab,a}$), returns to capital ($WF_{cap,a}$) and rents to land ($WF_{lnd,a}$) per industry (*a*). The price of aggregate intermediate inputs (PINTa) is the weighted sum of the prices of each individual intermediate input ($PQc.ica_{ac}$), where the weight is (ica_{ac}). The formal mathematical expression for $PINT_a$ is given by:

$$PINT_a = \sum_C PQ_c \,.\, ica_{ca}$$

The relationship between the supply price of domestically produced commodities sold on the domestic market (PDS_c) and the demand price for domestically produced commodities sold locally (PDD_c) is important for this study. Formally the relationship is as follows:

$$PDD_c = PDS_c + (\sum_{CT} PQ_{CT} \,.\, icd_{CT,C})$$

Clearly, PDS_c is valued at producer prices while PDD_c is a transitionary purchaser's price. Because at this point PDD_c is not yet inclusive of sales tax, but it is inclusive of domestic transaction costs. Therefore, the simulation that reduces domestic transaction cost in this study is expected to have a direct impact on both, PDS_c and PDD_c. It is clear from the above equation that reducing the transact cost component of the equation dcreases PDD_c. Moving the left-hand side domestic transaction cost component to the right provides more intuitive meaning of the impact on PDS_c as shown below:

$$PDD_c - (\sum_{CT} PQ_{CT} \,.\, icd_{CT,C}) = PDS_c$$

It is clear from the equation that reducing the domestic transaction cost component increases the supply price of domestically produced commodities sold on the domestic market. This is because the per-unit cost of supplying the commodities declines, therefore, the price received by producers must rise. Thus, $icd_{CT,C}$ represents a wedge between PDS_c and PDD_c.

The prices that have been discussed find an equilibrium based on the assumption of profit maximization by producers subject to constant returns to scale and thus perfectly competitive markets.

4.4.2 Quantity Relationships in the Model

Figure 8 illustrates the quantity relationships in the IFPRI CGE model. The diagram and discussion of the behavioural and quantitative relationships draw from Punt (2013) and Lofgren et al (2002).

As shown in the figure, domestic supply (QQ_c) is a combination of domestic production (QD_c) and imports (QM_c), thus in the literature QQc is often referred to as the composite good supplied domestically. The aggregation of QD_c and QM_c to form QQ_c is governed by the constant elasticity of substitution function CES and the relevant first-order condition which helps us obtain the equilibrium quantities. The proportions of QD_c and QM_c in QQ_c is dependent on the relative prices of the two goods, thus if the relative prices change, consumers will substitute between the two goods according to the CES. The mathematical determination of QQ_c based on the CES is given by:

$$QQ_c = \alpha_c^q . \left(\delta_c^q . QM_c^{-\rho_c^q} + \left(1 - \delta_c^q\right). QD_c^{-\rho_c^q}\right)^{-\frac{1}{\rho_c^q}}$$

Where α_c^q is an efficiency shift parameter, ρ (rho) is the substitution parameter and δ (delta) is the distribution parameter. The nature of the actual elasticity σ (sigma) is connected to the substitution parameter ρ (rho) through the following mathematical expression:

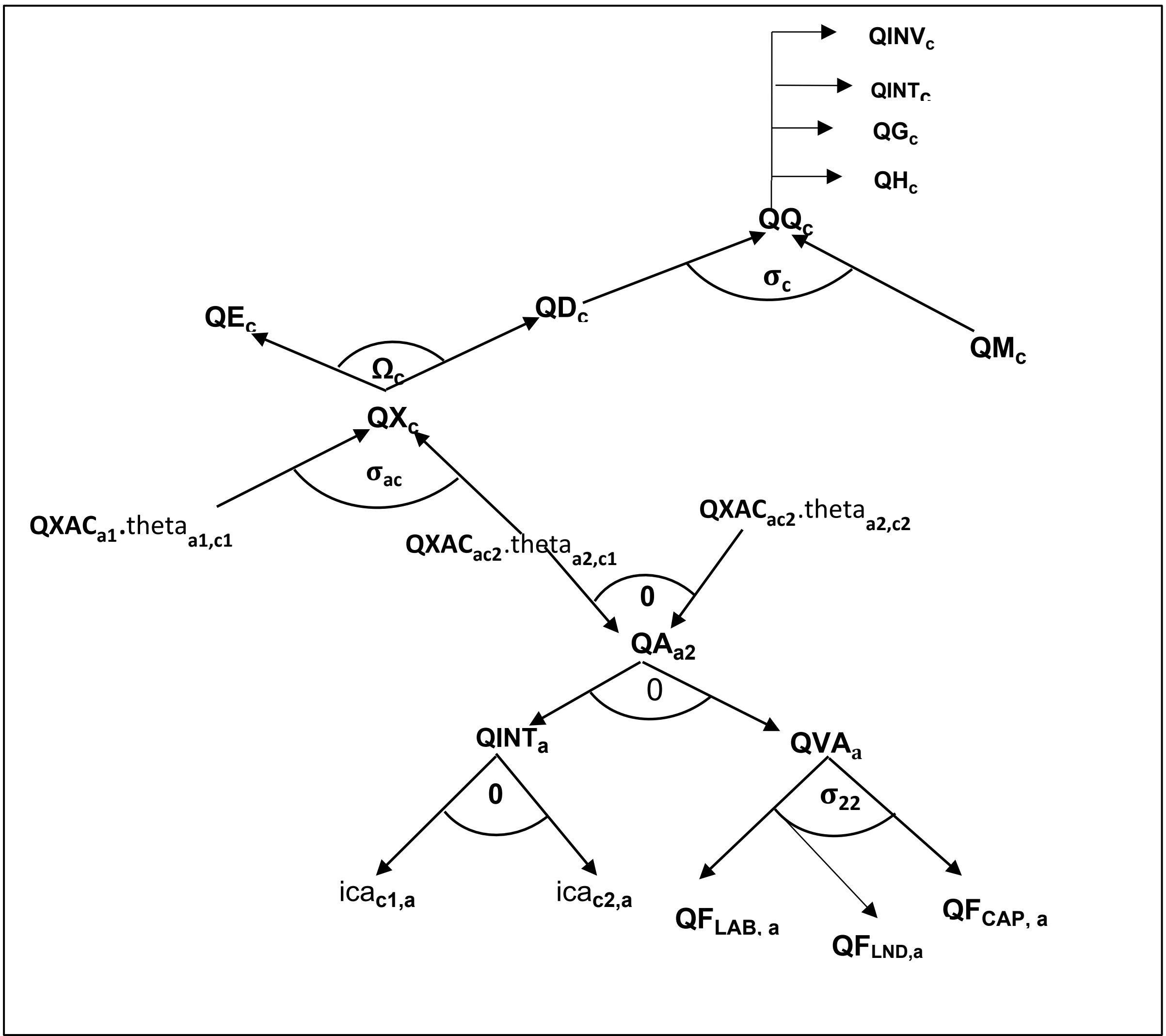
$$\sigma = \frac{1}{1+\rho} \text{ , } 0 < \sigma \leq \infty$$

As indicated, the actual equilibrium quantity is determined through the first-order condition of the CES, as well as the relative prices of domestically produced goods (PDD_c) and imports (PM_c) as shown below:

$$\frac{QM_c}{QD_c} = (\frac{PDD_c}{PM_c} . \frac{\delta_c}{1 - \delta_c})^{1/(1+\rho_c)}$$

Where ρ (rho) is a substitution parameter and δ (delta) is the distribution parameter. In equilibrium, the composite good (QQ_c) is equal to total domestic demand, i.e. intermediate demand ($QINT_c$), household final consumption (QH_c), government consumption (QG_c) and investment demand ($QINV_c$).

Figure 8: Quantity diagram based on IFPRI model



Source: Adapted from Punt (2013)

The total domestic output (QX_c) is either sold on the domestic market as represented by QD_c or is exported to other countries as QE_c. The actual distribution of QD_c and QE_c from QX_c is governed by the constant elasticity of transformation (CET). The CET formulation is given by:

$$QX_c = \alpha_c^t . \left(\delta_c^t . QE_c^{\rho_c^t} + (1 - \delta_c^t). QD_c^{\rho_c^t}\right)^{\frac{1}{\rho_c^t}}$$

The nature of the actual elasticity Ω (omega) is connected to the substitution parameter ρ (rho) through the following mathematical expression;

$$\Omega = \frac{1}{\rho - 1} , 0 \leq \Omega \leq \infty$$

The actual equilibrium quantities are determined through the first-order condition of the CET, as well as the relative prices of the products in the domestic market (PDD_c) and the export market (PE_c), which is shown below:

$$\frac{QE_c}{QD_c} = (\frac{PE_c}{PDS_c} . \frac{1-\delta_c^t}{\delta_c^t})^{\frac{1}{\rho_c^t - 1}}$$

Although the SAM data for the IFPRI model that is used in this study has got no secondary production, the model allows for multi-product industries, because one product can be produced by more than one industry. Thus, aggregate marketed production of any commodity $QXAC_{ac}$ is an aggregate of the marketed output of each commodity from all the industries producing the commodity. The aggregation is governed by the CES and the optimal combinations derived through the first-order condition, as well as influenced by the relative prices for a product in each industry. The CES function formulation is as follows:

$$QX_c = \alpha_c^{ac} . (\sum_a \delta_{ac}^{ac} . QXAC_{ac}^{-\rho_c^{ac}})^{-\frac{1}{\rho_c^{ac} - 1}}$$

Where α_c^{ac} is an efficiency shift parameter, δ_{ac}^{ac} is a share parameter for the domestic commodity aggregation function and ρ_c^{ac} is the domestic commodity aggregation exponent. The optimal combination of quantities of the commodity from each industry is dependent on the cost of inputs used to produce the commodity in each industry ($PXAC_{a,c}$) and the output price of the commodity (PX_c) through the first-order condition as follows:

$$PXAC_{ac} = PX_c . QX_c (\sum_a \delta_{ac}^{ac} . QXAC_{ac}^{-\rho_c^{ac}})^{-1} . \delta_{ac}^{ac} . QXAC_{ac}^{(-\rho_c^{ac} - 1)}$$

The production of each product by each industry ($QXAC_{\mathbf{ac}}.\theta_{\mathbf{ac}}$) can be aggregated over each product to obtain total industry output (QA_a), this aspect permits secondary production. Each product is a fixed proportion of the total industry output (QA_a), and thus the aggregation is done through the Leontief production function. The Leontief production function implies that as input use increases industry output increases by the same proportion.

In the upper level of the production nest, industry output (QA_a) is a Leontief technology aggregation of intermediate inputs ($QINTA_a$) and quantity of value-added (QVA_a), the actual combination of $QINTA_a$ and QVA_a to produce QA_a varies across industries. Individual intermediate input shares ($ica_{\mathbf{c,a}}$) are aggregated in fixed proportions (Leontief) over each commodity to obtain total intermediate input ($QINTA_a$). In terms of the demand for intermediate inputs that are combined with primary factors to make value-added, their demand is expressed through a standard Leontief function as shown below:

$QINT_{ca} = ica_{c,a} . QINTA_a$; where $QINT_{ca}$ is the quantity of commodity *c* used as intermediate inputs in activity *a.*

The Leontief production function means there is no substitution between individual intermediate inputs but are instead used in fixed proportion as shown formally below:

$$QVA_a = iva_a . QA_a$$

$$QINTA_a = inta_a . QA_a$$

Where iva_a is the proportion of value-added in the industry output (QA_a), and $inta_a$ is the proportion of intermediate inputs in industry output (QA_a).

Finally, the amount of value-added in the lower level of the production nest (QVA_a), is a CES aggregation of the three primary factors: labour ($QF_{lab,a}$), capital ($QF_{cap,a}$) and land ($QF_{lnd,a}$). The actual CES function elasticity of substitution (σ) is fixed between the three factors but varies across industries. The first-order condition for the CES allows us to obtain the optimal allocation across industries, and this is influenced by the relative factor prices. The multi-factor CES aggregation function is shown below:

$$QVA_a = \alpha_a^{va} . (\sum_{f \in F} \delta_{fa}^{va} . QF_{fa}{}^{-\rho_a{}^{va}})^{-1/\rho_a^{va}}$$

Where α_a^{va} is an efficiency parameter, δ_{fa}^{va} is the CES value-added share parameter for factor *f* in activity *a* and QF_{fa} is the quantity demanded of factor *f* in activity *a*.

Given that the model assumes perfectly competitive markets, industries find it profitable to demand for primary factors of production until the marginal cost is equal to the marginal value product in equilibrium. The factor and price demand relationship is depicted below:

$$WF_f . WFDIST_{fa} = PVA_a(1 - tva_a) . QVA_a . (\sum_{f \in F} \delta_{fa}^{va} . QF_{fa}{}^{-\rho_a{}^{va}})^{-1} . \delta_{fa}^{va} . QF_{fa}^{(-\rho_a{}^{va} - 1)}$$

Where WF_f is the average wage rate (marginal cost) of factor *f* and $WFDIST_{fa}$ is the wage distortion factor which captures the difference in wage earned by the same factor in different industries. PVA_a is the price of value-added, i.e. per unit industry expenditure on primary factors.

4.4.3 CES and CET Elasticities in the Model

In chapter two it was highlighted that CGE models suffer from an elasticity estimation problem, because of the difficulties in econometrically determining current elasticities for each study. Thus, in this study, the elasticities for the CES and CET functional forms are based on studies done by other researchers on Zambia (e.g. Fontana, 2002; Thurlow & Wobst, 2006). The elasticities in these studies are intuitively meaningful.

As indicated earlier, the composite good supplied in the economy is a CES aggregation of goods that are produced domestically and sold on the domestic market and imported goods. The CES governing this aggregation in this study was 3.0 for primary agriculture products, 0.75 to 3 for industrial products and 0.5 to 2 for services. It was also indicated that total domestic supply is either sold domestically or exported. The CET function governs the distribution of what quantity of goods are sold domestically and what quantity is exported. The elasticities for this function in the study was 1.25 for primary agriculture commodities, 1.25 for industry and 0.5 to 2 for services. It is important to note that the relative prices of the sets of goods are important for determining the optimal allocations. The elasticities are presented in table 6 below.

Table 6: CET and CES Elasticities for International Trade

	CET	CES
Agriculture	1.25	3
Industry	1.25	0.75 - 3
Services	0.5 - 2	0.5 - 2

Source: Own estimates based on literature.

In terms of production, the CES governs the combining of primary factors to form value-added, in this study the actual elasticity is set at 0.75 for primary agricultural activities. It ranged between 0.5 and 2 for the rest of the activities.

4.4.4 Modelling Transaction Costs

In the model transaction costs are captured as a proportion of total commodity supply in the economy. Transaction services are required to move commodities from producers to demanders. The model allows for the disaggregation of transaction costs according to costs incurred in moving commodities from the border to the domestic demanders (import transaction costs), costs incurred in moving commodities from domestic producers to the border (export transaction costs) and costs incurred in moving commodities from domestic producers to domestic demanders (domestic transaction costs). The mathematical model formulation is shown below:

$$QT_c = \sum_{CT}(icm_{CT,C} \,.\, QM_c + ice_{CT,C}.\, QE_C + icd_{CT,C}.\, QD_C)$$

Where QT_c is the quantity of commodity demanded as transactions service input. $icm_{CT,C}$ is a parameter for import transaction costs, $ice_{CT,C}$ is a parameter for export transaction costs and $icd_{CT,C}$ is a parameter for domestic transaction costs. Therefore, as earlier stated data changes to the Zambia SAM was done, to disaggregate the transaction costs account into its components of imports, exports and domestic.

In this study, the simulation relating to reducing domestic transaction costs took the form of scaling down the parameter $icd_{CT,C}$ by 30% for primary agricultural commodities only. This is because the interest of the study is only to assess the benefits of reducing transaction costs incurred in moving agricultural commodities from domestic producers to domestic demanders.

4.4.5 Modelling Agricultural Capital

In this study, the increase in agricultural capital from a modelling perspective is achieved by increasing the variable representing the quantity of factors demanded by each industry $QF_{f,a}$ by 30%. The increase is then specified to be applied for primary agricultural commodities only. The choice of 30% is based on this writer's observation about increasing capital in Zambia's agricultural sector as already highlighted in the statement of the problem.

4.5 Summary

This chapter presented a detailed description of the dataset and modelling framework employed in the study. The chapter has further discussed how the determination of SAM multipliers is achieved, and how they are important for discussing structural characteristics of the Zambian economy. CGE model behavioural relationships involving the determination of prices and quantities have been discussed, the important point to note is that there are many other functional forms that determine behavioural relationships in CGE models.

The chapter has also touched on the choice of elasticities and how the simulations are practically implemented in the model. The essence of the chapter was really to explain in detail the process that is involved in generating results in order to meet the objectives of the study.

Chapter 5

Presentation of Results and Insights

5.1 Introduction

In this chapter the results of the study are presented and discussed. First, the chapter presents and discusses results relating to sub-objective 1. This entails presentation and discussion of the analysis of the Zambia SAM for 2007 and the multipliers developed thereof. The discussion of the results relating to the CGE model, start with a description of the simulation scenarios and the model closures selected.

The rest of the results are then subsequently presented and discussed starting with results relating to simulation number 1, i.e. reduction in domestic transaction costs in Zambia's agricultural sector. The results relating to the simulation on increasing agricultural capital are then discussed. The chapter then proceeds to present results relating to the last simulation, i.e. a combined simultaneous simulation of the first two simulations. The chapter ends with a summary.

5.2 SAM Multipliers

In table 7, the output multiplier reports the economy-wide effect on production of a change in exogenous demand of a specific commodity. Using the *activity-by-commodity* submatrix, the column totals of the submatrix represent the total effect on industry output of a one-unit change in specific commodity exogenous demand. The output multiplier combines all direct, indirect and induced effects of a one-unit change in specific commodity exogenous demand across multiple rounds and reports the final increase in gross output of all production activities. The description of the commodity accounts in table 7 can be found in the appendix.

For instance, if the demand for the livestock commodity increased by ZMW1 billion, industry output in the economy will increase by ZMW3.60 billion. The livestock commodity has the largest multiplier, this is due to fewer import leakages associated with the commodity. In Zambia major livestock commodity like cattle, cannot be exported due to diseases of economic importance such as Contagious Bovine Pleuropneumonia (CBPP) and Foot-and-Mouth Disease (FMD). Hence most of the local demand is met by local production, with limited imports.

Table 7: Structural Characteristics (SAM Multipliers)

Commodity	cmaiz	crice	cocer	ccass	croot	cpuls	chort	ctoba	ccott	csugr	cocrp	clive	cpoul	cfore	cfish
Output multipliers	2.97	2.90	3.24	3.50	3.40	3.36	3.15	2.72	3.43	2.40	2.59	3.60	3.46	3.01	2.90
Value-added multipliers	1.54	1.48	1.70	1.80	1.74	1.85	1.58	1.40	1.83	1.09	1.19	1.84	1.53	1.54	1.29
Income multipliers	1.77	1.72	1.91	2.04	1.97	2.09	1.81	1.63	2.05	1.33	1.42	2.04	1.73	1.79	1.47
Commodity	cmine	cmeat	cmill	csugp	cfood	cbeve	ctobp	ctext	cwood	cpetr	cchem	cnmet	cmetl	cmach	coman
Output multipliers	2.72	3.42	3.41	2.74	2.93	1.76	1.26	2.11	2.67	2.00	0.80	1.70	1.00	0.52	0.76
Value-added multipliers	1.09	1.43	1.44	1.13	1.16	0.77	0.55	0.87	1.11	0.79	0.37	0.70	0.44	0.25	0.34
Income multipliers	1.30	1.64	1.68	1.36	1.37	0.94	0.64	1.03	1.33	0.94	0.43	0.83	0.51	0.29	0.40
Commodity	ccons	celec	cwatr	ctrad	chotl	ctran	ccomm	cfsrv	cbsrv	creal	cgsrv	ceduc	cheal	cosrv	
Output multipliers	2.95	3.08	3.09	3.17	3.33	1.40	2.21	2.43	2.65	3.31	3.31	3.30	3.30	2.89	
Value-added multipliers	1.43	1.32	1.34	1.52	1.51	0.64	1.15	1.26	1.25	1.46	1.70	1.71	1.69	1.67	
Income multipliers	1.71	1.56	1.59	1.76	1.77	0.75	1.40	1.54	1.48	1.73	1.92	1.92	1.91	1.95	

Source: Own calculations based on the 2007 Zambia SAM by Chikuba et al (2013)

Thus, when the demand for livestock increases, most of the increased incomes to households through linkages is spent locally, thus the SAM multiplier tends to be large with respect to livestock. In addition, the commodity also has good backward linkages, as most of the major livestock inputs are produced locally, and the country also has significant livestock processing, such as butcheries, sausage production, mince and more.

For other primary agricultural commodities, cassava and cotton have higher multipliers, the explanation for the high multipliers is the same as that for livestock above. Basically, the value chain for these crops is not affected by high import leakages and have good backward linkages.

In terms of sectoral comparison, primary agricultural commodities have generally higher multipliers than industrial and manufactured commodities. The only exception is food processing of meats and mill which have special characteristics as already alluded to. For example, the multipliers for mining which is 2.72 is lower than that of most agricultural commodities. This indicates the lack of transformation in the Zambian economy as shown in chapter three of this study. Further, the commodity with the lowest SAM output multiplier is machinery and vehicles. For this product, a ZMW1 billion increase in demand only increases total output in the economy by ZMW0.52 billion. The lower multiplier reflects high import leakages because there is very little or no production of these products in Zambia. The service sector generally has higher multipliers than the industrial sector. This reflects the significance of the service sector in the economy as explained in chapter three.

In terms of income multipliers, they measure the total change in income in the economy when there is a one-unit change in exogenous demand of a specific commodity. In table 7 for example, if the demand for livestock commodities increased by ZMW1 billion, total income in the economy rises by ZMW2.04 billion. In table 7 for example, if the demand for livestock commodities increased by ZMW1 billion, total income in the economy rises by ZMW2.04 billion. Again, the livestock commodity together with “pulses and oilseeds” have the highest income multipliers. This is due to lower import leakages and backward linkages.

The commodity associated with the lowest SAM income multiplier is machinery and vehicles. A ZMW1 billion increase in demand for machinery and vehicles only increases total income in the economy by ZMW0.29 billion. As indicated, this lower multiplier is a result of higher import leakages and lower backward linkages. The size of the income multipliers, by comparison, follow the same trend as that of output multipliers.

The value-added multiplier measures the total change in value-added or factor incomes caused by a one-unit change in exogenous demand of a specific commodity. In table 7, a

ZMW 1 billion increase in livestock commodities demand causes the total value-added in the economy to rise by ZMW1.84 billion. Livestock together with “pulses and oilseeds” have the largest value-added multiplier. Because of lower import leakages and backward linkages. Machinery and vehicles commodities have the smallest multiplier of ZMW0.25 billion. The multiplier is lower for reasons already alluded to in the income multiplier case.

The important point to note is that the Zambian economy is still predominantly agricultural led, thus structural transformation as described in the literature has not yet taken place. Given the higher multipliers for primary agricultural commodities, the agricultural sector is the right place to focus on to achieve economic development. The simulation results are presented in the next section.

5.3 CGE Model Results

5.3.1 Scenarios

As indicated already, three simulations are implemented in this study. The first is reducing transaction costs in the agricultural sector, second is increasing capital in the agricultural sector and the third is a combined simulation of the first two simulations.

Reduction in Agricultural Transaction Costs (SIM1)

This scenario is based on developments in Zambia’s agricultural sector as indicated in the statement of the problem. Basically, in Zambia’s 7th National Development Plan, the country is working toward reducing market coordination failures, this includes adequate provision of public goods such as roads and more. In particular, the country is introducing the warehouse receipt system in the agricultural sector. All these programs reduce transaction costs.

Therefore, a 30% reduction in domestic transaction costs in the agricultural sector is implemented. From a modelling perspective, the scenario entails reducing the parameter $icd_{CT,C}$ for primary agricultural commodities in the model by 30%.

Increase in Agricultural Capital (SIM2)

The scenario for increasing agricultural capital is also based on developments in Zambia’s agricultural sector. This was already highlighted in chapter 1 of this study. In short, it is based on the rising “investor farmers” who include civil servants, retired people, rising small scale farmers as well as foreign nationals from China, Namibia and South Africa. These farmers bring with them savings that they invest in farm machinery. This aspect is observed in the increasing farm size in the country. Interest is placed on the rise in agricultural capital after 2007, as shown in chapter 3.

Thus, a 30% increase in agricultural capital is introduced in the model to assess the impact. This entails increasing the quantity of capital that is used by agricultural industries represented by the variable $QF_{f,a}$ in the model.

Combined Simulation (SIM3)

Based on theory reviewed in chapter three, it was made clear that increasing technology in agriculture (production side) alone is a good thing but the impact on economic development would be much higher if this is complemented with a reduction in transaction costs (market side). Structural transformation and thus economic development would be enhanced if the two policies are implemented simultaneously. Hence, SIM3 is designed to test the theory.

From a modelling perspective, SIM3 entails the introduction of the third simulation which simply combines the first two simulations.

5.3.2 Model Closures

CGE models are a set of equations that must be solved simultaneously, therefore in order to ensure that a solution is found, the number of single equations must be equal to the number of system variables. If there is no equivalence between variables and equations, some variables must be fixed. The fixing of variables must reflect assumptions about the economy in question. The model has four equilibrium conditions. The goods market equilibrium condition for demand and supply, the factor market equilibrium for demand and supply of factors, the current account balance and the savings-investment balance. Thus, the model has the following macro-closures:

- First, with respect to the savings-investment balance, savings is assumed to be investment-driven, i.e. investment is fixed, thus it depends on the variation in the savings from households and corporations.
- Government savings, transfers and tax rates are assumed to be fixed at the base levels, thus what adjusts is government consumption.
- In the case of the current account balance, exchange rates are assumed to be flexible, thus the foreign savings are fixed.
- Capital is assumed to be fully employed and activity-specific; what adjusts is the rent distortion factor. The closure is necessitated since we are changing capital for a specific industry in our simulation.
- Labour is assumed to be unemployed and mobile; the assumption is based on the economic realities in Zambia where unemployment is prevalent for both skilled and unskilled labour.

- Land is assumed to be fully employed and mobile; land is mobile because it can be put to a different use, i.e. mobility between agricultural activities.
- The consumer price index is variable in the model because we are making changes to transaction costs which is a component of prices. What is fixed is the index for producer prices (DPI).

5.3.3 Results

This section presents the results of the three policy simulations. The presentation of the results takes the form of looking at the output effects, price effects, income effects and finally the macro-effects of each simulation. Sensitivity analysis is finally conducted to ascertain the validity of model results.

5.3.3.1 Output Effects (SIM1)

Table 8: Output Effects on Primary Agriculture (SIM1)

Agriculture	Simulation 1 %Change							
	QD	QA	QX	QQ	QE	QM	QINT	QVA
Maize	2.62	1.73	1.73	2.64	-8.26	9.73	1.73	1.73
Rice	1.77	1.19	1.19	1.77	-7.80	0.86	1.19	1.19
Other cereals	3.25	3.24	3.24	2.47	-1.17	-9.30	3.24	3.24
Cassava	3.70	3.70	3.70	3.70	0.00	0.00	3.70	3.70
Other root crops	2.74	2.74	2.74	2.69	-6.62	1.21	2.74	2.74
Pulses and oilseeds	2.07	1.68	1.68	2.16	-9.56	7.14	1.68	1.68
Horticulture	2.23	2.22	2.22	2.26	-2.98	3.43	2.22	2.22
Tobacco	0.94	-5.88	-5.88	0.91	-8.97	-5.66	-5.88	-5.88
Cotton	1.04	-3.20	-3.20	1.05	-9.93	2.02	-3.20	-3.20
Sugarcane	2.13	2.13	2.13	2.13	-2.35	-8.92	2.13	2.13
Other export crops	6.54	2.14	2.14	1.47	0.81	-6.36	2.14	2.14
Livestock	4.66	4.65	4.65	4.63	3.60	-11.53	4.65	4.65
Poultry	6.46	6.44	6.44	4.82	6.16	-11.39	6.44	6.44
Forestry	0.43	0.43	0.43	0.43	-0.26	-6.77	0.43	0.43
Fisheries	7.36	7.36	7.36	7.35	6.35	-13.11	7.36	7.36

Source: Own table based on simulation results

In table 8, results relating to the impact of reducing transaction costs in primary agriculture are presented. In the model, domestic transaction costs are modelled as parameter shares of the quantity produced and sold domestically (QD) and represent a wedge between the price of domestically produced commodities sold on the domestic market (PDD) and the producer price (PDS). Therefore, the direct effect of reducing transaction costs on primary agricultural commodities is to reduce PDD for primary agricultural commodities. From the quantity perspective, the reduction in PDD means that the quantity of domestically produced primary agricultural commodities sold on the domestic market (QD) is expected to increase. In table 8, QD increased for all primary agricultural commodities. With the highest increase recorded for fisheries at 7.36% and the lowest for forestry at 0.24%.

For maize and “pulses and oilseeds” QD increased even though their respective PDD did not reduce (see table 9 for PDD results). The reason is that the specified CES elasticity which combines quantity of labour, capital and land in the lower level of the production nest was too small to allow for efficient substitution between the three inputs for the two commodities. When this parameter was increased from 0.75 to 2.75 in the sensitivity analysis the change in PDD for both commodities became negative. Further, the increase in QD comes from the increase in the quantity demanded of intermediate inputs for these commodities (QINT).

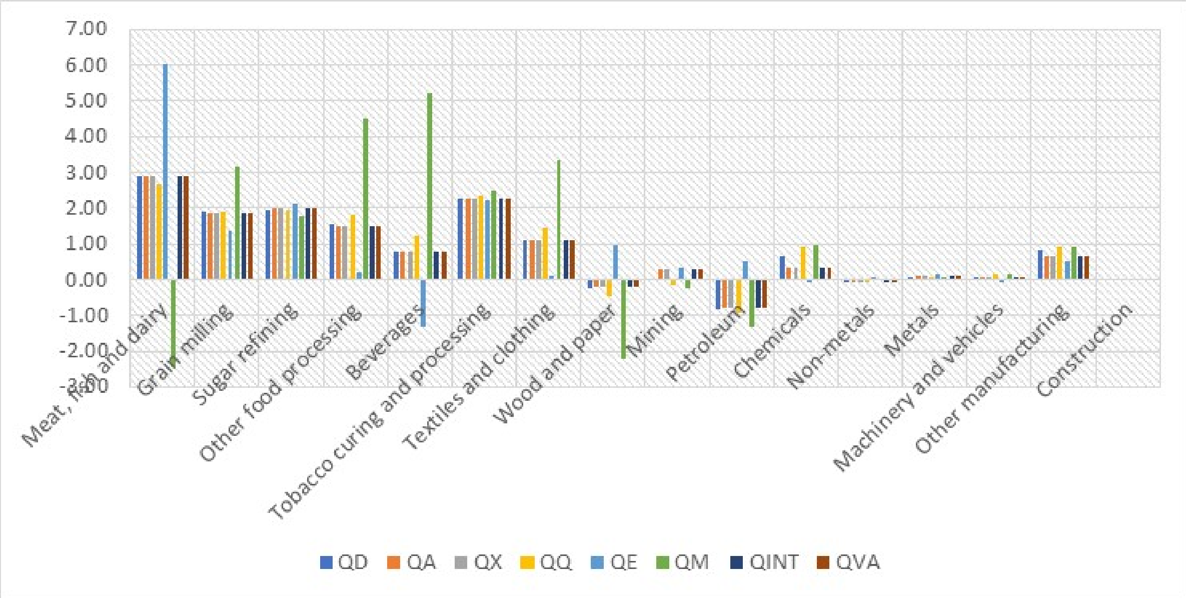
The activity level or industry commodity output (QA) is the same as the quantity of aggregate marketed commodity output (QX), because activities sell all that they produce, and the data in the Zambia SAM has no secondary production. The quantity of domestic supply (QX) is the source of QD and quantity of exports (QE) through the CET. Given that QD increased for all primary agricultural commodities. Thus, QX also increases as shown in the table. However, two commodities cotton and tobacco in table 8 experienced decreases in QX. This is because the increase in QD for these commodities was too small relative to the decrease in QE, thus the QX decreased.

Since the quantity of composite good (QQ) is a CES aggregation of QD and quantity of imports (QM). The increase in QD above causes QQ to increase. In table 8, QQ increased for all commodities, with the greatest increase recorded for fisheries at 7.35%. When QQ increases, it means an increase in either QD or QM depending on their relative prices. Thus, for commodities where the price of QM is higher relative to the price of QD, the quantity of imports (QM) declines as is in the case of for example sugarcane and other commodities in table 8.

The increase in QX and QA above requires that inputs used in their production must also increase. The QA is a Leontief aggregation of the quantity of intermediate inputs (QINT) and quantity of value-added (QVA). Thus, an increase in QA causes both QINT and QVA to increase by the same proportion. In table 8, the greatest increases for both variables are for fisheries at 7.36%. For commodities where QX and QA reduced i.e. tobacco and cotton, the respective QINT and QVA decreased by the same proportion.

In figure 9, the impact of reducing transaction costs for the primary agricultural sector on industry is shown. For the agricultural processing sub-sector, i.e. from “meats, fish and dairy” to “wood and paper”, the impact is similar to that for primary agricultural commodities in table 8. The main link between primary agriculture and agricultural processing is by intermediate inputs. Primary agricultural commodities are mostly used as intermediate inputs in agricultural processing. The decline in the price of primary agricultural commodities, therefore, stimulates the agricultural processing industry output (QA) except for “wood and paper”.

Figure 9: Output Effects on Industry (SIM1 %change)



Source: Own chart based on simulation results

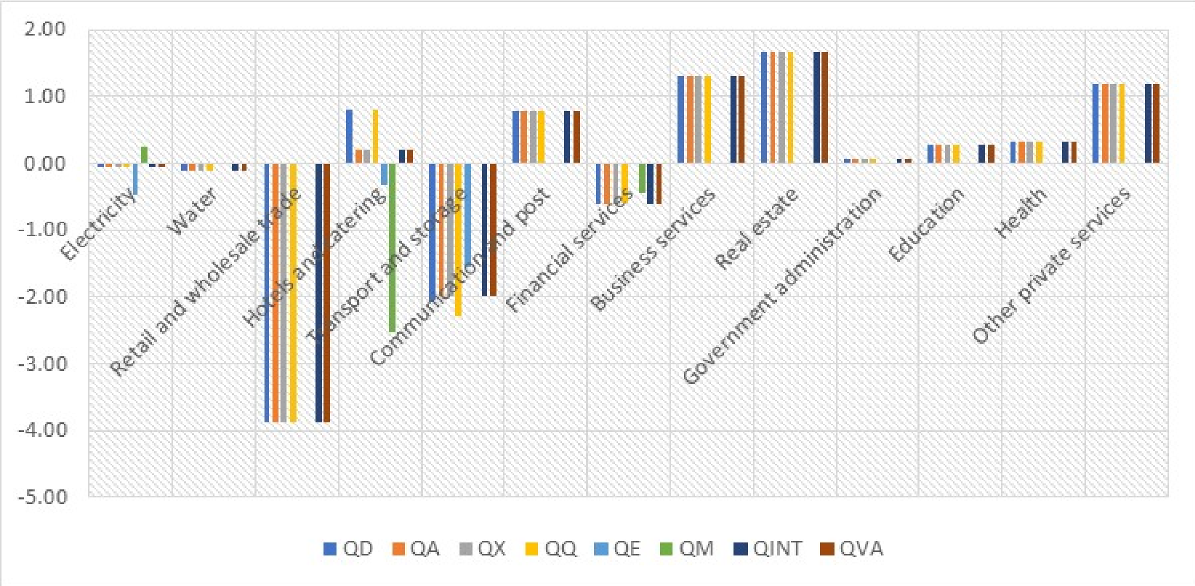
Because QA is a Leontief aggregation[1] of QINT and QVA, the increase in QA causes a proportionate increase in QVA for agricultural processing as shown. The increase in QVA for agricultural processing is important for this study as it promotes structural transformation. QX is an aggregation for each commodity produced by all industries, and because there is no secondary production QA and QX are equal, thus the increase in QA is the same as the increase in QX. The change in QX affects whether producers produce for the domestic market (QD) or the export market (QE) depending on the relative prices of the two commodities. Thus, for those commodities where the price of QD is higher relative to the price of QE, an increase in QD is observed. For the commodities where the price of QD is lower relative to the price of QE an increase in QE is observed. The increase in QD above for agricultural processed commodities causes QQ for these commodities to rise and depending on the relative prices between QD and QM and proportion of the two goods in QQ, either QM rises as is the case for most commodities or it falls. Thus, in general, QD increased for all agricultural processing commodities.

For the other activities of the industrial sector, i.e. from mining to “other manufacturing” the impact is indirect through availability and prices of other commodities. As shown in figure 9, QD for most of the commodities increased. This had an effect of stimulating QX and QA

[1] Leontief aggregation means that there is no substitution between individual intermediate inputs but that they are used in fixed proportion.

through the mechanism explained for table 8. Thus, QINT and QVA also increased for these commodities. However, high import commodities such as non-metals and petroleum experienced a decrease in QD, a decrease in QVA was also recorded for non-metals and petroleum products. High export mining commodity also experienced a decline in QD, but its QVA increased due to the increase in exports.

Figure 10: Output Effects on Services (SIM1 %change)



Source: Own chart based on simulation results

In the service sector, the effects were indirect, and the results were mixed. The important point to note is that this sector experienced an increase in the quantity of value-added (QVA) mainly in services that support agricultural processing and manufacturing. These services include among others "communication and post" and "hotels and catering". This is consistent with the theory reviewed in chapter two. The large decreases in quantities of "transport and storage" and "retail and wholesale trade" is because these are the components of transaction costs that were reduced in the simulation.

5.3.3.2 Price Effects (SIM1)

In table 9, price changes with respect to SIM1 are captured. The direct impact of SIM1 is on the PDD, which is expected to reduce. For primary agricultural commodities in the table, the demand price of domestically produced commodities sold on the domestic market (PDD) generally decreased for most of the commodities, however for two commodities maize and "pulses and oilseeds" a decrease was recorded. As already indicated, this decrease is associated with high intermediate demand from agricultural processing industries. The highest decrease in PDD was recorded for fisheries at 7.55%.

Table 9: Price Effects on Primary Agriculture (SIM1)

Agriculture	Simulation 1 %Change								
	PDD	PDS	PA	PX	PQ	PE	PM	PINT	PVA
Maize	1.47	8.71	7.96	7.96	1.46	-0.61	-0.77	-0.57	12.45
Rice	-1.08	7.61	7.12	7.12	-1.08	-0.57	-0.78	-0.89	11.74
Other cereals	-4.99	3.00	2.99	2.99	-4.75	-0.54	-0.80	-1.49	4.58
Cassava	-0.53	7.70	7.70	7.70	-0.53	0.00	0.00	-0.94	11.80
Other root crops	-1.28	7.34	7.34	7.34	-1.27	-0.56	-0.79	-1.06	11.54
Pulses and oilseeds	0.83	9.53	9.20	9.20	0.80	-0.57	-0.79	0.18	11.26
Horticulture	-0.36	3.59	3.59	3.59	-0.37	-0.65	-0.75	-0.96	6.66
Tobacco	-2.96	7.90	2.03	2.03	-2.95	-0.66	-0.75	-0.84	3.67
Cotton	-0.45	8.95	5.28	5.28	-0.45	-0.62	-0.77	-1.04	7.14
Sugarcane	-4.51	3.07	3.07	3.07	-4.51	-0.56	-0.79	-0.79	8.04
Other export crops	-4.92	3.81	0.36	0.36	-3.36	-0.68	-0.74	-1.87	3.01
Livestock	-6.19	0.23	0.23	0.23	-6.18	-0.58	-0.79	-1.89	1.29
Poultry	-6.67	-0.36	-0.38	-0.38	-6.19	-0.59	-0.78	-1.67	2.42
Forestry	-3.18	-0.11	-0.11	-0.11	-3.18	-0.66	-0.75	-0.85	0.31
Fisheries	-7.55	0.23	0.23	0.23	-7.55	-0.52	-0.79	-0.86	2.08

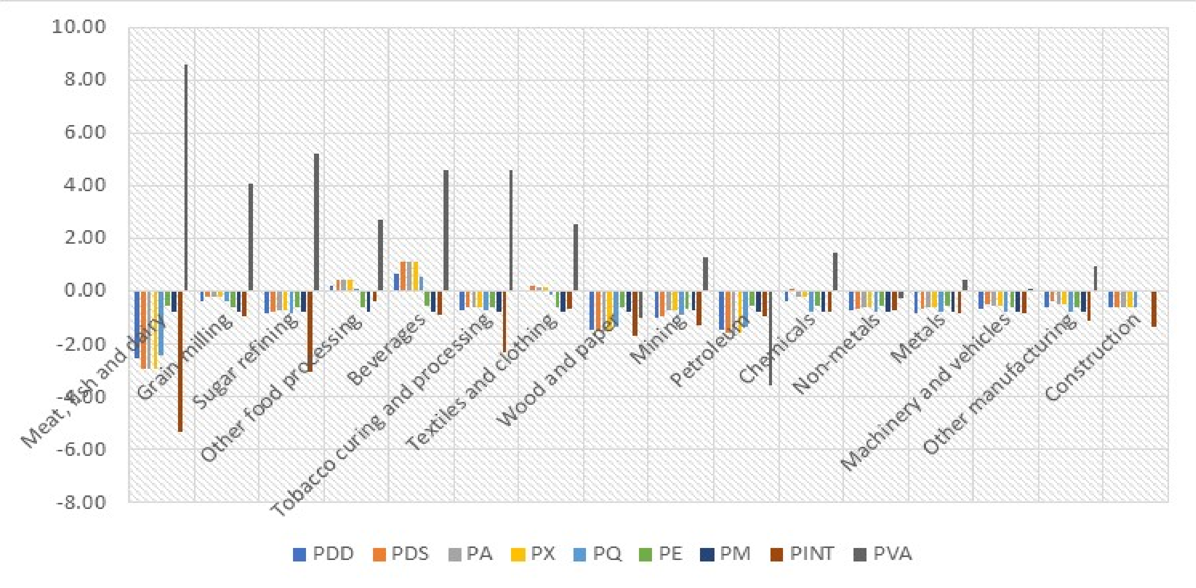
Source: Own table based on simulation results

Given that the price of the composite commodity (PQ) is a CES aggregation of PDD and price of imports (PM), the increase in PDD, therefore, causes PQ to increase. A decrease in PDD causes PQ to also decrease as shown in the table. The reduction in PQ similarly causes a reduction in PM, because both imports and domestic commodities must sell at the same price in the local market. The reduction in primary agricultural transaction costs also directly affects the supply price of domestically produced goods sold on the domestic market (PDS). Reducing transaction costs reduce the costs incurred by the farmers in delivering primary agricultural commodities to the demanders. Thus, increasing the per-unit price they receive. In table 9, PDS increased for all primary agricultural commodities but for poultry and forestry.

For the same reason given for PDS, implementing SIM1 increases industry output price (PA) and output supply price (PX). In the table, PA and PX increase except for poultry and forestry. The price of intermediate inputs (PINT) generally decreases due to the reduction in transaction costs. The expansion in the economy implies a greater demand for production factors, which generally lead to an increase in the price of value-added (PVA). Further, the increase in PDS means that the local market became more lucrative, hence more commodities are sold there. This causes the prices of exports to fall due to reduced demand.

Figure 11 shows the impact of SIM1 on the prices on industry. Besides the notable impact on PVA and PINT the impact on other prices is indirect and small. The link is on the increased output of industry stimulated by reduced prices of intermediate inputs as explained for table 8 above. Thus, the general trend for most of the prices is that of reducing. However, value-added shows an increase in price for some industries. The reason lies in selected closures for capital where it is assumed to be fully employed and activity-specific and thus the only change is in its price.

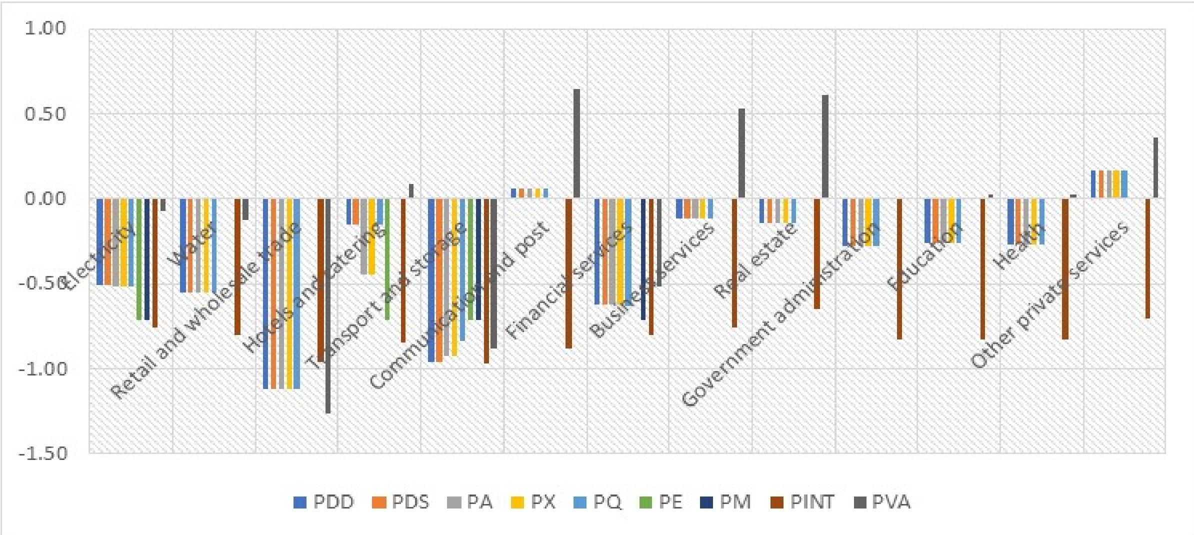
Figure 11: Price Effects on Industry (SIM1 %change)



Source: Own chart based on simulation results

Figure 12 shows the effect of SIM1 on the service sector. The impact on this sector was also indirect. Hence the reduction in most prices as shown in figure 10 is due to increased output as explained in the case of industry. However, communication and "other private services" had increases in prices. The price of value-added also showed some increases for some services, this is due to the capital closure selected where capital is assumed to be fully employed and activity-specific, so that only its price increases to achieve equilibrium.

Figure 12: Price Effects on Services (SIM1 %change)



Source: Own chart based on simulation results

5.3.3.3 Output Effects (SIM2)

Table 10 shows the output effects of the second simulation. The direct impact of increasing agricultural capital used by primary agricultural industries by 30% is on the quantity of value-added for primary agricultural industries (QVA), because the quantity of value-added for primary agricultural industries (QVA) is a CES aggregation of the primary factors which include capital. In table 10, increasing agricultural capital increases the quantity of value-added for all primary agricultural industries. The highest increase is recorded for "other export crops" at 29.75% and the lowest for the forestry industry at 2.20%. Further, the increase in QVA also increases industry output (QA), and because QA is a Leontief aggregation of QVA and the quantity of intermediate inputs (QINT), its increase means that more QINT is required. Thus, a proportionate increase in QINT is observed for all primary agricultural industries. Since the domestic supply of each commodity (QX) is obtained by summing the production of each industry for each commodity over each industry, the increase in QA also increases QX for all primary agricultural industries as shown in the table. In addition, the increase in QX in table 10 causes quantity produced for the domestic market (QD) and quantity produced for the export market (QE) to increase for all primary agricultural commodities because QX is a CET aggregation of both QD and QE.

Finally, the increase in QD above causes QQ to increase for all primary agricultural commodities because the quantity of the composite good (QQ) is a CES aggregation of QD and QM. The actual equilibrium quantities of QD and QM in QQ also depends on the relative prices of the two commodities. Therefore, the quantity of imports (QM) increased for a few primary agricultural commodities but decreased for most of them, a consequence of relative prices already alluded to.

Table 10: Output Effects on Primary Agriculture (SIM2)

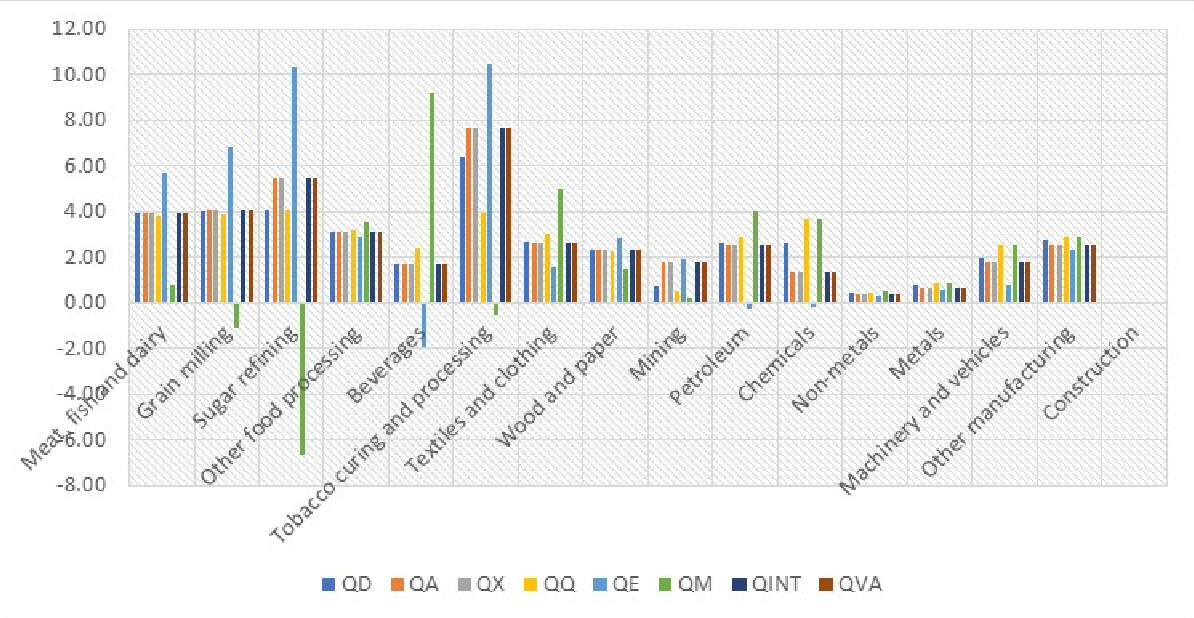
Agriculture	Simulation 2 %Change							
	QD	QA	QX	QQ	QE	QM	QINT	QVA
Maize	5.34	6.41	6.41	5.28	17.35	-14.55	6.41	6.41
Rice	4.02	5.01	5.01	3.93	18.96	-18.59	5.01	5.01
Other cereals	4.59	4.60	4.60	4.17	8.65	-2.30	4.60	4.60
Cassava	4.77	4.77	4.77	4.77	0.00	0.00	4.77	4.77
Other root crops	5.89	5.89	5.89	5.59	11.04	-2.90	5.89	5.89
Pulses and oilseeds	6.51	6.78	6.78	6.26	14.16	-6.37	6.78	6.78
Horticulture	7.29	7.30	7.30	6.92	15.09	-7.49	7.30	7.30
Tobacco	3.66	20.23	20.23	3.51	26.87	-26.27	20.23	20.23
Cotton	2.68	4.87	4.87	2.65	8.13	-6.54	4.87	4.87
Sugarcane	5.87	5.87	5.87	5.87	43.34	-38.76	5.87	5.87
Other export crops	20.21	29.75	29.75	12.70	32.44	1.16	29.75	29.75
Livestock	4.84	4.92	4.92	4.81	12.53	-8.22	4.92	4.92

Agriculture	Simulation 2 %Change							
	QD	QA	QX	QQ	QE	QM	QINT	QVA
Poultry	6.45	7.08	7.08	5.16	14.79	-7.62	7.08	7.08
Forestry	2.20	2.20	2.20	2.18	17.04	-23.59	2.20	2.20
Fisheries	5.18	5.18	5.18	5.18	8.86	-0.97	5.18	5.18

Source: Own table based on simulation results

In figure 13, the impact of increasing capital in the primary agricultural sector on industry is shown. For the agricultural processing sub-sector, i.e. from "meats, fish and dairy" to "wood and paper", the impact on quantities are large because these industries use more of primary agricultural commodities as intermediate inputs.

Figure 13: Output Effects on Industry (SIM2 %change)

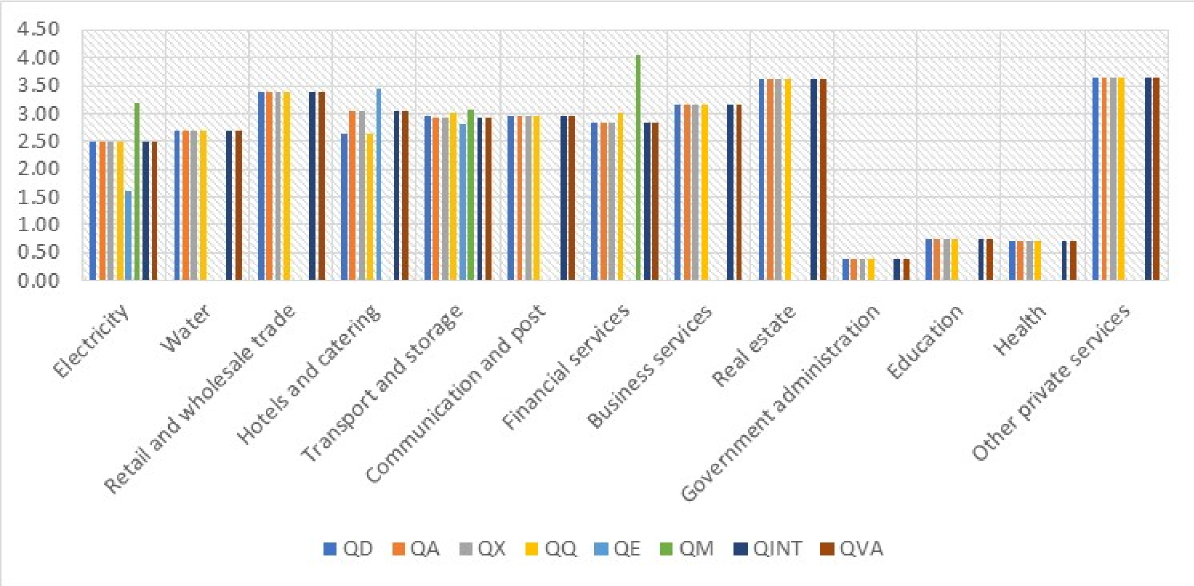


Source: Own chart based on simulation results

The general trend is that all quantities increased. The only exception is for the quantity of imports (QM) which declined for grain milling, sugar refining and "tobacco curing and processing" commodities. The reason is that SIM2 causes more local processing of these commodities as they are capital intensive. As locally processed commodities become available their prices reduce and thus consumption of competitive imports must reduce.

For the other elements of the industrial sector, i.e. from mining to "other manufacturing" the impact is also indirect and small. The important point to note is that value-added increased for all industries; an important element for structural transformation.

Figure 14: Output Effects on Services (SIM2 %change)



Source: Own chart based on simulation results

In figure 14, in the service sector the effects where indirect, however, all outputs increased. The relationship and changes in quantity variables follow the mechanism already explained. The important point to note is that this sector experienced an increase in value-added (QVA) for all services. The major increase in QVA was in services that support industrial expansion.

5.3.3.4 Price Effects (SIM2)

In figure 11 the direct effect of increasing capital used in primary agriculture is on the quantity of value-added for primary agriculture industries (QVA) which increases. Therefore, the impact on prices starts on the price of value-added (PVA) which decreases due to the downward pressure on specifically the price of capital used by primary agriculture. The impact on other prices is due to the increase in quantities already reported in table 10.

The important observation about the impact of increasing capital use in agriculture is the increase in the price of imports for all agricultural commodities (PM) and as well as the increase in the price of all agricultural exports (PE). The decrease in PM is partly due to the depreciation in the exchange rate in this simulation. The exchange rate depreciated by 1.51% in this simulation.

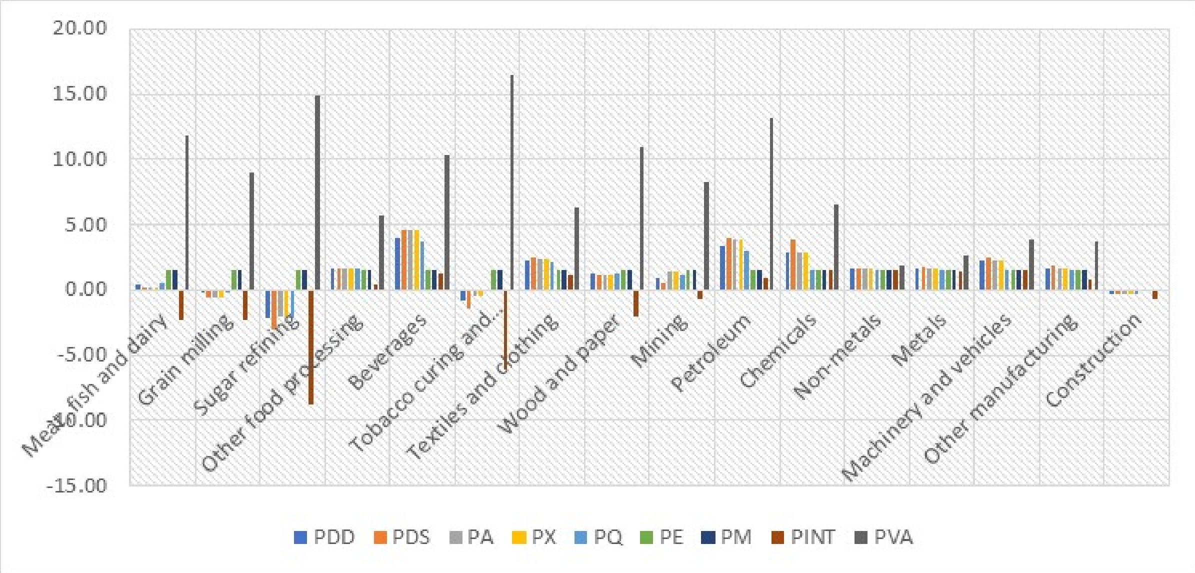
Table 11: Price Effects on Primary Agriculture (SIM2)

Agriculture	Simulation 2 %change								
	PDD	PDS	PA	PX	PQ	PE	PM	PINT	PVA
Maize	-5.35	-6.87	-6.11	-6.11	-5.33	1.54	1.49	0.62	-9.65
Rice	-6.48	-8.78	-8.09	-8.09	-6.45	1.55	1.48	0.66	-13.14
Other cereals	-0.80	-1.48	-1.47	-1.47	-0.67	1.56	1.48	1.17	-2.41
Cassava	-1.69	-2.53	-2.53	-2.53	-1.69	0	0	0.95	-4.18
Other root crops	-1.41	-2.23	-2.23	-2.23	-1.32	1.56	1.48	1.04	-3.86
Pulses and oilseeds	-2.78	-3.93	-3.74	-3.74	-2.71	1.55	1.48	-1.31	-4.29
Horticulture	-3.40	-4.02	-4.01	-4.01	-3.29	1.53	1.49	1.10	-7.47
Tobacco	-9.41	-13.62	-2.75	-2.75	-9.36	1.52	1.49	1.39	-5.13
Cotton	-1.65	-2.58	-0.92	-0.92	-1.64	1.54	1.49	1.31	-1.58
Sugarcane	-15.45	-20.30	-20.30	-20.30	-15.45	1.56	1.48	1.50	-48.37
Other export crops	-4.17	-6.05	-0.14	-0.14	-2.09	1.52	1.50	-0.02	-0.27
Livestock	-2.92	-4.04	-3.98	-3.98	-2.91	1.55	1.48	-0.78	-5.60
Poultry	-3.20	-4.40	-3.94	-3.94	-2.81	1.55	1.48	-2.63	-6.80
Forestry	-7.88	-8.91	-8.91	-8.91	-7.88	1.52	1.49	1.44	-14.77
Fisheries	-0.54	-1.18	-1.18	-1.18	-0.54	1.57	1.48	1.43	-5.64

Source: Own table based on simulation results

In figure 15, the impact of SIM2 on the prices on industry are shown, the effects were indirect. The link is on the increased output of industry stimulated by reduced prices of intermediate inputs as explained for table 8 above. However, the general trend for most of the prices is that of increasing instead of reducing. The trend is attributed to the selected closure for the consumer price index (CPI), which was assumed to be flexible. For SIM1 and SIM3 the CPI reduced by 1.10% and 0.70% respectively, however, for SIM2 the CPI increased by 0.40%. Hence the observed impact on industry prices. Further, value-added shows an increase in price for all industries. The reason lies in selected closures for capital where it is assumed to be fully employed and activity-specific and and since there is expansion but no capital increase for the non-agricultural industries, there is upward pressure on the price of capital.

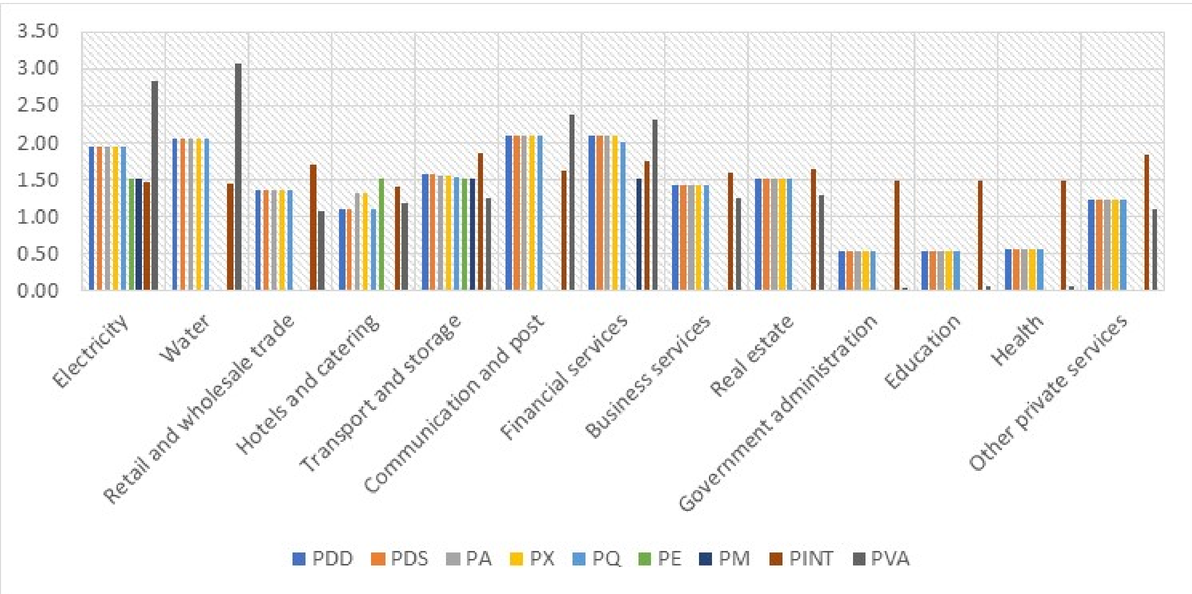
Figure 15: Price Effects on Industry (SIM2 %change)



Source: Own chart based on simulation results

For the service sector, the impact of SIM2 was also indirect (figure 16). The trend reflects an increase in all prices, this indicates increased demand for services in this simulation. Further, the increase in prices is also because of the selected closure on the consumer price index (CPI), where the CPI is made flexible. The important point, however, is that the price of value-added also showed some increases for all services.

Figure 16: Price Effects on Services (SIM2 %change)



Source: Own chart based on simulation results

5.3.3.5 Output Effects (SIM3)

In table 12, the changes to quantities as a result of increasing capital used in primary agriculture and reducing transaction costs are presented. The direct impacts, in this case, is both on the quantity of value-added (QVA) and quantity of domestically produced commodities sold on the domestic market (QD). The two simulations work through the mechanisms already explained . When capital is increased in agriculture it causes QVA for all primary agricultural commodities to increase. The increase in QVA causes QA and QX to rise for all primary agricultural commodities. It is the increase in QX that causes QD and QE to rise. However, because the equilibrium quantities for QD and QE in QX depend on their relative prices, there is a decline for QE for cotton by 2.94%.

The increase in QD appears to offset the decrease in QM, causing QQ to also increase. This is because the equilibrium quantities for QD and QM in QQ also depends on the relative prices of the commodities.

Table 12: Output Effects on Primary Agriculture (SIM3)

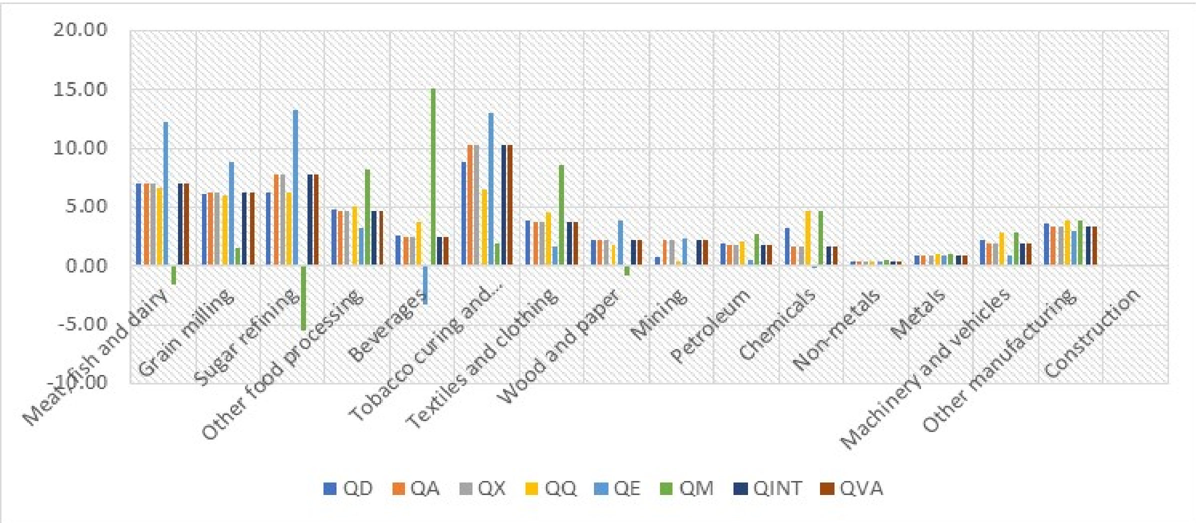
Agriculture	Simulation 3 %change							
	QD	QA	QX	QQ	QE	QM	QINT	QVA
Maize	8.43	8.41	8.41	8.38	8.16	-7.65	8.41	8.41
Rice	6.02	6.30	6.30	5.92	10.30	-20.20	6.30	6.30
Other cereals	8.18	8.18	8.18	6.93	7.70	-11.88	8.18	8.18
Cassava	8.89	8.89	8.89	8.89	0.00	0.00	8.89	8.89
Other root crops	9.09	9.09	9.09	8.70	4.07	-2.31	9.09	9.09
Pulses and oilseeds	8.96	8.77	8.77	8.78	3.40	-0.34	8.77	8.77
Horticulture	9.99	9.99	9.99	9.62	12.20	-4.99	9.99	9.99
Tobacco	4.71	11.81	11.81	4.51	14.78	-32.32	11.81	11.81
Cotton	3.77	1.15	1.15	3.75	-2.94	-4.73	1.15	1.15
Sugarcane	8.50	8.50	8.50	8.50	43.29	-48.62	8.50	8.50
Other export crops	28.48	32.61	32.61	14.55	33.80	-6.31	32.61	32.61
Livestock	10.04	10.12	10.12	9.99	17.28	-19.76	10.12	10.12
Poultry	13.78	14.49	14.49	10.65	23.10	-19.55	14.49	14.49
Forestry	2.75	2.76	2.76	2.72	17.05	-29.60	2.76	2.76
Fisheries	13.34	13.34	13.34	13.34	16.47	-14.35	13.34	13.34

Source: Own table based on simulation results

Further, as shown in table 12, the changes in quantities are much higher than in (SIM2) where capital was increased individually. It is because an additional effect comes from the reduction in transaction costs. When domestic transaction costs are reduced in agriculture, the direct impact is to further increase QD for all agricultural commodities. The increase in QD causes a further increase in QQ. For QM because the commodities prices are relatively higher than those of QD, a decrease in quantities of QM is observed. In addition, the increase in QD causes a further increase in QX which subsequently cause a further increase in QA. The increase in QA causes further increases in QVA and QINT for reasons already explained. The two simulations have a big impact on the quantity of value-added (QVA). For example, "other export crops" QVA increased by 32.61%[2].

In figure 17 below the impact of decreasing domestic transaction cost and increasing capital in the agricultural sector on industry output is shown. For agricultural processing sub-sector, i.e. from "meats, fish and dairy" to "wood and paper", the impact is indirect by the use of cheap and more primary agricultural intermediate inputs.

Figure 17: Output Effects on Industry (SIM3 %change)



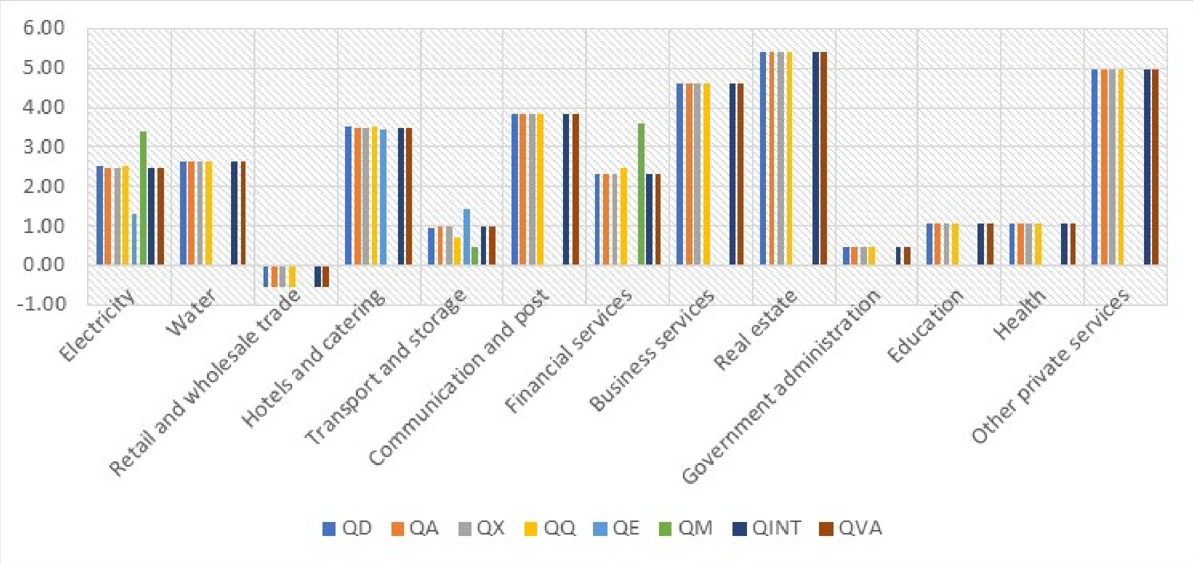
Source: Own chart based on simulation results

Thus, the general trend observed is that all quantities increased except for a few commodities for imports and exports. The quantities of exports and imports are affected by their prices relative to the price of local commodities as well as the exchange rate. Suffice to mention that the quantity of value-added increased for all the agricultural processing industries. "Tobacco curing and processing" QVA increased the most by 10.22%.

For the other elements of the industrial sector, i.e. from mining to "other manufacturing" the impact is indirect and minimal as they do not mainly use primary agricultural intermediate inputs. The quantity of value-added (QVA) increased for most of all the industries.

[2] What became apparent was that the SAM does not record payments to land for the sugarcane industry and the 'other export crops' industry. This may not accurately reflect the real situation and may have influenced the larger than normal result for "other export crops".

Figure 18: Output Effects on Services (SIM3 %change)



Source: Own chart based on simulation results

In the service sector the effects where indirect (figure 18). The relationship and changes in quantity variables follow the mechanism already explained in the first table of this simulation. The general trend is that quantities have generally increased for this simulation as the services expand to support the expanded industrial expansion. The important point to note is that this sector experienced an increase in value-added (QVA). However, “retail and wholesale trade” had a reduction in QVA and other quantities, this can be explained by the fact that “retail and wholesale trade” is a component of transaction costs that was reduced.

5.3.3.6 Price Effects (SIM3)

In table 13, price changes with respect to the combined simulation are captured. The direct impact of SIM1 is on PDD which is expected to reduce. The direct effect of SIM2 is on PVA which is expected to reduce. The reduction in PVA in SIM2 subsequently also causes PDD to reduce through the mechanism already alluded to. Thus both SIM1 and SIM2 work in the same direction to reduce PDD in the combined simulation. Thus, in general, the decrease in PDD in SIM3 is greater than for each of the two individual simulations. The only exception is for the maize commodity which had its PDD increase in SIM1 for reasons already explained. However, PDD for maize decreased in SIM3 because the increase in PDD in SIM1 was smaller than the decrease in PDD for maize caused by SIM2. Therefore, the demand price of domestically produced commodities sold on the domestic market (PDD) decreased for all primary agricultural commodities. The highest decrease in PDD was recorded for sugarcane at 21.44%. Given that the price of the composite commodity (PQ) is a the weighted average of PDD and the price of imports (PM), the increase in PDD causes PQ to increase. The reduction in primary agricultural transaction costs (SIM1) also directly affects the supply price of domestically produced goods sold on the domestic market (PDS). However, SIM2 has the opposite effect of reducing PDS. Thus, for commodities where the increase in PDS caused by SIM1 is higher than the decrease in PDS caused by SIM2, an increase in PDS is observed. For example PDS for cotton increased by 6.60%. For commodities where the increase in PDS due to SIM1 is smaller than the decrease in PDS caused by SIM2, a decrease in PDS is observed. For example PDS for sugarcane decreased by 19.03%. The same explanation holds for PA and PX.

For the price of imports (PM) and the price of exports (PE) in SIM1, both prices reduced, however in SIM2 they increased. Thus, the observed increase in PM and PE in SIM3 is because the increase in both prices caused by SIM2 is higher than the decrease caused by SIM1.

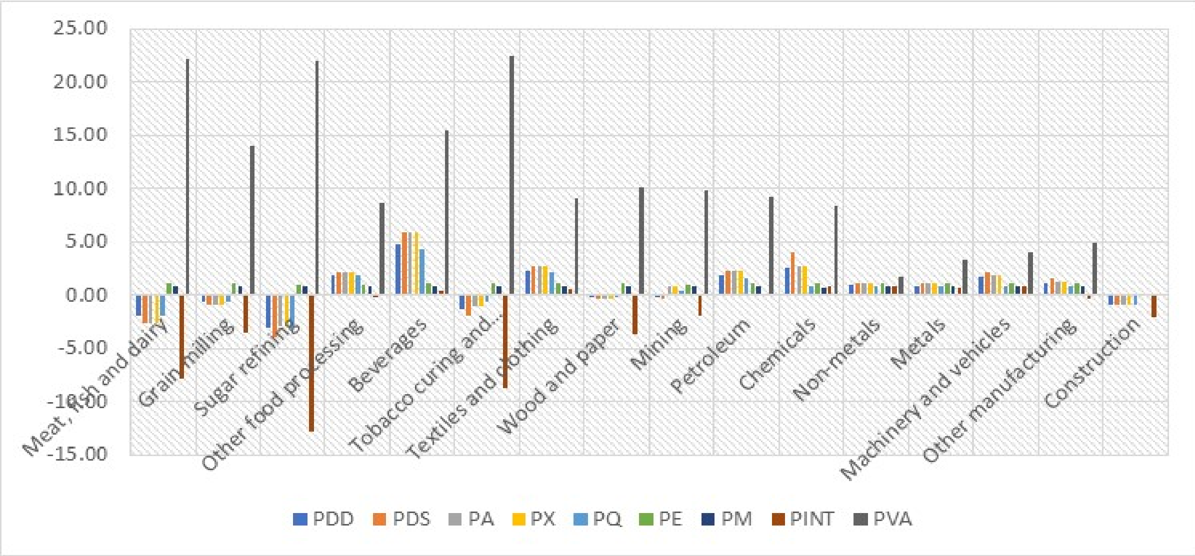
Table 13: Price Effects on Primary Agriculture (SIM3)

Agriculture	Simulation 3 %change								
	PDD	PDS	PA	PX	PQ	PE	PM	PINT	PVA
Maize	-4.44	1.26	1.24	1.24	-4.42	1.06	0.82	0.05	1.87
Rice	-8.31	-2.02	-1.82	-1.82	-8.28	1.13	0.80	-0.23	-2.74
Other cereals	-5.88	1.53	1.53	1.53	-5.51	1.17	0.78	-0.29	2.17
Cassava	-2.42	5.02	5.02	5.02	-2.42	0.00	0.00	0.02	7.40
Other root crops	-2.85	5.03	5.03	5.03	-2.73	1.15	0.79	0.00	7.55
Pulses and oilseeds	-2.16	5.45	5.30	5.30	-2.11	1.12	0.79	-1.24	6.79
Horticulture	-3.95	-0.59	-0.59	-0.59	-3.84	1.00	0.85	0.18	-1.11
Tobacco	-12.80	-6.17	-1.11	-1.11	-12.75	0.99	0.85	0.64	-2.11
Cotton	-2.01	6.60	4.44	4.44	-2.00	1.04	0.82	0.32	5.65
Sugarcane	-21.44	-19.03	-19.03	-19.03	-21.44	1.15	0.79	0.79	-44.56
Other export crops	-9.21	-2.26	0.24	0.24	-5.67	0.96	0.88	-1.94	2.82
Livestock	-9.27	-3.92	-3.86	-3.86	-9.26	1.11	0.80	-2.79	-4.40
Poultry	-10.20	-5.08	-4.60	-4.60	-9.36	1.10	0.80	-4.62	-4.57
Forestry	-11.09	-9.01	-9.01	-9.01	-11.08	0.98	0.86	0.65	-14.48
Fisheries	-8.20	-0.98	-0.98	-0.98	-8.20	1.20	0.79	0.64	-3.74

Source: Own table based on simulation results

The important observation about the impact of the combined simulation is the increase in PM as well as the increase in PE as indicated already. The increase in PM is partly due to the depreciation in the exchange rate in this simulation. The exchange rate depreciated by 0.91% in this simulation.

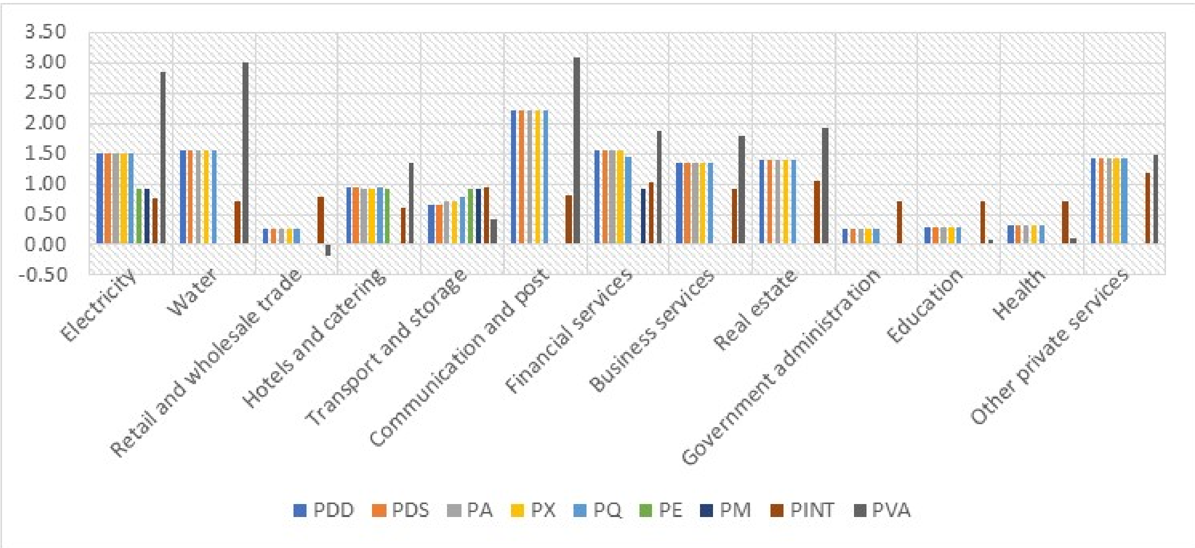
Figure 19: Price Effects on Industry (SIM3 %change)



Source: Own chart based on simulation results

As shown in figure 19 the impact of the two simulations on the prices in industry was indirect and minimal, except for PINT and PVA. The important point is that the price of value-added (PVA) increased for industries.

Figure 20: Price Effects on Services (SIM3 %change)



Source: Own chart based on simulation results

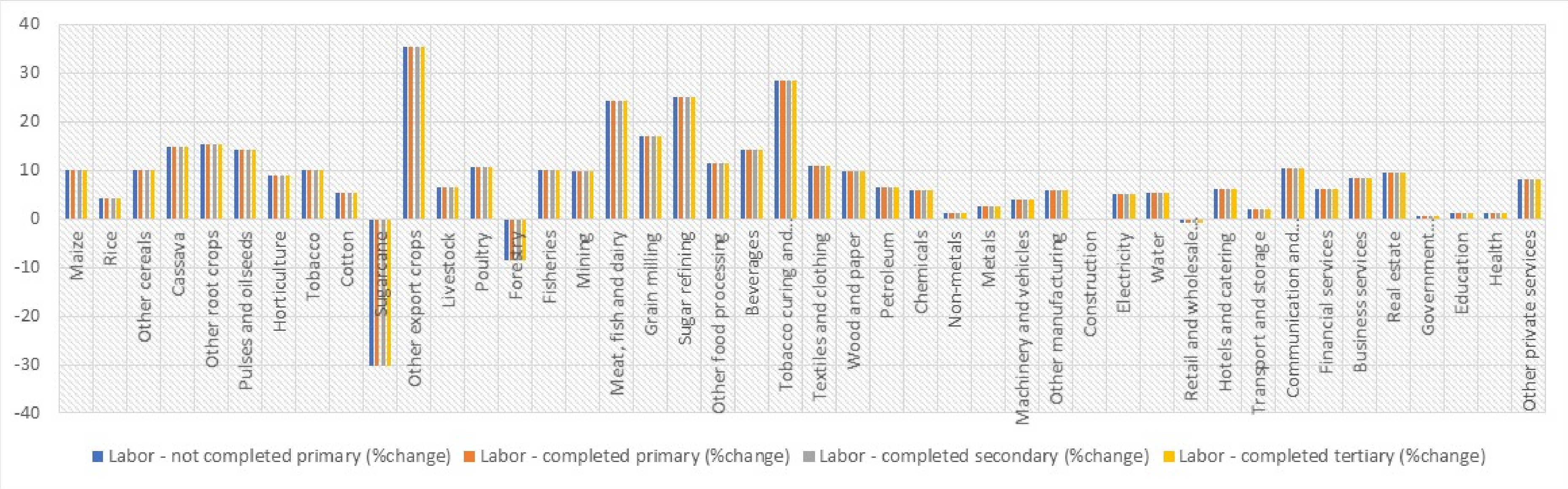
For the service sector, the impact of SIM3 was also indirect. The trend reflects an increase in all prices, indicating increased demand for services in this simulation. Further, the increase in prices is also because of the selected closure on the consumer price index (CPI), where the CPI is made flexible. The impact of SIM2 dominated that of SIM1 for this result. The important point, however, is that the price of value-added also showed increases for all services, again this is mainly due to the capital stock increase which causes an expansion of the service sectors and hence it creates upward pressure on the price of capital faced by the service sectors.

5.3.3.7 Effect on Quantity of Labour Employed (QF) (SIM3)

One of the important aspects of structural transformation is the movement of labour away from primary agriculture to industry. Therefore, Figure 21 shows the impact of the combined simulation on the reallocation of labour across the general sectors of primary agriculture, industry and services. The chart includes all activities in each sector to allow for insight.

As shown in figure 21, reducing transaction costs and increasing capital in primary agriculture has the impact that the increase in labour in primary agriculture is relatively smaller than the increase in labour in industry, i.e. a proportional shift from primary agriculture to industry.

Figure 21: Effects on Quantity of Labour Employed (SIM3 % change)

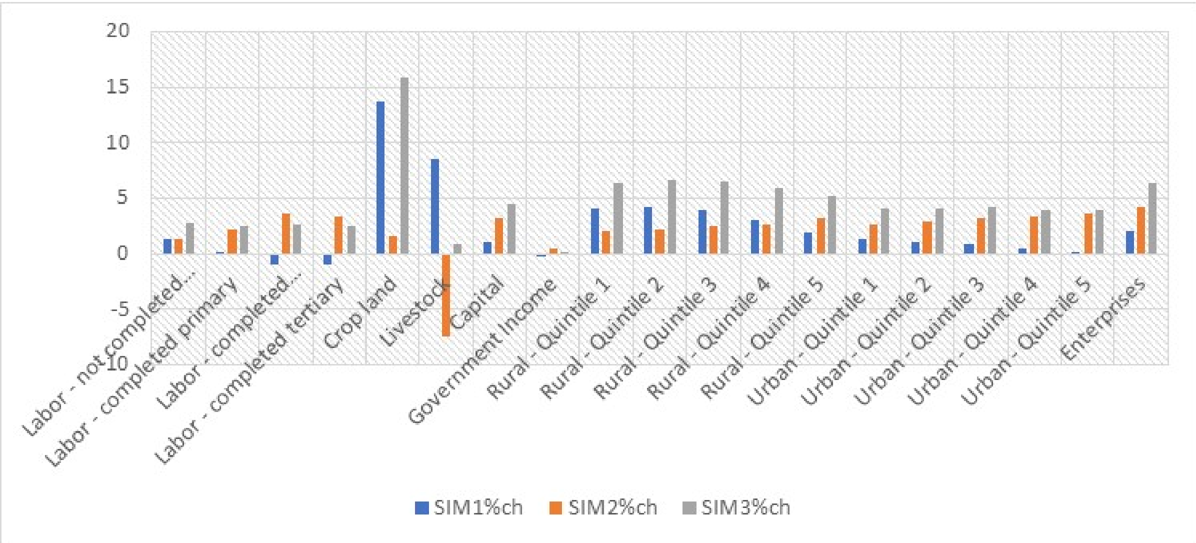


Source: Own chart based on simulation results

In general, the percentage change in employment increased more for industry than for primary agriculture and services. Within the industrial sector, employment was created more in agricultural processing. In the agricultural processing subsector, most of the employment was created in tobacco curing and processing, sugar refining and “meat, fish and dairy” activities. In primary agriculture, there was a lot of employment created in the “other export crops”. This is because these crops are high-value products and are labour intensive. Sugarcane and forestry production recorded significant decreases in the quantity of labour employed. This is because the price of capital reduced the most in these industries. In the sugarcane industry the price of capital reduced by 56.43% while in the forestry industry it reduced by 37.50%. Because the price of labour remained constant, therefore, capital became relatively cheaper than labour. Thus, the reduction in the quantity of labour employed in both industries. It is important note that the SAM data used in the study does not include payments to land from the sugarcane and forestry industries. This could also be driving the observed result. The service sector recorded the lowest increase in the quantity of labour employed. With labour increasing more for communication because this activity supports industrial expansion.

5.3.3.8 Income Effects (SIM1, SIM2 and SIM3)

Figure 22: Income Effects (All SIM %change)



Source: Own chart based on simulation results

In figure 22, the income effects of the three policy scenarios are shown. It is found that reducing transaction costs in the agricultural sector increases factor payments most to cropland and livestock by 13.64% and 8.56% respectively. This is because reducing transaction costs stimulates agricultural production. Income to all other factors increases equally except for labour that completed secondary education and labour that completed tertiary education. In the labour category, labour that has not completed primary school benefit the most. Mainly because the expanded agricultural production mostly takes place in rural areas.

For household income, the greatest household category beneficiaries of reducing transaction costs in agriculture are the “rural-quintile 1” and “rural-quintile 2”. These are the lowest rural income earners. What is clear is that reducing transaction costs is more beneficial to poor households. The same trend is observed for urban households, households with low-income levels are the greatest beneficiaries of the policy.

Further, increasing capital in agriculture is more beneficial to labour that has completed secondary education and labour that has completed tertiary education, with incomes rising by 3.63% and 3.34% respectively. Clearly, increasing capital favours skilled labour because this is the kind of labour that complements capital well. The same trend is observed for household income. Increasing agricultural capital increases the incomes of the rural elite. Mainly because these are the people who own more capital. Owners of capital receive returns to capital. In the urban sector, higher-income households equally benefit the most for the same reasons.

Implementing the two simulations simultaneously increases the incomes of the less educated labour more. Income to labour that has not completed primary school increased most at 2.80%. Cropland is the greatest beneficiary, with its income increasing by 15.88%. Mainly because the land is required to support the expanded agricultural production. The selected closure on land also contributes because it is fully employed and mobile. Increased demand for land is seen in increased return to land if the area cannot expand.

For household income, the trend is that the two policies are more beneficial to poor households. In the rural areas, the “rural-quintile 2” are the greatest beneficiaries, with their income level rising by 6.58%. In the urban areas, the household categories that benefit the most are the “urban-quintile 1” and “urban-quintile 2” at 4.02% and 4.16% respectively. These findings are consistent with our hypothesis that reducing transaction costs and increasing agricultural capital increases household incomes, especially for the poor.

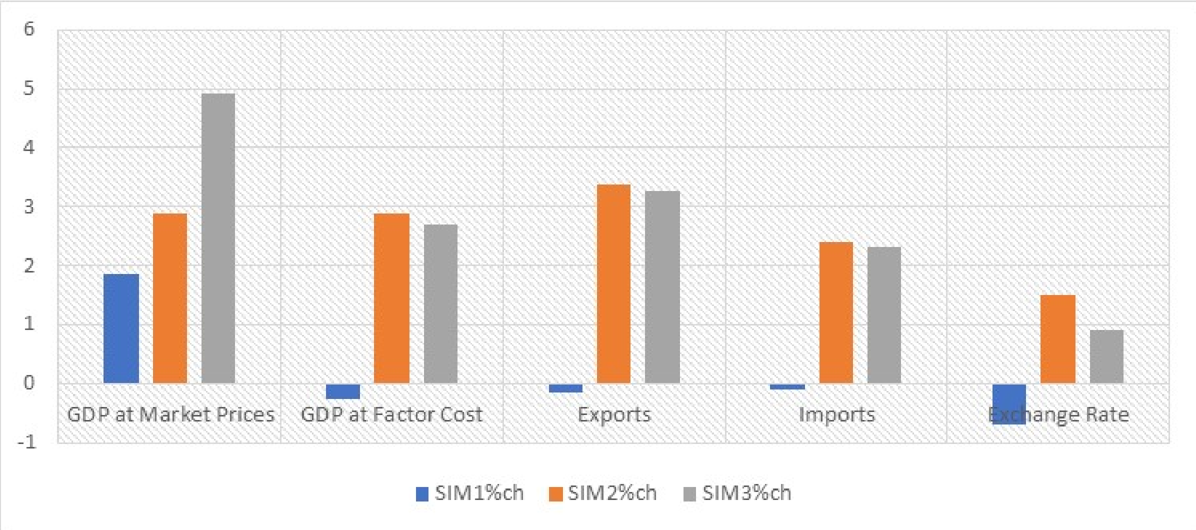
Government income decreases for SIM1 and increases for SIM2 and SIM3. The increase in capital benefits the government most because it benefits the relatively well to do who contribute to direct taxes. Enterprise income increased for all simulations.

5.3.3.9 Macro-Economic Effects (SIM1, SIM2 and SIM3)

In figure 23, the impact of the policy simulations on selected macro-economic variables is depicted. It is found that all the policy simulations increase the real GDP at market prices. The GDP at market prices increased the most in the combined simulation. What is clear is that all the scenarios are growth-enhancing.

The GDP at factor cost or value-added increased for all simulations except for the simulation which involves reducing transaction costs in agriculture. For SIM1, GDP at factor cost reduced by 0.27%.

Figure 23: Macro-Economic Effects (All SIM %change)



Source: Own chart based on simulation results

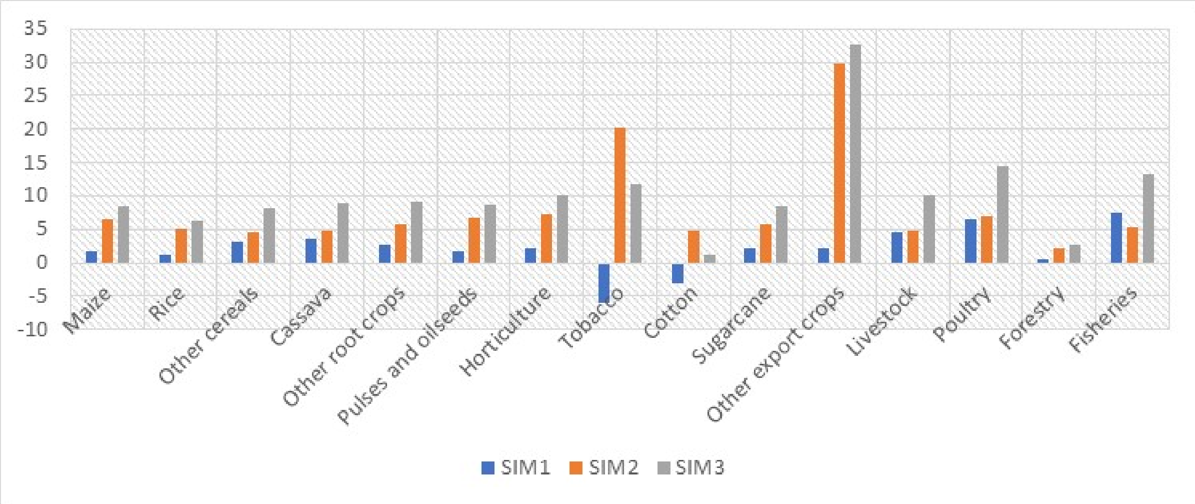
Exports and imports increased for SIM2 and SIM3 but reduced for SIM1. The decrease in exports in SIM1 is because of the appreciation in the exchange rate. For SIM2 and SIM3 percentage increase in real exports was more than for imports. For SIM1 the exports decreased more than the decrease in imports. Thus, SIM2 and SIM3 are more export enhancing.

The exchange rate appreciated when transaction costs were reduced in the agriculture sector, however, it depreciated for the other scenarios. For SIM1, it appreciated by 0.710% and depreciated the most for SIM2 at 1.51%.

5.3.3.10 GDP at Factor Cost per Activity Effects (SIM1, SIM2 and SIM3)

An important indicator in assessing structural transformation is the sectoral contribution to total output in the economy. Therefore, this section compares the contribution of each broad sector to the GDP after reducing transaction costs and increasing capital in primary agriculture. Each sector is captured separately with its respective activities to allow for a more detailed discussion. Sector contributions are then compared.

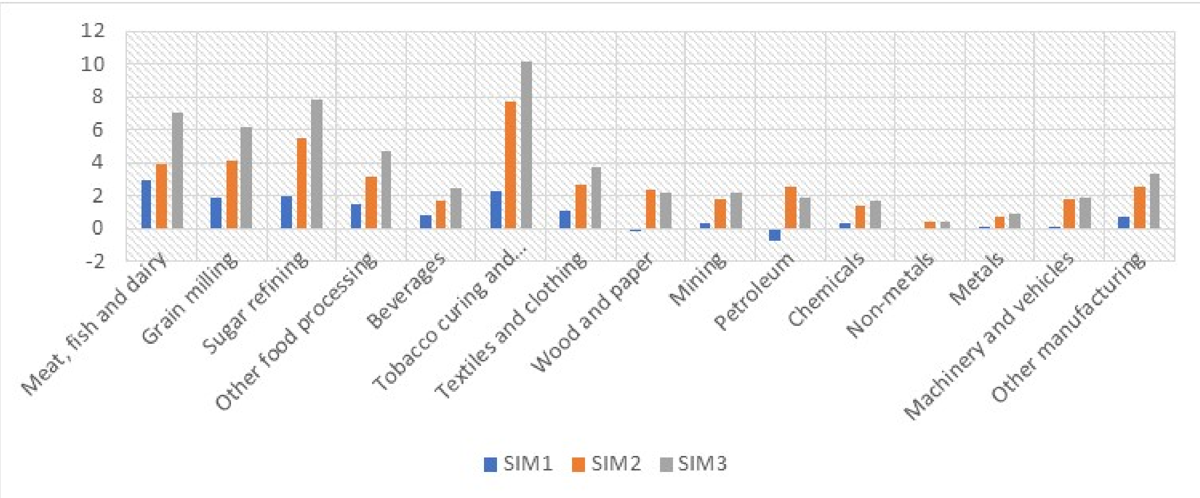
Figure 24: Macro-Economic Effects Primary Agriculture (All SIM %change)



Source: Own chart based on simulation results

In figure 24, changes in the primary agriculture activity contribution to the GDP at factor cost is depicted. It is found that GDP at factor cost or value-added contribution increased for all agricultural sectors for all simulations, except in SIM1 where it declined for cotton and tobacco. However, for the combined simulation SIM3 the GDP at factor cost contribution increased for all primary agriculture activities. This indicates increased primary agricultural output which is important for kick-starting structural transformation.

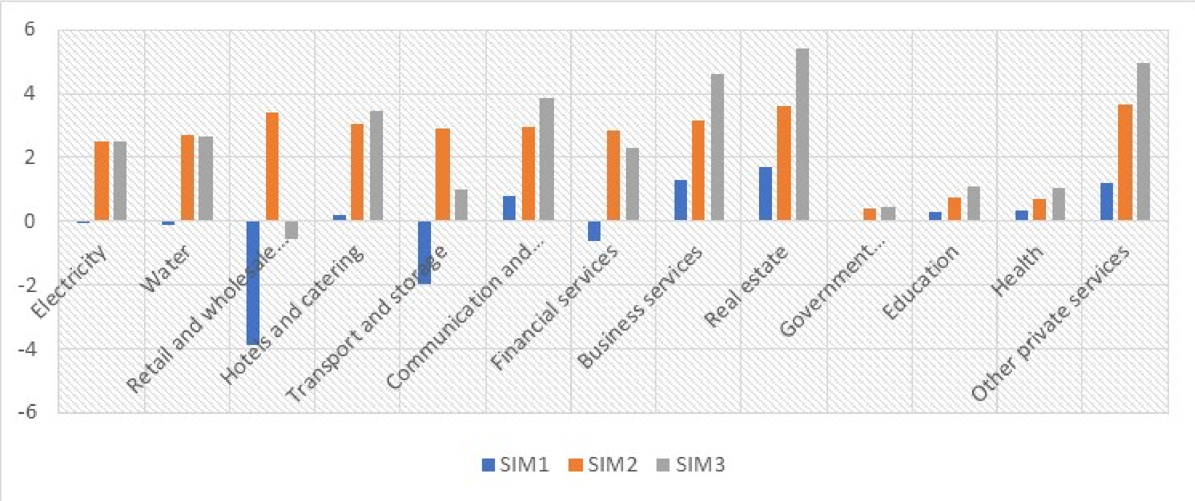
Figure 25: Macro-Economic Effects Industry (All SIM %change)



Source: Own chart based on simulation results

In figure 25, changes to GDP at factor cost contribution per industrial activity is presented. The important point to note is that in the impact of the combined simulation, all industries' contribution to GDP at factor cost increased. The most increases are in agricultural processing as they directly benefit from the changes in primary agriculture through intermediate inputs. For SIM3, the contribution to GDP at factor cost for the industrial sector generally increased less than the contribution of the primary agricultural sector. This is because of SIM1 which was more agricultural production enhancing. However, the important point is that the industrial sector also increased its contribution, with agricultural processing contributing the most.

Figure 26: Macro-Economic Effects Services (All SIM %change)



Source: Own chart based on simulation results

In the services sector, the contribution to the GDP at factor cost by services increased in all simulations except in SIM1 where it reduced for “retail and trade”, “transport and storage” and financial services (figure 26). The reduction in the contribution by trade and transport is expected because these form part of the transaction costs that are reduced in SIM1. However, the reduction in financial services is not expected. The important point to note is that in the combined simulation, all services contribution to GDP at factor cost increased. The increase is more in those services that support structural transformation.

5.4 Sensitivity Analysis

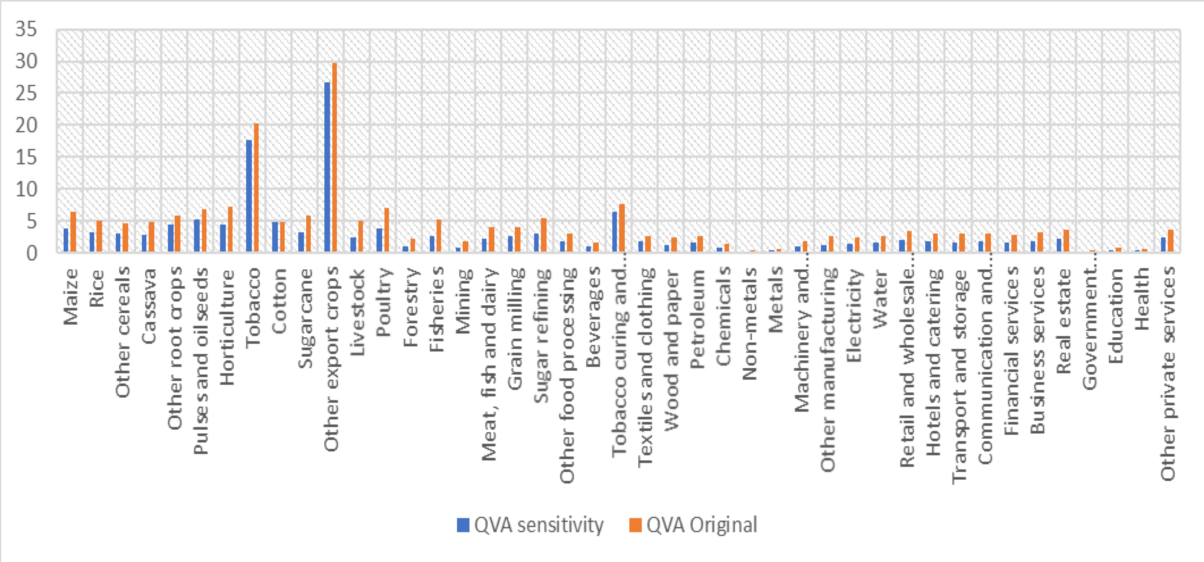
As indicated already in this study, because of non-econometrically determined elasticities, sensitivity analysis is undertaken to validate model results. In this section, the CES elasticity at the lower level of the production nest was changed for primary agricultural commodities. This CES aggregates the quantity of primary factors, i.e. labour, capital and land to form value-added. The results for the CES elasticity was analysed from the perspective of SIM2.

Further, the elasticity for the CES function which aggregates the quantity of imports (QM) and the quantity of domestically produced goods sold on the domestic market (QD) was increased. In the model, this elasticity is 3.00 for primary agricultural commodities. In the sensitivity analysis, it was increased to 5.00 for primary agricultural commodities. Results with respect to this sensitivity analysis were analysed for SIM1.

5.4.1 Sensitivity Analysis CES at Lower Level of Production Nest

The CES elasticity value for primary agricultural activities in the model is 0.75, this value was increased for sensitivity analysis to 2.75. The results of the sensitivity analysis are analysed for SIM2. The following table shows the results for the sensitivity analysis.

Figure 27: Sensitivity Analysis CES at Lower Level (SIM2 %change)



Source: Own chart based on simulation results

The direct effect of changing the CES elasticity at the lower level of the production nest for primary agricultural activities is expected to be on the quantity of value-added (QVA). Since the CES elasticity was increased, it means that the activities can more easily substitute between the three factors: labour, capital and land. This aspect increases production allocative efficiency because activities can use relatively more of the cheaper factors or more of the factors that become more readily available.

In figure 27, results indicate that increasing the CES elasticity at the lower level of the production nest reduces the value-added for all activities. This result was not expected, given that increasing the CES elasticity increases the substitution efficiency between primary factors. However, a careful look at the results provides insight into the observed results.

Given that the sensitivity analysis is analysed for SIM2 where capital was increased for primary agricultural activities. Thus, for SIM2 the price of capital in each of the primary agricultural activities reduced. This should have been the source of the substitution efficiency, however, the closure on capital hinders the efficiency. Because the capital that has become cheaper is unfortunately fully employed and activity-specific. In addition, the price of land increased by

1.63% for those primary agricultural commodities that use land[3]. Further, there was no change in the price of labour because it is was unemployed and mobile. The above situation explains the observed reduction in QVA for primary agricultural activities when the CES at the lower level of the production nest was increased. The following table shows changes in the price of each factor in each activity ($WFA_{f,a}$).

Table 14: Price of Factor F in activity A (SIM2 %change)

Activity	Capital	Livestock[4]	Labour	Land
Maize	-30.82	0.00	0.00	1.63
Rice	-34.65	0.00	0.00	1.63
Other cereals	-26.96	0.00	0.00	1.63
Cassava	-28.14	0.00	0.00	1.63
Other root crops	-26.86	0.00	0.00	1.63
Pulse and oilseeds	-26.37	0.00	0.00	1.63
Horticulture	-28.36	0.00	0.00	1.63
Tobacco	-14.52	0.00	0.00	1.63
Cotton	-26.09	0.00	0.00	1.63
Sugarcane	-60.73	0.00	0.00	0.00
Other export crops	-0.53	0.00	0.00	0.00
Forestry	-38.16	0.00	0.00	0.00
Fisheries	-28.86	0.00	0.00	0.00
Livestock	0.00	-29.06	0.00	0.00
Poultry	0.00	-28.03	0.00	0.00

Source: Own calculations based on model results

For industry and services increasing the CES at the lower level of the production nest for primary agricultural commodities, had an indirect effect. For these activities, the QVA reduced because the price of capital increased in each of these activities (not shown here). Further, there was no change in the price of labour and land due to selected closures, as well as the fact that the activities do not use much land. Therefore, allocative efficiency reduced, causing QVA to fall.

It is clear from figure 27 that the differences between the two QVAs are not much, this indicates the stability of the model. The value-added is used to illustrate the sensitivity of the model because it is one of the variables that are important for this study in terms of structural transformation.

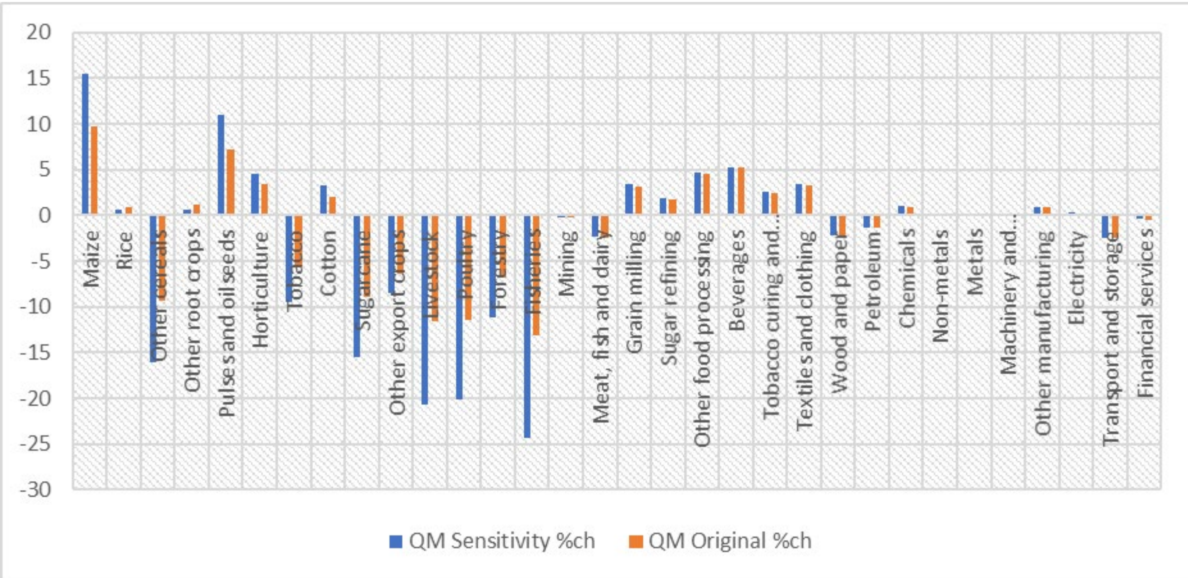
[3] What became apparent was that SAM does not record payments to land for the sugarcane industry and the 'other export crops' industry. This may not accurately reflect the real situation and may have influenced some of the results.

[4] Note that in Zambia livestock is considered as capital; e.g. oxen help in ploughing

5.4.2 Sensitivity Analysis CES Armington Elasticity

As indicated, the Armington CES function combines the quantity of imports and the quantity of domestically produced commodities sold on the local market to make the composite good (QQ). The CES elasticity was increased from 3.00 to 5.00 for primary agricultural commodities. It should be noted that this increase the responsiveness of the agricultural commodities to price changes compared to other commodities. Figure 27 shows the effect of the change on QM for SIM1.

Figure 28: Armington Elasticity (SIM1 QM %change)



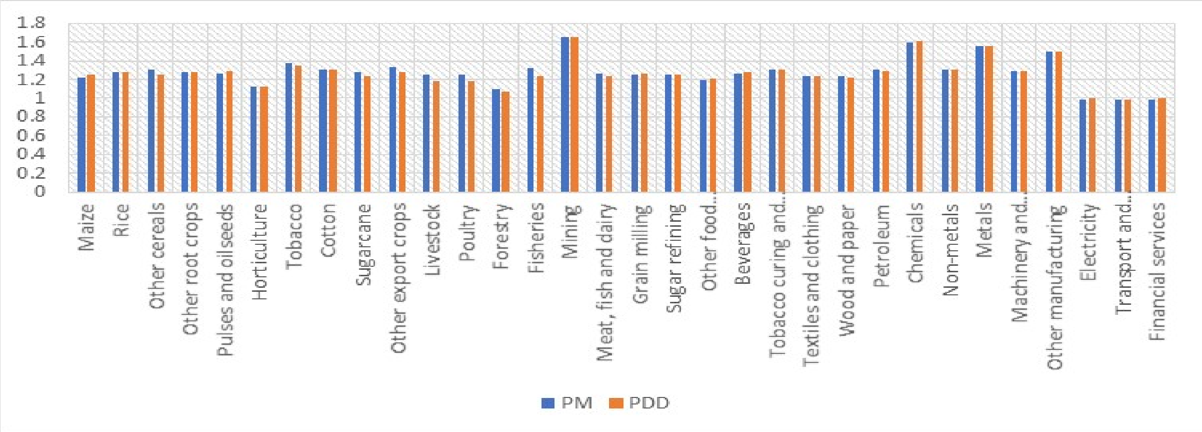
Source: Own chart based on sensitivity analysis results

In figure 28, the direct effect of increasing the Armington elasticity for primary agricultural commodities is on the quantity of imports (QM). Since the elasticity was increased, the expectation was that there would be reallocation in the proportions of QD and QM in QQ. So that, the quantity with a lower relative price increases its proportion in QQ. Because with high elasticity, consumers can easily substitute between QD and QM and consume more of the cheaper commodity. Thus, QM is expected to reduce in the sensitivity analysis.

For primary agricultural commodities, results indicate that in general increasing the CES elasticity for primary agricultural commodities reduced imports for most of the primary agricultural commodities. This is expected because consumers have more flexibility to consume more of the cheaper local produce, where the local produce has lower relative prices. However, for maize, pulse and oilseeds, horticulture and cotton QM increased. Because these commodities had a PDD that was higher relative to PM as shown in figure 29.

As shown in figure 29, for maize, pulse and oilseeds, horticulture and cotton PDD was higher relative to PM. Thus, with more efficiency in substitution consumers consumed more of the cheaper imports.

Figure 29: Comparison Between PDD and PM (SIM1 %change)



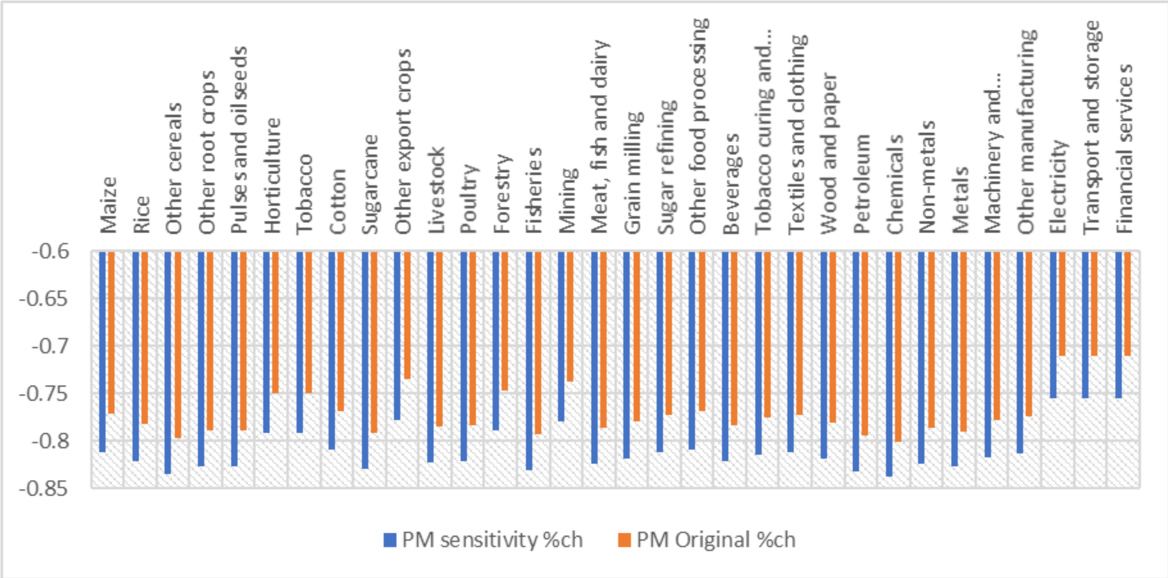
Source: Own calculations based on sensitivity analysis results

The impact of increasing the Armington import elasticity on QM for industry activities and services was indirect. The important point to note is that for all commodities the direction of the changes in QM was the same in the sensitivity analysis model and the original model. This is an indication that the results from the main model are robust.

The impact of increasing the Armington import elasticity on the price of imports (PM) is shown in figure 30. Increasing the Armington import elasticity directly affects the price of imports PM. As consumers acquire more flexibility in substituting between imports and local products, the demand for imports falls. Hence the price of imports PM must also reduce so that imports and local products sell at the same price on the domestic market. Because the change in the CES elasticity was implemented only for primary agricultural commodities, thus the direct effect is on these commodities. Commodities in industry and service sectors are only indirectly affected.

In figure 30, the price of imports for primary agricultural commodities declined for all the primary agricultural commodities. The decline in PM for the sensitivity analysis was more than for the original model reflecting the impact of the change in the CES. The change is consistent with what was expected.

Figure 30: Armington Import Elasticity (SIM1 PM %change)



Source: Own chat based on sensitivity analysis results

In figure 30, the percentages changes in PM for the sensitivity analysis model and the main model are all in the same direction. In addition, the differences in terms of the magnitude of the percentage changes for PM between the original and sensitivity model are small. This further confirms that the main model results for this study are robust.

5.5 Summary

In this chapter, SAM multipliers for the Zambian economy were computed. The reason for computing the multipliers was to provide an additional source of insight to the CGE model. In addition, three simulations, which include reducing transaction costs in primary agriculture, increasing capital for primary agriculture and a combined simulation of the two simulations were implemented in a CGE model. The essence of the simulations was to first assess how transaction costs and agricultural capital separately impact on activity value-added and thus help to draw conclusions on structural transformation. Second, the combined simulation was implemented to assess the complementarity of transaction costs and capital in aiding structural transformation. All the simulations in this chapter are based on developments in the Zambian economy as highlighted in chapter one.

The results from the SAM multiplier model indicate that the agricultural sector is the right sector to start with in the transformation of the Zambian economy. Results show that in general primary agriculture has the largest output, income and value-added multipliers compared to industry and service sectors. In addition, within industry, agricultural processing has larger multipliers as it has more backward linkages in the economy.

For the CGE model, results from SIM1 show that reducing transaction costs in primary agriculture has a direct impact on the prices of primary agricultural commodities that are produced and sold domestically. The simulation also directly affects the prices that producers of primary agricultural commodities receive for their supply. Reducing transaction cost in primary agriculture reduces the price that demanders of these commodities pay and increases the price that producers receive. On the production side, the increase in supply price was seen to have stimulated more production of primary agricultural commodities. More production of primary agricultural commodities resulted in more supply of intermediate inputs for agricultural processing, thus stimulating agricultural processing output. This aspect is a positive stride toward transforming the economy. Further, the lower price that demanders of primary agricultural commodities pay resulted in mostly higher consumption of the composite good. This also meant more availability of food to the industry at lower prices, although the impact was small. It also resulted in an increase in consumers real incomes, an important element for structural transformation. It is equally important to note that the quantity of value-added increased for all agricultural processing activities as well as for most of the other industry activities. Reducing transaction costs in primary agriculture was found to be pro-poor as it resulted in more income increases to poor rural households and the less educated labour force.

In the second simulation that involved the increase of agricultural capital in primary agriculture, the direct impact was on the value-added for primary agriculture. It is found that increasing capital in primary agriculture increased the value-added of primary agricultural activities. This aspect is also important for structural transformation. Production and supply of primary agricultural commodities increased, this further stimulated agricultural processing. In terms of incomes, this policy benefited the skilled labour and rich households relatively more. Skilled labour complements capital well and rich households own most of the capital.

The final simulation that combined the two simulations simply intensified the results of the first two simulations. Production, consumption and supply of commodities all increased. More importantly the value-added for both primary and processing agriculture activities increased. Within the industry category, value-added increased more for agricultural processing. Indicating that the resulting transformation is driven by agricultural processing as expected. Value-added for other industry activities increased minimally. Services that support structural transformation also increased their value-added. The combined policies were found to be pro-poor from an income perspective. It was found that the less educated labour force's incomes increased more although there was more increase for the relatively educated labour due to increased capital. Households that are poor benefited the most for this simulation. It is, however, important to note that in general incomes increased and these incomes are important in fostering structural transformation.

Chapter 6

Conclusions and Recommendations

The Zambian economy is not structurally transformed, at least not in the sense described in the literature. Although agriculture's share in the total output has been declining, the decline corresponds to an increase in the share of services and not manufacturing. In 2017 the service sector contributed 56.33% to GDP. In the theory on structural transformation, the service sector is only expected to increase its share in total output after manufacturing has developed. This is not the case for Zambia.

Further, despite the declining share of agriculture in the total output of the economy, the sector still contributes a large share to employment in the economy. Most labour in Zambia still operates on the farm where labour productivity is still very low. The expanding service sector is not labour intensive. Much of the growth in this sector is in terms of value-added but not much employment is created. We find that over the period 1995-2016, despite agriculture contributing the largest share to employment, the growth rate in the employment share of agriculture declined annually by 1.34%, while that of industry and services increased annually by 2.23% and 2.36% respectively. The decline in the growth of the employment share of agriculture is too small to have the required impact on structural transformation. Further, industry must have increased its share of employment growth more than services if there was evidence of structural transformation.

Productivity in agriculture in terms of value-added per worker is very low, it generally shows a declining trend. We find that between 1991-2017 agricultural value-added productivity declined annually by 1.84% while industry and services productivity increased annually by 0.78% and 1.84% respectively. For structural transformation to take place, agricultural productivity must be increasing until it converges with other sector productivities. This is not the case for Zambia. The growth in agricultural capital that is supposed to fructify the labour in production is also still too small. This study finds that between the year 1995 and 2017 agricultural gross capital formation only grew by 10.70%.

Most of the empirical literature on structural transformation in Zambia have focused on trends in terms of sectoral contribution to total output and employment. The literature also focusses on changes in sectoral productivity and historic developments on structural transformation in the country. Therefore, this study further sought to find out how transaction costs and agricultural capital can help in transforming the Zambian economy. The study combined insights from a linear model, i.e. SAM multiplier model and a non-linear model, i.e. CGE model.

The results from the SAM multiplier model indicate that the agricultural sector is the right sector to start with in the transformation of the Zambian economy. Results, in general, show that primary agriculture has the largest output, income and value-added multipliers compared to the industry and service sectors. The livestock commodity was found to have the largest output multiplier of 3.60 because the commodity has fewer import leakages. In Zambia major livestock commodity like cattle, cannot be exported due to diseases of economic importance such as CBPP and FMD, hence most of the local demand is met by local production, with limited imports. It is found that if the demand for livestock commodity in Zambia increased by ZMW1 billion, industry output in the economy would increase by ZMW3.60 billion.

In addition, within industry, agricultural processing commodities had larger multipliers as they have more backward linkages in the economy. For example, “meat, fish and dairy” had the largest output multipliers of 3.42 within the industry category. The commodity has higher linkages for the same reasons mentioned for livestock above. An important insight drawn from the multiplier analysis is that commodities that are not exported and have limited or no imports at all such as livestock and cassava have large multipliers. It can be said that the burning of Zambian beef in the export market is a blessing in disguise as the country has an opportunity to process raw beef while being insulated from excessive imports. It is some kind of “special infant industry” protection. The same can be said of local foods that have little export market but are consumed in large quantities locally like cassava.

Based on the results from the CGE model in this study, it is found that reducing transaction costs in primary agriculture had a direct impact on the prices of primary agricultural commodities that are produced and sold domestically (PDD). The simulation also directly affected the prices that producers of primary agricultural commodities that are sold on the domestic market receive for their supply (PDS). Reducing transaction cost in primary agriculture reduces the price that demanders of these commodities pay and increases the price that producers receive. For example, PDD for fisheries commodities reduced by 7.55% while PDS for cassava increased by 7.70%. On the production side, the increase in supply price was seen to have stimulated more production and supply of primary agricultural commodities, i.e. increase in industry output (QA and QX). For livestock commodities, both QA and QX increased by 4.65%. More production of primary agricultural commodities resulted in more supply of intermediate inputs for the agricultural processing activities, thus increasing agricultural processing output. For instance, industry output (QA) for “meats, fish and dairy” increased by 2.91%. This aspect is a positive change toward transforming the economy. Further, the lower price that demanders of primary agricultural commodities pay resulted in mostly higher consumption of the composite good. For example, quantity demanded of livestock composite commodity increased by 4.63%. This also meant more availability of food to the industry at lower prices although the impact was small. It also resulted in an increase in consumers real incomes, an important element for structural transformation as indicated in chapter two of this study. It is equally important to note that the quantity of value-added increased for all agricultural processing activities as well as for most of the other industry activities. As an example, the quantity of value-added for “sugar refining” increased by 2.00% Reducing transaction costs in primary agriculture was found to be pro-poor as it resulted in more income increases to poor rural households and the less educated labour force. Income to labour that has not completed primary education increased the most within the labour category at 1.35%. Income to the second poorest household category in rural areas increased the most within the household category at 4.13%.

In the second simulation that involved the increase of agricultural capital in primary agriculture, the direct impact was on the value-added for primary agriculture. It is found that increasing capital in primary agriculture increased the quantity of value-added (QVA) of primary agricultural activities. For example, the quantity of value-added in tobacco production increased by 20.23%. This aspect is also important for structural transformation. Production and supply of primary agricultural commodities increased, which further stimulated agricultural processing. For instance, industry output for processed “meats, fish and dairy” increased by 3.94%. In terms of incomes, this policy benefited more skilled labour and rich households. Skilled labour complements capital well and rich households own most of the capital. For example, income for labour that has completed secondary and tertiary education increased by 3.63% and 3.34% respectively. within the household category income for the richest in urban areas and the richest in rural areas increased by 3.59% and 3.18% respectively.

The final simulation that combined the two simulations simply intensified the results of the first two simulations. Production, consumption and supply of commodities all increased. More importantly the value-added for both primary and agriculture processing activities increased. Within the industry category, value-added increased more for agricultural processing. For example, the quantity of value-added in industries that process “meats, fish and dairy” increased by 7.05%. Indicating that the resulting transformation is more agricultural processing driven. Value-added for other industry activities increased minimally. Services that support structural transformation also increased their value-added.

In addition, the contribution to GDP at factor cost results showed that both the agricultural and industrial sectors increased their shares. The agricultural sector increased its share more than the industrial sector, this is because of the weight of SIM1 which was more agricultural production enhancing. Within industry, however, agricultural processing activities increased their contribution to GDP at factor cost the most. Further, an analysis for the change in the quantity of labour employed by sector showed that in general the share of labour in primary agriculture decline relative to industry. This indicates structural transformation. For example, in the agricultural processing subsector, more employment was created in tobacco curing and processing, sugar refining and "meat, fish and dairy" activities at 20.80%, 17.06% and 13.01% respectively.

The combined policies were found to be pro-poor from an income perspective. It was found that the less educated labour force's incomes increased more although there was more increase for the relatively educated labour due to increased capital form SIM2. Labour that had not completed primary education experienced the most increase in income at 2.80%. Households that are poor benefited the most for this simulation. Within the household's category, the first and second poorest household in the rural areas experienced the most increase in incomes at 6.37% and 6.58% respectively. It is, however, important to note that in general incomes increased and these incomes are important in fostering structural transformation as highlighted in chapter two of this study.

Although transaction costs are often not given prominence in the empirical literature on structural transformation, this study finds that they are relevant. When complemented with increased capital in agriculture advancement in agricultural processing is observed, as shown in the CGE model results. In terms of agricultural policies that support the two simulations, apart from capital coming through household savings in the model, the government could play an important role by ensuring that an environment that enables farmers to access investment funds at low-interest rates is created. The provision of public goods such as roads is critical in reducing transaction costs.

Further, this study confirms a well-known finding in economics that agricultural led economic growth is more poverty-reducing. In a simulation that reduced agricultural transaction costs and increased agriculture capital simultaneously, as already indicated, it was found that household income for the rural poor increased the most. On the contrary, the household income of the urban well-off increased the least.

It is important to note that although the results obtained in this study are based on general equilibrium, there are still other factors outside the model that could impede the observed results. For example, the Zambian economy has in the recent past borrowed heavily from China and on the open international market, the country has thus been struggling with a huge backlog of debt. Factors like these, including changes in the political environment, could have a significant effect on the effectiveness of agricultural policies.

Finally, sensitivity analysis was conducted to assess the robustness of the model results. The CES elasticity that aggregates labour, capital and land to form value-added was changed from

0.75 to 2.75 for primary agricultural commodities. The direct effect of this change was to improve the efficiency of substitution between the primary factors and hence ensuring the there was more allocative efficiency. The results were analysed for SIM2. Results of the sensitivity analysis based on comparing the quantity of value-added in the sensitivity model and the original model showed little difference. In addition, the Armington import elasticity was increased for sensitivity analysis from 3.00 in the main model 5.00. The results were analysed for SIM1 by focusing on the quantity of imports and the price of imports variables. Again, the differences in the results were small in magnitude and were all in the same direction. It can, therefore, be said that the model results from this study are robust. However, it is recommended in this study that research that generate model elasticities relating to the constant elasticity of substitution (CES), constant elasticity of transformation (CET) and the linear expenditure system (LES) is conducted, so that that the validity of the CGE model results is strengthened.

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Appendices

Description of SAM accounts

Activities		
amaiz	cmaiz	Maize
arice	crice	Rice
aocer	cocer	Other cereals
acass	ccass	Cassava
aroot	croot	Other root crops
apuls	cpuls	Pulses and oilseeds
ahort	chort	Horticulture
atoba	ctoba	Tobacco
acott	ccott	Cotton
asugr	csugr	Sugarcane
aocrp	cocrp	Other export crops
alive	clive	Livestock
apoul	cpoul	Poultry
afore	cfore	Forestry
afish	cfish	Fisheries
amine	cmine	Mining
ameat	cmeat	Meat, fish and dairy
amill	cmill	Grain milling
asugp	csugp	Sugar refining
afood	cfood	Other food processing
abeve	cbeve	Beverages
atobp	ctobp	Tobacco curing and processing
atext	ctext	Textiles and clothing
awood	cwood	Wood and paper
apetr	cpetr	Petroleum
achem	cchem	Chemicals
anmet	cnmet	Non-metals
ametl	cmetl	Metals
amach	cmach	Machinery and vehicles
aoman	coman	Other manufacturing
acons	ccons	Construction
aelec	celec	Electricity
awatr	cwatr	Water
atrad	ctrad	Retail and wholesale trade
ahotl	chotl	Hotels and catering
atran	ctran	Transport and storage
acomm	ccomm	Communication and post
afsrv	cfsrv	Financial services
absrv	cbsrv	Business services
areal	creal	Real estate
agsrv	cgsrv	Government administration

aeduc	ceduc	Education
aheal	cheal	Health
aosrv	cosrv	Other private services

Transaction Costs	
TRNC-D	Domestic transaction costs
TRNC-E	export transaction costs
TRNC-M	Import transaction costs

Factors	
flab-n	Labor - not completed primary
flab-p	Labor - completed primary
flab-s	Labor - completed secondary
flab-t	Labor - completed tertiary
flnd	Crop land
fliv	Livestock
fcap	Capital

Households	
hhd-r1	Rural - Quintile 1
hhd-r2	Rural - Quintile 2
hhd-r3	Rural - Quintile 3
hhd-r4	Rural - Quintile 4
hhd-r5	Rural - Quintile 5
hhd-u1	Urban - Quintile 1
hhd-u2	Urban - Quintile 2
hhd-u3	Urban - Quintile 3
hhd-u4	Urban - Quintile 4
hhd-u5	Urban - Quintile 5

GOV	government
ROW	rest of the world
S-I	savings-investment
DSTK	stock changes
TRNCSTDOM	domestic transactions cost account
TRNCSTEXP	export transactions cost account
TRNCSTIMP	import transactions cost account
INSTAX	direct taxes on domestic institutions
FACTAX	direct factor taxes
IMPTAX	import taxes
EXPTAX	export taxes
VATAX	value-added taxes
ACTTAX	indirect taxes on activity revenue
COMTAX	indirect taxes on commodity sales in domestic mark