Analysis of the economic impact of a disaggregated agricultural sector in South Africa: A Social Accounting Matrix (SAM) multiplier approach

By

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ABSTRACT

The South African economy is developing and moving towards the secondary and tertiary sectors as indicated by the decline of the agricultural sector's contribution to GDP in the past years. However, South African agricultural statistical reports still reflect the impact of this sector in economic development based on this declining GDP, direct employment and production value only. This traditional and narrow definition of economic contribution neglects the important indirect and induced economic impact of this sector.

The main objective of this study is to quantify the economic impact of the disaggregated agricultural sector within the South African economy using a SAM multiplier model which is a useful methodology to examine the direct, indirect and induced impacts of the sector within the entire economy. The review of the literature reveals that the application of this methodology in studying the role and impact of agriculture is very limited in South Africa.

The dataset used in this model is a highly disaggregated national SAM in both agricultural and non-agricultural sectors developed as part of this study for the 2014 base year. The developed detailed 2014 SA SAM has 268 accounts: 104 industries (of which 46 are for agriculture, forestry, fisheries and food processing), 133 commodities, 6 factors, 14 households, 4 tax accounts, one account for transaction costs, core government, savings-investment, stock changes, enterprises, and rest of the world. The model was used for detailed computation of multipliers and policy simulations.

The results of this study demonstrated the impact of agricultural sectors on output, and incomes of labor, capital, land, enterprise and households. The results have underlined the impact of agricultural sectors, particularly fruits and vegetables as South African key sectors in generating higher labour income for unskilled and low skilled workers and in generating higher income for the low income households. These results are therefore of relevance to agricultural policy and decision makers as they make it possible to identify promising agricultural and food sectors for investment and subsidies based on these sectors' greater impact on not only output, but on the generation of income and value added as well.

OPSOMMING

Die Suid-Afrikaanse ekonomie ontwikkel en beweeg na die sekondêre en tersiêre sektore soos aangedui deur die afname in die landbousektor se bydrae tot BBP in die afgelope jare. Suid-Afrikaanse landboustatistiese verslae weerspieël egter steeds die impak van hierdie sektor op ekonomiese ontwikkeling, gegrond op hierdie dalende BBP, direkte indiensneming en produksiewaarde, wat ‘n tradisionele en eng definisie van ekonomiese bydrae is, aangesien dit die belangrike indirekte en geïnduseerde ekonomiese impak van hierdie sektor negeer.

Die hoofdoel van hierdie studie is om die ekonomiese impak van die gedisaggregeerde landbousektor binne die Suid-Afrikaanse ekonomie te kwantifiseer deur 'n SAM-gebaseerde vermenigvuldiger model te gebruik wat 'n nuttige metode is om die direkte, indirekte en geïnduseerde impak van die sektor binne die hele ekonomie te ondersoek. Die literatuuroorsig dui daarop dat die toepassing van hierdie metodologie in die bestudering van die rol en impak van landbou in Suid-Afrika baie beperk is.

Die datastel wat in hierdie model gebruik word, is 'n hoogs gedisaggregeerde nasionale SAM in beide landbou- en nie-landbousektore wat as deel van hierdie studie vir die 2014-basisjaar ontwikkel is. Die ontwikkelde gedetailleerde 2014 SA SAM het 268 rekeninge: 104 nywerhede (waarvan 46 vir landbou, bosbou, vissery en voedselverwerking), 133 kommoditeite, 6 faktore, 14 huishoudings, 4 belastingrekeninge, een rekening vir transaksiekoste, sentrale regering, spaar / investering, voorraadveranderinge, ondernemings en die res van die wêreld. Die model is gebruik vir die gedetailleerde berekening van vermenigvuldigers en beleidsimulasies.

Die resultate van hierdie studie het die impak van landbousektore op uitset en die inkomste van arbeid, kapitaal, grond, ondernemings en huishoudings, getoon. Die resultate het die impak van landbousektore, veral vrugte en groente, as Suid-Afrikaanse sleutelsektore onderstreep om hoër arbeidsinkomste vir ongeskoolde en lae geskoolde werkers te genereer en om hoër inkomste vir die lae-inkomste huishoudings te genereer. Hierdie resultate is dus van belang vir landboubeleidmakers en besluitnemers aangesien dit dit moontlik maak om belowende landbou-

en voedselsektore te identifiseer vir beleggings en subsidies gebaseer op sektore se groter impak, nie net op uitset nie, maar ook op die verdeling van inkomste en toegevoegde waarde.

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ACRONYMS AND ABBREVIATIONS

CE	Cross Entropy
C-by-I SAM	Commodity-by-Industry Social Accounting Matrix
CGE	Computable General Equilibrium
DAFF	Department of Agriculture, Forestry and Fisheries
DBSA	Development Bank of Southern Africa
DTI	Department of Trade and Industry
GCE	Generalised Cross Entropy
GDP	Gross Domestic Product
GNP	Gross National Product
IFPRI	International Food Policy Research Institute
IICA	Inter-American Institute for Cooperation and Agriculture
IO	Input-Output
MDG	Millennium Development Goal
MERRISA	Macroeconomic Reforms and Regional Integration in Southern Africa
NDP	National Development Plan
NEPAD	New Partnership for Africa's Development
PEP	Partnership for Economic Policy
PROVIDE	Provincial Decision-Making Enabling
SA	South Africa
SAM	Social Accounting Matrix
SARB	South African Reserve Bank
Stats SA	Statistics South Africa
SUTs	Supply and Use Tables
UK	United Kingdom
UN SNA	United Nations Systems of National Accounts
US	United States

CHAPTER 1: INTRODUCTION

1.1 Background and motivation

The debate concerning agricultural potential in economic growth seems to be centuries old, but the realization that agriculture is central to the growth process in poor countries is relatively recent (Meijerink and Roza, 2007). However, de Janvry (2010) points out that this realization is still unfolding as conceptualization of the role of agriculture for development, and redesigning of approaches for the effective implementation of the agriculture for development are still insufficient amongst the governments and policy makers. Nevertheless, news headlines and policy agendas for international development agencies including the World Bank and United Nations, show that agriculture is back on the agenda again. This is reflected in the most influential development report 2008 of the World Bank (World Bank, 2007) and its successor, the 2030 Agenda for Sustainable Development report of the United Nations (FAO, 2017). The former report argues that growth in the agricultural sector contributes proportionally more to the poverty reduction than growth in any other economic sector giving the implication that focus be on the agricultural sector for achieving the first Millennium Development Goal of the United Nations, while the latter report states that due to the fundamental connection between people and the planet, food and agriculture are at the heart of the 2030 agenda in ending poverty, hunger and malnutrition.

This therefore persuaded more countries to regard agriculture as a strategic asset. However, IICA (2004) argues that the importance attached to it in political circles and among decision-makers varies. In South Africa, the central commitment of government to economic transformation has been well established. Employment and improved income distribution are high on the agenda. So the significance of the South African agricultural sector is largely for its potential to create jobs and improve equity. This is evidenced by the government National Development Plan (NDP) vision 2030 which proposes to create close to 1 million jobs by 2030 in agriculture (NPC, 2012).

The primary agricultural sector's value of production in South Africa was R263 201 million in 2016 (DAFF, 2017). Its volume increased from around 18 million metric tons in 1975 to 28 million tons in 2006 (Tregurtha and Vink, 2008). Tregurtha and Vink (2008) point out that the absolute increase in the volume of agricultural production has played a role in the development of the

country's manufacturing sector, placing it in the same order of magnitude with other middle income countries. The South African agricultural contribution to Gross Domestic Product (GDP) declined from more than 6% in the 1970s to 2.0% in 2015 (DAFF, 2017). This indicates that the South African economy is maturing, hence moving towards the tertiary sector.

Greyling (2012) argues that the decline in the agricultural sector's contribution to GDP to that extent does not portray the true picture of the sector's impact on the greater economy due to the fact that the agricultural sector does not operate in a vacuum. Hussain et al. (2003) (cited in Cloete, 2010) are of the same opinion, indicating that the impact of a particular industry on the whole economy cannot be isolated. Tregurtha and Vink (2008) are of the same view emphasizing that focusing only on the declining, direct GDP contribution of agriculture negates the important, indirect role that it plays in the South African economy. The aforementioned arguments are validated with the example that purchases of goods such as fertilisers, chemicals and implements by the agricultural sector create important backward (upstream) linkages with the manufacturing sector, while forward (downstream) linkages are formed through the supply of raw materials to industry notably that about 70% of agricultural output is used as intermediate products by the food, beverage and textile sector (Tregurtha and Vink, 2008).

According to Meijerink and Roza (2007), the reflection of the importance of agriculture in economic development by its share in total GDP is traditional and therefore too narrow. They propose that in order to know the role played by agriculture in economic development, it is imperative to take a broader view by investigating numerous ways in which it links up and plays an important role in other sectors of the economy. Johnston and Mellor (cited in Greyling, 2012) identified five types of inter-sectoral linkages that highlight agriculture's role in economic growth. These linkages are: providing food for domestic consumption, releasing labour for industrial employment, extending the market for domestic industrial output, increasing the supply of domestic savings as well as earning foreign exchange.

Since the NDP articulates a vision for agriculture in which supportive infrastructure, policy and government investment can expand agricultural production to create 250 000 direct jobs and another 130 000 indirect jobs, it is fundamental to consider that the interactions of agriculture with the rest of the economy may differ among the different agricultural subsectors. This is due to a range of technical constraints, the dynamics of heterogeneous markets and the level of organization

of each subsector, which varies from one product to another (NEPAD, 2013). In order for this policy to be sustainable, strong economic growth is a necessity and for long run economic strength, policy management of such growth must emphasize the agricultural subsectors whose growth is balance of payments friendly (Eckert, Liebenberg and Troskie, 1997). Furthermore, for investment also to yield the lucrative returns it should be prioritized in high potential agricultural subsectors. This therefore indicates a requirement for a study to quantify the potential contributions of this sector.

The South African Department of Agriculture, Forestry and Fisheries through its annual and six monthly publications of the 'Abstract of Agricultural Statistics', 'Trends in Agricultural Sector' and 'Economic Review of the South African Agriculture' respectively, describe the economic impact of the agricultural sector in terms of its contribution to GDP, employment and production value. This description, though correct, is limited as it focuses only on the direct contribution of the agricultural sector and neglects the important indirect and induced economic impact of the sector.

A SAM multiplier model is a useful methodology to examine the direct, indirect and induced impacts of the detailed agricultural sector within the entire economy. The direct impacts are initial immediate impacts caused by the specific activity, which will subsequently initiate a series of iterative rounds of income creation, spending and re-spending, resulting in indirect and induced impacts. The indirect impacts are changes in production, employment and income as a result of the direct effects on the industry sector that may be directly or indirectly related to the initial impacted sector. The induced impacts are general changes in the household sector's earnings and spending patterns as a result of direct and indirect impacts. The combination of direct, indirect and induced impacts makes up the total effect or impact of an exogenous change on a particular industry or economy. Hussain et al. (2003) (cited in Cloete, 2010).

A scan of literature reveals that some of studies which were conducted in South Africa with regard to examining the role and impact of agricultural sector are literature review studies. These are: Nel (1964), Van Rooyen (1997), Oosthuizen (1998), Mabuza (2009) and Greyling (2012). Other studies quantified the role and impact of agricultural sector in South Africa using either traditional input-output model or SAM multiplier model. The studies that used the traditional input-output

model for quantification include: Brand (1969), Van Zyl et al. (1988), Pundo (2005), and Meliko and Oni (2011). Input-output models only capture agriculture's links within the production sub-system of the economy whereas agriculture's links with the wider economy extend beyond this scope to the distribution of factor income as well as the pattern of consumer demand in the economy, as captured by SAM-based models (Roberts, 1994). There are fewer studies which used SAM multiplier model for quantification of agriculture's economic impact in South Africa. They include Eckert, Liebenberg and Troskie, (1997), Townsend and McDonald (1997) and Ramigo (2017). Two of these studies are dated. The first and the third (recent) studies are at provincial level and not at national level while the second study used a SAM with only a single account for agriculture. This therefore indicates that no published studies have recently quantified the impact of the disaggregated agricultural sector at the national level using SAM multiplier models in South Africa.

Liu et al. (2005) point out that the highly aggregated representation of both agricultural and non-agricultural sectors poses difficulties in models that can be used for policy analysis. The study therefore, overcomes this problem by developing a highly disaggregated SAM in agricultural, food and non-agricultural sectors for usage in detailed agricultural policy analysis. The motivation for the analysis of the disaggregated agricultural sector is brought by the expectation that the South African agricultural sector has high potential for creating jobs and improving equity. In addition, Liu et al. (2005) indicate that agricultural markets are generally more distorted globally compared to non-agricultural markets and that the distortions differ among specific agricultural products.

1.2 Objectives of the study

1.2.1 General objective

To quantify the economic impact of the disaggregated agricultural sector within the South African economy.

1.2.2 Specific objectives

- To develop a SAM for South Africa with detailed agricultural accounts.

- To compute the SAM multipliers in order to highlight the potential of agriculture in contributing to the output, value added, household incomes and household consumption in the national economy.
- To simulate the impact of the changes in export demand of key agricultural and food products on the national economy using a SAM quantity model.

1.3 The research method

In undertaking this study, the SAM multiplier model named a SAM quantity model is employed to examine the economic impact of a disaggregated agricultural sector within the South African economy. This model is an extension of the traditional input-output model. It is based on a SAM with non-square supply matrix with secondary production and the model assumes household consumption is endogenous. The multipliers computed from this model are more complete and therefore tend to yield larger values than those computed from traditional input-output models, as this model captures the full circular flow (Sadoulet and de Janvry, 1995). This model simulates the impact of the changes in final demand and household income in agricultural sectors on the national economy. Prior to running the simulations using this model, a set of multipliers are estimated and discussed.

The dataset underlying this model is a SAM. A SAM in general is a square matrix that represents consistently all monetary flows of goods, services and income between all the agents of the economy within a reference period (usually a base year). The SAM used as a dataset in this study is a 2014 SA SAM with detailed agricultural accounts and it is developed as part of this study. It is constructed following the structure similar to the one proposed by Pyatt (1988) which makes it an ideal database for conducting economy-wide impact assessments that include SAM multiplier analysis and computable general equilibrium (CGE) modeling.

The detailed 2014 SA SAM is constructed by first, deriving a macro SAM using control totals from the South African Reserve Bank (SARB) quarterly bulletins and disaggregating it into 62 industries, 104 commodities and single accounts for transaction costs, labour, capital, households, enterprises, government, taxes, savings-investment, stock changes and rest of the world (RoW) using coefficients from 2014 supply and use tables (SUTs). After this disaggregation, this SAM is named the primary step SAM. It identifies a single agricultural industry account, 2 agricultural

commodity accounts, a single food industry account and 14 food commodity accounts. Agricultural accounts are further disaggregated into 31 accounts (31 industries by 31 commodities) using agricultural statistics and a single food industry is disaggregated into 13 industries using shares from 2010 SUTs. After this disaggregation, this SAM is named the intermediate step SAM. Finally, the single accounts for labour, tax and households in the intermediate step SAM are disaggregated into 4 labour accounts, 4 tax accounts and 14 household accounts using shares from 2012 SA SAM. The single capital account is split into land and capital.

Due to the diversity of the various data sources used during the disaggregation process of the SAM, the balancing procedure is applied using the Generalized Cross Entropy (GCE) method which uses the computer code in the General Algebraic Modelling System (GAMS) language. It is applied at three stages, that is, after disaggregating the macro SAM, after disaggregating the primary step SAM and finally after disaggregating the intermediate step SAM. The balanced detailed 2014 SA SAM is then used to calibrate the SAM quantity model. The compilation of the 2014 SA SAM, computations of multipliers and simulations with the SAM quantity model are performed in the Microsoft Excel.

The extension of the basic input-output model to a SAM quantity model suitable for a non-square supply matrix that captures secondary production, such as that found in the commodity-by-industry SAM developed in this study, follows Miller and Blair (2009). Miller and Blair (2009) however discuss this extended model only in the context of a model that assumes household consumption to be exogenous (i.e. an open model). Therefore the theory is further developed as part of this thesis for application in the context of a closed model that assumes household consumption to be endogenous. It is as a result of the assumption of endogenous household consumption that SAM multipliers are typically larger than input-output multipliers because the inclusion of household consumption in the multiplier matrix allows for the capturing of the induced (consumption) effect in addition to the direct and indirect production effects. Although closed model SAM multipliers are often discussed in the literature, it is usually related to SAMs with a single production matrix, i.e. not with explicit commodity and industry accounts and associated supply and use matrices, with an implicit assumption of square supply matrices without secondary production. This study

therefore combines both the assumption of non-square supply matrices with secondary production and the assumption of endogenous household consumption.

For the detailed description and development of a SAM quantity model, and a discussion of the comprehensive method of construction of the 2014 SA SAM, refer to chapter 3 and chapter 4 respectively.

1.4 Relevance and contribution of the study

This study contributes to the existing literature and policy in the following ways:

- Providing an updated SAM for SA with detailed agricultural accounts that can be used in SAM-based models for policy analysis and policy making of agricultural management and national economic development.
- Describing the practical way of disaggregating the agricultural sector given the currently available data sources in order to contribute towards the future attempts to disaggregate a sector in an existing SAM and to highlight shortages in data availability.
- Developing the theoretic framework to extend the open input-output model based on a commodity-by-industry SAM proposed by Miller and Blair (2009), to a closed input-output model based on a commodity-by-industry SAM, i.e. allowing for the assumption of endogenous household consumption in the model while using a SAM that captures secondary production in its (non-square) supply matrix.
- Provision of disaggregated SAM multipliers of South African agriculture at a national level. This can contribute to the existing debate on the role and impact of the agricultural sector.
- SAM multiplier models make it possible to run simulations that provide criteria for identifying key sectors in the economy in terms of greater production and consumption linkages, generation of more value added and finally having greater impacts on income distribution. Therefore the results of this research are intended to guide the policy makers in prioritizing winning agricultural sectors in order to negotiate better development strategies.

1.5 Organization of the thesis

The rest of the thesis continues as follows:

Chapter 2 lays down the theoretical descriptions of SAMs and SAM multiplier models. The justification of using the SAM-based multiplier models as well as the empirical literature concerning the use of these models in the agriculture sector, also form part of this chapter.

Chapter 3 presents the detailed description and the procedure for developing a SAM quantity model used in this study.

Chapter 4 presents a discussion of the actual dataset (2014 SA SAM) developed as part of this thesis. The process followed in the construction of this SAM, i.e., methodology adopted, data sources used, assumptions made, criteria chosen in disaggregating the SAM's accounts, balancing procedure as well as some findings from this SAM are fully discussed in this chapter.

Chapter 5 presents results and discussions of the analysis of the economic impact of the agricultural and food sectors to the South African economy by means of SAM multipliers and simulations from a SAM quantity model.

Chapter 6 gives the summary of the major findings of the study and concluding remarks. Also, in this chapter, the necessary limitations of the study are acknowledged and finally suggestions for future research are made.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter commences by discussing the theory of SAMs as well as SAM multiplier models. Before discussing the latter it first examines general equilibrium modelling approaches with the aim of laying a justification for using a SAM multiplier modelling in quantifying the economic impact of the South African agriculture. It then proceeds by reviewing comprehensively the studies conducted recently internationally, in Africa and then in South Africa, which applied SAM multiplier analysis in agricultural related issues. It finally concludes by giving implications from reviewed studies.

2.2 The theory of SAMs

The SAM framework can be traced back to 18th century France and Quesnay's *tableau economique*, and its roots also are associated to the pioneering work in social accounting by Gregory King. However, according to Pyatt and Round (1977), SAMs originated as a consequence of discontent with the United Nations earlier Systems of National Accounts (UN SNA) which presents transactions in an economy in a double entry format and gives emphasis to economic growth patterns, separating the social and demographic variables. Modern social accounting is largely inspired by the work of Stone in connection with the Cambridge growth model in 1950s and 60s and Stone's work with the UN SNA project gave further impetus to developing a disaggregated household sector description. Pyatt, Round and Thorbecke advanced the work in 1970s to apply the idea of a SAM to developing countries and in 1980s Thorbecke, Khan and others at Cornell also advanced the work leading to disaggregation of technologies and the inclusion of the informal sector separately within a SAM (Khan, 2007).

2.2.1 The concept of a SAM

A SAM can be defined as the presentation of selected accounts from the system of national accounts (SNA) in matrix format which elaborates the linkages between a supply and use table and institutional sector accounts (United Nations, 1994). Its main features are threefold according to the World Bank (2011):

- It represents accounts as a square matrix, showing incomes and expenditure for each account as a corresponding row and column of the matrix. This matrix portrays clearly the connections between each pair of agents, as transactions are shown the cells.
- It is comprehensive in that, it captures all the economic activities of the system, such as consumption, production, accumulation and distribution. It also captures the details in social dimensions like institutions.
- It is flexible in that, although it is usually set up in a standard, basic framework there is a large measure of flexibility both in the degree of disaggregation and in the emphasis placed on different parts of the economic system.

The most basic principles underlying a SAM are ***the requirements of double-entry bookkeeping*** and ***the concept of a circular flow.***

Double-entry bookkeeping

The most fundamental law of economics states that for every income there is a corresponding outlay or expenditure. This law, according to Pyatt (1988) is the equivalent for economists of the physicist's law of energy conservation as it plays a similar role in defining the completeness of a model or analytic formulation that no theory or model is deemed correct unless it is complete in the sense that all incomes and outlays are fully accounted for. This fundamental law underlies the double-entry accounting procedure that makes up the macroeconomic accounts of any country (Reinert & Roland-Holst, 1997). Pyatt (1988) therefore sees a SAM as a simple and efficient way of representing this fundamental law.

A SAM is a square matrix that records receipts and payments (according to the principle of double entry) in a region or a country during an accounting period. Receipts (representing incomes) are recorded in rows while payments (representing expenditures) are recorded in columns. The entries in the SAM are transaction values, that is, the product of prices and quantities. Generally, a particular cell in a SAM, $\{t_{i,j}\}$, is defined as incomes or receipts of account *i* from account *j*, or inversely, it describes the payments or expenditures of account *j* to account *i*. That is if *i* is a set describing the members of the set of row accounts and if *j* is the set describing the members of the set of column accounts, then the SAM is $n \times n$ matrix with $i,j: \{ i=1,\ldots n; j=1,\ldots n \}$. In adherence to the principle of double entry bookkeeping, the total incomes must be equal to total payments for

every account.

$$\sum_{j}^{n} t_{i,j} = \sum_{i}^{n} t_{i,j} \qquad (1)$$

It is the adherence to the fundamental law of economics described above that makes a SAM to be complete and consistent. It is however necessary to note that the main difference between SAM accounts as compared to traditional accounts (where bookkeeping is done with the aid of T-accounts) is that in the SAM every entry only appears once (Punt, 2013) and also, while T-accounts are balanced individually, a SAM ensures that all accounts are simultaneously balanced (PROVIDE, 2003).

In helping to understand the concept better of a SAM that captures all transactions in the economy, the discussion of the circular flow in relation to a SAM is presented next.

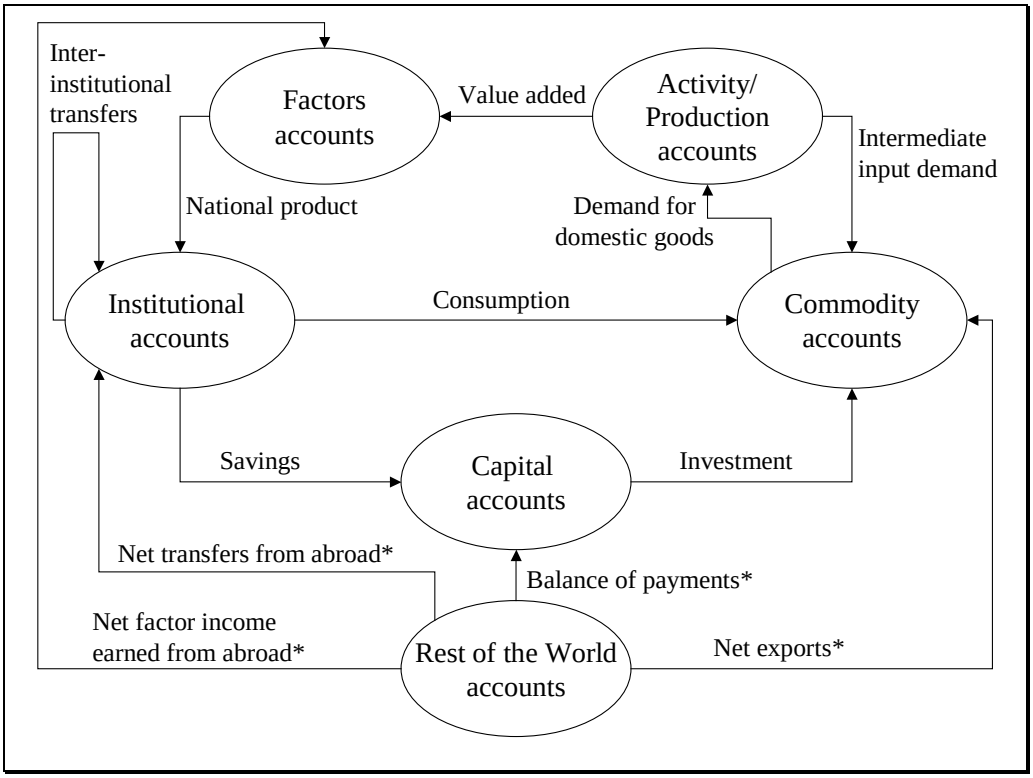
The concept of circular flow

According to Pyatt and Round (1985:9), a SAM constitutes "a circular flow of income around the familiar macro-economic look of demands on activities, leading to demands for factors, hence to the incomes of institutions, and from there back to demands on activities". The best way to explain the movement of goods and services in an open economy is by using a circular flow diagram. A SAM is interested in the flow of resources or funds in the economy and as a result figure 1 below illustrates the circular flow diagram using the SAM approach or perspective. The direction of flow of funds is in the opposite direction compared to if we were concerned with the direction of movement of goods and services.

The key to figure 1 as shown in PROVIDE (2003) is that government, households and incorporated business enterprises are all regarded as institutions and although some inter-institutional tax transfers and tax transfers from factors to government are captured in this figure, tax payments from activities and commodities are excluded for simplicity. It is also necessary to note that flows which are associated with the rest of the world (RoW) accounts as indicated with a star (*) can be in the opposite direction as well. The occurrence of net imports will cause a flow from the commodity account to the RoW account while that of net transfers will cause a flow from (to) the

institutional accounts to (from) the RoW account.

Figure 1: The circular flow of funds as it relates to a SAM



Source: PROVIDE (2003)

Figure 1 above is explained by beginning with industry (production) accounts. The industries produce goods and services out of combination of intermediate inputs and factor inputs (capital, labour and land). The payments of intermediate inputs by industries are directed to commodity accounts while payments of factor inputs (value added) go to factor accounts.

Commodity accounts purchase domestic goods from industries and supplement them by imports from the RoW. The source of income for commodity accounts is from institutional accounts (government and household consumption), RoW (export earnings) and capital accounts (investment).

Institutional accounts are the owners of factors of production and as a result they get funds from factors accounts. They also get funds as transfers i.e. households may receive social grants from

government while government may receive income tax from households and these are referred to as 'inter-institutional transfers' while other transfers are from the RoW. All the income that is not spent by institutional accounts is saved in the capital accounts. The positive balance of payments from RoW also contributes to this pool of savings. Capital accounts use this pool of savings to finance investment.

2.2.2 C-by-I SAMs versus IO SAMs

SAMs can be constructed based on either supply and use tables (SUTs) or input-output (IO) tables in national accounting and economic analysis. SAMs based on SUTs are referred to as SU SAMs or as commodity-by-industry (C-by-I) SAMs in accordance with Miller and Blair (2009). SAMs based on IO tables are referred to as IO SAMs.

The SUTs provide a detailed picture of the supply of goods and services by domestic production and imports, and the use of goods and services for intermediate consumption and final use. The SUTs are commodity-by-industry matrices and both commodity and industry classifications are used. They are often referred to as rectangular input-output tables since the classification of products can be more detailed than the classification of industries or vice versa. The supply table shows the supply of goods and services by product and by type of supplier. It comprises a matrix with the output of domestic industries and a vector of the total imports by product. On the other hand, the use table shows the use of goods and services by product and by type of use, i.e. as intermediate consumption of industries, final consumption, gross capital formation and exports. It also contains the components of value added by industry, i.e. compensation of employees, other taxes less subsidies on production, consumption of fixed capital and net operating surplus (Eurostat, 2008).

The 1993 and 2008 SNAs prescribe that goods and services may be valued at basic prices, producer prices or purchaser prices so the supply table includes the output valued at basic prices, imports, trade and transport margins and net taxes on products while the use table includes the intermediate consumption, final consumption and capital formation, all valued at purchaser's prices, plus exports. C-by-I SAMs use the information from SUTs and as a result, the similar prices apply to

the relevant sub-matrices in these SAMs. The supply matrix of these SAMs shows explicit recording of either main product outputs of industries or multiple products since the main product outputs of industries reflect as entries only on the diagonal of the supply matrix while the multiple products reflect as entries both on the diagonal and off the diagonal of the supply matrix (Punt, 2013).

An IO table is a product-by-product or industry-by-industry matrix which rearranges both supply and use information into a table using either a product or an industry classification for both rows and columns (Eurostat, 2008). The construction of an IO table involves a certain degree of data manipulation which results in loss of information as it requires the elimination of all secondary outputs through reallocation procedures (Punt, 2013). The choice between a product-by-product IO SAM or an industry-by-industry IO SAM depends on the purpose for which the SAM is constructed, the 2008 SNA indicates that from the price perspective, product-by-product IO SAMs are preferred because in the product-by-product matrices, price indices are strictly consistent whereas the industry-by-industry IO SAMs have the advantage of recording value added by industry.

Feuerbacher (2014) indicates that the choice between C-by-I SAM and IO SAM depends on whether secondary products are available and to what degree the change in prices are traceable. This study chooses the structure of a C-by-I SAM over IO SAM because the secondary production is accounted for (reflected by the fact that the SAM contains relatively more products than industries). IO SAMs lose the details in terms of which industries produce which products and is therefore not suitable for this study.

2.2.3 The structure and content of a SAM

There are typically six types of accounts in a SAM: the industries or activities, commodities or products, factors (labour and capital), institutions (households, firms, and the government), the capital, and rest of the world (Pyatt, 1991; Sadoulet & De Janvry, 1995). These accounts are presented in a standard SAM layout in table 1 and they relate directly to those in figure 1 above. McDonald and Punt (2004) point out that there are many alternative ways to lay out a SAM and

none of which is necessarily right or wrong. Punt (2013) add more on this by stating that the order also, in which the groups of agents appear in a SAM does not matter. These major types of accounts in a SAM may be broken down into several subaccounts and are disaggregated on the basis of the intended focus of the analyses that can be conducted using the SAM, as well as the availability of data.

Industry or Production accounts

Industry accounts or production accounts represent industries producing goods and services. Industries may produce single or multiple commodities. The production block in the SAM closely resembles the supply and use tables (Kearney, 2003), so industries may produce multiple products or commodities, also in some cases, this block resembles the input-output tables and so industries may be assumed to produce single products or commodities. The 'use' of inputs by industries is recorded in the column entries and it includes: intermediate inputs (both domestic and imported) and value added. The sum of column entries in the production accounts indicate the total inputs bought by industries. The values of output of products supplied by industries are only recorded in the row entries of the production accounts. It is however important to note that according to SNA (cited in Punt, 2013), any product produced is regarded as an output as long as it can be sold on markets or transferred between agents in the economy, no matter whether it is actually sold or given away.

Table 1: A schematic structure of a SAM

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

Source: Adapted from McDonald and Punt (2001)

Commodity or product accounts

The commodity accounts record the goods and services that are supplied during the accounting period. The row accounts for commodities identify the distribution of commodities between intermediate input and final demand. The final demand is composed of investment demand, export demand from the rest of the world and consumption demand by different institutions (households, governments and enterprises (if applicable)). All products for domestic consumption are valued at the purchaser's prices, which is inclusive of all relevant sales taxes and tariffs (PROVIDE, 2003). All prices along the row adhere to the law of one price as they are the same irrespective of which agent purchases the commodity and the only exception concerns exports since they are usually valued at export prices (a function of exogenously determined world prices). The column accounts for commodities record the domestic production of commodities by industries, imports and commodity taxes of various types. The commodity accounts also record transaction costs which are the costs associated with domestic, import and export marketing and transportation for each traded product.

Factor accounts

The factor accounts typically include labour and capital and in some cases, land is also distinguished (Punt, 2013). Labour may be disaggregated based on skills or geographical area depending on the availability of data and the issue under consideration (Kearney, 2003). In the rows, factor accounts reflect the value added by the production sectors or industries which includes wages for labour, returns to capital such as rentals on buildings and machinery and returns to land (the use of natural resources). Still in the rows, income may also flow from the rest of the world to supplement the value added factor income in order to make what is called "GNP at factor cost" (McDonald, 2008). In the columns, factor accounts reflect factor payments made to households, enterprises, the government and the rest of the world as labour income, distributed and non-distributed profits, tax payments and payments to overseas owned factors respectively.

Institutional accounts

Institutional accounts consist of three accounts in the SAM presented in table 1 and these are: households, enterprises and the government. Incomes to institutions are recorded as row entries and expenditures as column entries. Income to households is in the form of labour income, proprietor's income, capital earnings from enterprises, government transfers, and earnings from abroad. Expenditure by households is in the form of consumption, transfers to other households, direct taxes and savings. The households are disaggregated typically by socio-economic groups which could be based on income levels, skill levels, rural or urban, and farm or non-farm and this is crucial to mapping out the income distribution patterns (Arita et al., 2011). Income to government is in multiple forms: tax revenues such as tariffs on imports, direct taxes, profit taxes etc., distributed profits and transfers from abroad, like aid (McDonald, 2008). Expenditure by government is made up of transfers and government consumption demand. Income to enterprises is from non-distributed firm profits and transfers whereas expenditure by enterprises is in the form of taxes and transfers to other institutions, transfers to the rest of the world, and enterprise consumption (if applicable) and savings.

Capital accounts

The capital account refers to investment and its funding. It includes capital investment and change in stocks in the column. In the row it includes funding of investment which is recorded as savings from households, enterprises, and government as well as the balance of foreign trade on the capital account.

Rest of the world accounts

The rest of the world account records the international trade in goods and services (imports and exports), and factor income received or paid abroad, as well as transfers between international and domestic institutions.

2.2.4 Objectives of a SAM

According to King (1985) a SAM has two objectives:

- Organisation of information: This is usually information about the economic and social structures of a country, region in a country, city, or any other unit of interest in a particular year.
- Provision of a statistical basis for the creation of a plausible model: This assists in analysing how the economy works as well as to predict the effects of policy interventions, institutional changes, etc., in a country or region.

Organisation of information

SAMs are a very good way of displaying information since the structural interdependence in an economy at both the macro and meso levels are shown in a SAM in an explicit way. Furthermore, its construction helps in bringing together data from many disparate sources such as national accounts data, household surveys, etc., that help to describe the structural characteristics of an economy and this in turn helps to improve the range and quality of estimates, by highlighting data needs and identifying key gaps (World Bank, 2011). Hence it provides the first step in upgrading the statistical information (Pyatt & Round, 1985).

Basis for modelling

A SAM provides a comprehensive set of data on almost all economic participants and as a result it is used widely by economic planners and development economists towards policy analysis and it also links policy, data and models (Pyatt & Round, 1985). According to Pyatt (1988), SAMs represent a useful analytical framework for modeling due to the fact that they provide a direct input or act as databases into a range of models, including multiplier models (this is especially crucial in the context of this study) and they are also an integral part of computable general equilibrium (CGE) models. The disaggregated SAMs with different products, industries, labour groups and institutions provide suitable data for these economy-wide models.

2.2.5 Disaggregating and balancing SAMs

The United Nations (1994) (cited in Kearney, 2003) gives a distinction between the aggregated matrix and disaggregated or detailed matrix as follows: an aggregated matrix indicates the main transaction categories as well as the domestic and national balancing items, contains national

accounts figures, and portrays a picture of the entire economy, while a detailed matrix shows interrelated transactions by paying and receiving units (interrelationships among economic flows) and may be used for analytical applications. A SAM may be used as an aggregate or detailed matrix. However to what extent a SAM should be disaggregated varies in degree and depends on a purpose for developing a certain SAM, a model that uses the SAM, the policy issue analysed and also, availability of data could be another factor or a constraint. Kearney (2003) states that a disaggregated SAM usually makes allowances for a number of factor and household accounts, different industries and products and therefore a highly disaggregated SAM specifies industry activities, while a less disaggregated SAM may specify sectoral activities.

Disaggregation of a SAM such as is attempted in this study requires more data and effort. In addition, a challenge in estimating a disaggregated SAM for a recent year is to find an efficient and cost-effective way to incorporate and reconcile information from a variety of sources, including data from prior years. Aslan (2005:2) states that:

> Although it is very likely for researchers to find statistically coherent macroeconomic data (e.g., national accounting data that are published annually: supplementary data in public finance, such as tax rates for various institutions and indirect tax rates for domestic and imported commodities), data in disaggregated sector (e.g., employment, input-output structure), data in the subcategory of goods and services that are subject to international trade, and data in each type of household's demand over the commodity vector are all published with time lag and are based on different units (e.g., exchange rate, price indices).

When the collected data are inconsistent or there exists missing data for some of the variables, the researcher is bound to employ one of the various statistical techniques or SAM balancing techniques to remove 'small' errors, which will ensure that the SAM balances. These balancing techniques are discussed below.

The RAS method

This method is popular in balancing input-output tables; however it still finds a place in balancing SAMs. It is applicable in the case where consistent SAM for a particular prior period is available and the intention is to update it for a later period, given new information on row and column totals while information on the flows within the SAM is lacking (Robinson, Cattaneo and El-Said, 2001).

The problem that needs solution is presented below following Robinson, Cattaneo and El-Said (2001) as:

$$t_{ij}^{*} = a_{ij}^{*} y_{j}^{*} \tag{2}$$

$$\sum_{j} t_{ij}^{*} = \sum_{j} t_{ji}^{*} = \mathbf{y}_{i}^{*} \tag{3}$$

Where a_{ij}^{*} is a new SAM coefficient matrix that needs to be found, t_{ij}^{*} is a SAM transactions matrix with the new row and column totals and y_{j}^{*} represents known new row and column totals.

A solution to the problem stated above is reached by generating a new matrix $\mathbf{A}^{*}$ from the existing matrix $\overline{\mathbf{A}}$ by finding bi-proportional adjustment that satisfies new known row and column totals as follows:

$$a_{ij}^{*} = r_i \overline{a}_{ij} s_j \tag{4}$$

Or, in matrix notation:

$$\mathbf{A}^{*} = \hat{\mathbf{r}}\overline{\mathbf{A}}\hat{\mathbf{s}} \tag{5}$$

Where $(\hat{})$ indicates a diagonal matrix of elements of r_i and s_j that can be obtained by an iterative adjustment procedure.

This method "has been used for this purpose since the 1970s and is relatively simple. Its implementation is relatively cheap in terms of computing resources and all that is needed is the row and column sums to be used as controls" (Lemelin, Fofana & Cockburn, 2013). The SAM coefficients are important as they capture interdependence in the economy. Unfortunately, RAS relies on scaling adjustments across whole rows and down whole columns which is undesirable because it distorts the technology relationships worth preserving in SAMs (Punt, 2013). Another drawback is that it is not able to accommodate other sources of data than those on row and column totals, i.e., new cell values which are supposed to be accurately measured cannot be fixed (Lemelin, Fofana & Cockburn, 2013).

In this study, these drawbacks are taken into consideration and as a result, this method is not applied to avoid the distortion of technical (column) coefficients that can arise.

The Stone-Byron method

The Stone-Byron method (analogous to the method of restricted least squares) was suggested by Stone, Champernowne and Meade in 1942, discussed later in a SAM context for the first time by Stone in 1977 and since then, it has been used in compiling several SAMs including the Ghana SAM (Round, 2003). "This method is more flexible than the RAS method because it is suitable in cases where there are linear constraints between the elements of the SAM, which can either be that some of the row and column totals are unavailable, or linear restrictions on sums of subsets of elements, or restrictions on ratios of elements" (Punt, 2013:42). In addition, Round (2003) indicates that it makes it easier to incorporate judgment on the relative reliability of data sources and is therefore closer to the spirit of the problem at hand. In cases where all restrictions are linear, the minimand is as follows:

$$L\left(X^{*}:X,V\right)=\sum_{i,j}\left(x_{ij}^{*}-x_{ij}\right)^{2}\Big/v_{ij} \tag{6}$$

Where X is the initial estimate SAM , X^{*} is the revised SAM that satisfies the constraints, the elements of X and X^{*} can be expressed as ordered elements of vectors x and x^{*} respectively, V is the variance-covariance matrix associated with the vector x_{ij} and v_{ij} is analogous to the variances of the elements.

The Cross Entropy (CE) method

Kullback and Leibler (quoted in Lemelin et al., 2013:6) defines Cross Entropy as a measure of the one-way divergence of a posterior probability distribution (the adjusted matrix), from a prior distribution (the unadjusted matrix). Round (2003) points out that this method is formally similar to the generalized RAS method, although with some significant differences (such as, CE tries to maintain the coefficient structure of a SAM, A^{*} where the initial column coefficients are $A=a_{ij}$ rather than maintaining the transaction flows) and additional complexities (like the minimand in CE has to include the estimation of a set of error weights, w_{ih} which are part of the generation of error variables, e_{i}). This is presented as an equation as follows:

$$L\left(A^{*},W:A\right)=\sum_{i,j}a_{ij}^{\ *}\ln\left(a_{ij}^{\ *}\Big/a_{ij}\right)+\sum_{i,h}w_{ij}\ln\left(nw_{ih}\right) \tag{7}$$

According to Round (2003), the error variables help to balance the corresponding row and column totals, although they do not form part of the minimand. He continues by stating that the error weights and error variables are part of a more complex constraint set which assist in maintaining the accounting relationships between coefficients and flows in addition to normal accounting constraints. These features therefore contribute to the flexibility of the cross entropy.

The Generalised Cross Entropy (GCE) Method

The generalised cross entropy method (GCE) assumes the existence of values which are subject to various kinds of unspecified measurement errors, for the data that is being estimated. As part of estimation process, this method utilizes a prior for each value estimated as well as the characteristics of the measurement errors generated so that it can compare the measurement errors against the estimates. After, error distributions are then estimated that can explain the difference between the measured values and the estimated values that are determined as part of the process. Nevertheless, the detailed prior information regarding the measurement process can therefore be incorporated into the estimates. Furthermore, this method allows that better quality data can be given greater weight than lower quality data and prior information about row and column totals and various macro aggregates can be included to improve the accuracy of the estimation (Punt, 2013). The other advantage of this method is that it is better at estimating column coefficients which is important in preserving the technology relationships in a SAM.

Due to the advantages this method offers as well as the availability of a GAMS code for this method, this method is applied in this study.

2.3 Previous SAMs for South Africa

The first SAM for SA was developed by the Central Economic Advisory Service for the year 1978 and later its contents were updated to the year 1992 in order to undertake intertemporal analysis of aspects of income distribution in SA (Kearny, 2003). SAMs developed for SA from 1992 onwards include amongst others, the following:

- Thurlow and Van Seventer as cited by Punt (2013:113) developed SAMs which are used by the International Food Policy Research Institute (IFPRI) for the years 1998 and 2000. The addition to this list is a recent SA SAM for the year 2009 (Davis &Thurlow, 2013) and for the year 2012 (Van Seventer et al., 2016).
- The team in the Provincial Decision-Making Enabling (PROVIDE) Project of the SA national and provincial Departments of Agriculture developed a SAM for 2000 (PROVIDE, 2006). This SAM was completely redeveloped and updated to a 2007 base year by Punt (2013).
- Statistics South Africa (Stats SA) which is the SA national statistical agency as cited by Punt (2013:113) developed SAMs for the years 1998, 2002 and 2005. The addition to this list is a 2011 SA SAM (Stats SA, 2014). Mabugu et al., also cited by Punt (2013:113) developed a 2005 SAM commissioned by Partnership for Economic Policy (PEP).
- SAMs developed by Conningarth Economists which are used in consultancy work. Conningarth (2001) compiled a disaggregated SAM for South Africa commissioned by the Department of Trade and Industry (DTI). Conningarth Economists (2009) also developed a SA SAM for 2006 commissioned by Development Bank of Southern Africa (DBSA) (Conningarth Economists, 2015a). Conningarth Economists (2015b) had developed a SAM for 2014, but it does not show the secondary production.

As a comment concerning the mentioned SAMs above, Punt (2013) states that SAMs by IFPRI, PEP network and PROVIDE project are ideal for policy analysis concerned with redistribution of income as they are detailed in factor and household accounts. However, the IFPRI and PEP network SAMs do not contain detailed agricultural accounts while the PROVIDE project SAMs do (Punt, 2013). She continues to state that SAMs by Stats SA follow the layout of the 1993 and 2008 SNAs and therefore are not ideal for policy analyses concerned with redistribution of income as they are not detailed in factor and household accounts and besides, they only have single industry and commodity accounts for agriculture, forestry and fisheries.

Based on the stated comments, it is clear that there are very few developed SAMs in South Africa which are suitable for detailed analysis of the agricultural sector. This study therefore develops a 2014 SA SAM with detailed agricultural accounts to enable the quantification of the impact of the agricultural sectors within the South African economy.

2.4 SAM multiplier analysis

A SAM multiplier modeling approach is used in fulfilling the aim of this study. This section therefore, presents a justification for choosing it over other modeling approaches. The theory of this approach and the empirical evidence of this approach in agriculture are also presented.

2.4.1 Justification for using SAM multiplier modeling approach as opposed to other modeling approaches

The economic impact of the South African disaggregated agricultural sector can be examined using different modeling methods. There are three major modeling methods which are widely used to quantify such concerns: traditional input-output (IO) models, SAM multiplier models and Computable General Equilibrium (CGE) models. All these three general equilibrium models share many similarities in basic accounting structure and also have their strengths and weaknesses which are highlighted in the following studies; Adelman and Robinson (1986), Frechtling (2011), McDonald and Punt (2005), Roberts (1994), Roland-Holst and Sancho (1995), Sadoulet and De Janvry (1995), Van Wyk et al. (2015), WCPT (2007) and Zhou et al. (1997).

Denniss, 2012 (quoted in Van Wyk et al., 2015:156) points out that "an important part of the modeling process is to select the type of model that can shed the most light on the issues considered to be most important while ignoring the smallest number of other elements of the problem that might be considered relevant".

2.4.1.1 SAM multiplier models versus traditional IO models

The input-output analysis deals with the empirical study of the interdependence among the various sectors in the economy of a particular nation, region, state, etc. It shows the uses of the output from each sector or industry as an input to other industries or sectors in the economy. Traditional IO models use data from input-output tables and the basic objective of these models is to trace or describe how an industry's product is distributed throughout a region or economy. Traditional IO models include inter-sectoral flows of intermediate inputs and capture one major source of linkages in the economy. However, these models ignore the flows from producing sectors to factors of

production (value added) and then to entities such as the government and household sectors and finally back to the demand for goods. Because of these features, they are regarded as simplified or basic general equilibrium models which are suitable only for short-term analyses of small policy changes.

On the other hand, SAM multiplier models are similar to traditional IO models in the sense that the range of issues suitable for analysis by both models are the same, even the assumptions underlying both models are comparable as they are both demand driven or quantity models. However SAM multiplier models have virtue over IO models since they use SAMs as their underlying data as opposed to input-out tables. SAMs capture the full circular flow of transactions in the economy as transactions between households and factor markets and between factor markets and international markets (the rest of the world) are fully captured. This therefore allows analysis to be extended beyond the production linkages to include issues of income distribution, employment and households' welfare. In addition, this makes multipliers computed from SAM multiplier models to be larger as compared to multipliers computed from IO models. Furthermore, not only direct and indirect effects are estimated but induced effects arising from feedbacks between types of accounts in a matrix are captured as well. Because of these features, SAM multiplier models best fit to the objectives of this study, since agriculture's links with the wider economy extend beyond dependencies within the production sub-system of the economy captured by the traditional IO models.

2.4.1.2 SAM quantity models versus CGE models

General equilibrium models are categorized as flexible price models due to their ability to include substitution and endogenous price determination. CGE models are price driven and also enable complex interdependencies to be modeled unrestricted by the constraint of linearity. The database for CGE models includes a range of elasticities in addition to a SAM. The aforementioned features make CGE models to have wider application possibilities and particularly powerful with regard to issues involving relative price changes, such as fiscal policy and trade policy interventions.

Despite the fact that CGE models enable complex interdependencies to be modeled, they cannot be utilized in this study since there are typically no multipliers explicitly calculated with CGE models in comparison to SAM quantity models which are the issues of interest in this study. Although SAM quantity models are constrained by some economic assumptions, they are still more attractive as compared to CGE models since there is no need to borrow supply/demand elasticities from other studies.

2.4.2 Theoretical description of SAM multiplier models

These models are linear, similar to input-output models, but they are calibrated to SAMs as opposed to an input-output tables. When undertaking SAM multiplier analysis, the SAM needs to be partitioned into endogenous and exogenous accounts. Sadoulet and de Janvry (1995) describe endogenous accounts as those that can be influenced within the system or whose level of expenditure is directly influenced by changes in income, while exogenous accounts constitute those whose expenditures are independent of the changes in income. SAM multipliers therefore are based on coefficients in the various columns generated by changes in the value of any of the exogenous accounts. It is the common practice that accounts beyond the control of domestic institutions are made exogenous and these accounts are: government (including taxes), capital and rest of the world.

Four different types of SAM multiplier models identified in the old literature are income (accounting) multiplier models or unconstrained multiplier models (which are based on average expenditure propensities) (Pyatt, 1988; Breisinger et al., 2010), fixed price multiplier models (which are based on marginal expenditure propensities) (Pyatt & Round, 1979), mixed multiplier models or constrained multiplier models (relaxing the assumption of perfectly elastic supply functions made in the first mentioned multiplier models) (Subramanian & Sadoulet, 1990; Lewis & Thorbecke, 1992; Breisinger et al., 2010) and price multiplier models (replacing assumption of fixed relative prices by an assumption of fixed relative quantities) (Roland-Holst & Sancho, 1995). The recent literature on SAM multiplier models is given mostly by Miller and Blair (2009). They classify SAM multiplier models as quantity models and price models. This classification is the one

preferred and used in this study, therefore SAM quantity model is discussed in details in chapter 3 as it is the one applied in this study.

2.5 Empirical evidence regarding the application of SAM multiplier analysis in agricultural related issues

2.5.1 Selected international studies

Adelman and Robinson (1986) constructed a United States (US) SAM for 1982 and used a variety of multiplier models to analyze the impact of different exogenous shocks on a single agricultural account with a particular focus on the links between the agricultural and nonagricultural sectors. They drew a number of lessons from simulations in regard to the role of agriculture in the US economy which are as follows.

- Formulation of policies that benefit farmers should be targeted directly at them due to the small trickle across to agriculture of income-raising measures outside of agriculture even though this is in contrast to the situation of the farm sector in developing economies.
- Partial equilibrium analysis of the impact of policy upon farmers is likely to be misleading as a result of the large trickle across out of agriculture.
- The anti-middleman attitude of farmers has a strong basis since middlemen do capture the largest part of benefits from farm production.
- Exports of agricultural products have a large impact on the farmers' income, meaning *inter alia*, that general trade policy matters to the farm sector.
- Programs to raise farm incomes lead to a trickle up of income in the overall economy which is again in contrast with the situation in developing countries where most of the poor are farmers and agricultural labourers.

Roberts (1994) used a modified version of a SAM Leontief model to investigate the linkages between UK agriculture and the rest of the economy. She specifically examined the nature and the importance of the 'net SAM linkage effects' of agriculture which means the effects not captured by IO analysis. The empirical results from this study suggested the relatively small net SAM linkage effects of the agricultural and food accounts. The results illustrated further the differences

between agricultural commodities deriving from the structure of production, the distribution of factor incomes and the pattern of consumer demand in the UK economy. The author concluded that SAM linkage effects are best for "determining the magnitude of benefits that leak from the farm sector to the wider economy".

Bautista (2000, as cited by Pundo, 2005) used a SAM multiplier model to assess the economy-wide quantitative impacts caused by an increase in household income in agriculture on the Central Region of the Vietnam economy. The results indicated the strong agricultural growth linkages on the Central Region of the Vietnam. In addition, agricultural sectors have large output, value added and income multipliers than non-agricultural sectors in this region.

Rocchi, Romano and Stefani (2002) analysed income distribution in Italy, with a special emphasis to agricultural sector, using a SAM multiplier model. The findings from this study indicated that "fully decoupled income supporting schemes such as transfers to agricultural households are the most equitable interventions and determine a perfect targeting of the distributive effect on the relevant institutional sectors". The study also showed that "partially decoupled income supporting interventions, as the ones implemented under" the current Common Agricultural Policy (CAP), are more effective compared to others indirectly generating positive impacts on the income of agricultural households. Finally it showed that agricultural support interventions show less desirable effects in terms of their distributive impacts as their distributive impacts are biased against poorer households both in the agricultural and the non-agricultural sectors.

IICA (2004) utilized a SAM multiplier model to quantify agriculture's true contribution to the economy in 11 countries in the western hemisphere (Argentina, Brazil, Canada, Chile, Colombia, Costa Rica, Mexico, Peru, United States, Uruguay and Venezuela) that are members of the Inter-American System. This study specifically addressed agriculture and agri-food concepts, calculated agricultural linkages, simulated agriculture's impact on the economic activity of the countries as well as highlighted agriculture's contribution to the livelihoods of rural dwellers and the sector's potential for contributing to the development of national economies. The results from this study underscored the significance of the value added of the agricultural production chain to the domestic economies of American countries. This therefore corrected the traditional and the narrow view of agriculture's contribution in economic development. Furthermore, this study "validated the methodology in 11 countries and underscored the role of agriculture as a supplier of inputs, a

generator of value added and foreign exchange, and an important factor in the redistribution of income".

Wijerathna and Karunagoda (2007) developed a SAM multiplier model for Sri Lanka in order to understand forward and backward economic linkages in the rural agricultural economy of Sri Lanka as well as estimating accounting multipliers that illustrate the impact of any exogenous intervention in the economy. From their results they found agriculture as a predominant sector in Sri Lanka's economy, accounting for 80% of the total household income of an average family. In addition, while estimating multipliers for major production sectors, they showed that the impact of any external injection in the crop production sector was higher compared to other sectors since on average, the return from one unit of external injection on the crop production sector was 2.5 times the initial injection. They concluded that out of all major crops, paddy is outstanding as it can create the highest multiplier impact.

D'Haese et al. (2008) used a SAM with disaggregated accounts for the dairy sector to estimate the multiplier effects of change in the dairy chain on its actors and on other sectors in the economy of Reunion Island. Specifically to analyze the multiplier effects of changes in demand of local dairy products and government support. Their analysis, suggests that increased demand of local dairy products may mainly benefit the processing industry and to a lesser extent the farmers. Their analysis further revealed that a removal of subsidies paid to farmers, the cooperative and the processing industry can have a significant direct and indirect impact. They however highlighted that even though the removal of the support would be entirely compensated by increased demand for local dairy products, the net effect is estimated to be negative for the dairy chain.

2.5.2 Selected studies in Africa

Bautista and Thomas (1998) performed a SAM multiplier analysis using an agriculture-focused Zimbabwe SAM for 1991 which was developed under IFPRI's project on macroeconomic reforms and regional integration in Southern Africa (MERRISA). The purpose of the analysis was to investigate the economy-wide effects of exogenous income increases in various agricultural subsectors in Zimbabwe with a particular focus on the effects on overall income growth and equity. The results from the study indicated that among the five growth paths considered, the "smallholder

road to agricultural development" yields the largest increase in national income as it benefits smallholder households the most, but the income gains to the two other low-income household groups are lower compared to those arising from the four other agricultural growth paths. Moreover, food crop production, in which smallholders have a dominant share, showed a larger GDP multiplier than both the traditional (tobacco and cotton) and nontraditional (horticulture) export crop sectors, which are dominated by large-scale commercial farms. Juana and Mabugu (2005) used the same SAM as Bautista and Thomas (1998) but focused their study on assessing the small-holder agriculture's contribution to the economy of Zimbabwe with a SAM multiplier analysis. Based on their results, they concluded that the investment in small-holder agriculture should be seen as investment in the whole economy. Their study further showed clearly that small-holder agriculture promotes sustainable development and the inclusion of rural communities, especially the poorest in economic activities.

Sassi (2010) combined three different models being the input-output and the unconstrained and constrained multiplier models based on a 2003 SAM of Kenya for a better characterization of the country's economic linkages in a context of international market volatility. The purpose of the study was to understand the role of public spending in the primary sector in addressing the current food crisis and in contributing to overall economic growth and alleviating poverty and food insecurity according to the first Millennium Development Goal (MDG). The results of the study pointed to the potential positive impact of government intervention in agriculture on economic development and its limits, particularly with reference to the growth-equity nexus. Using the same 2003 SAM for Kenya, Gakuru and Mathenge (2012) developed a multiplier simulation model which tracks the linkages among demand-driven shocks and economic growth, income generation, and income distribution for different economic groups. The empirical results from the multiplier analysis indicated that due to high inequality in Kenya, stimulation of growth in agricultural and manufacturing sectors mainly benefit the richest urban household deciles who own most of the factors of production.

Bahta (2013) made use of a 2000 SAM for Lesotho to investigate the key features of the Lesotho economy and the role played by the agricultural sector. The descriptive review together with multiplier analysis from this SAM revealed the fundamental importance of agriculture development that is its dominance with respect to income generation and value of production. This

study indicated that in Lesotho, agriculture contributes 23% of gross domestic product and 12% of the total value of production while employing 26% and 24% of labour and capital respectively. The study further showed that the construction sector has the highest open SAM output multiplier but in terms of employment multipliers, agriculture and mining sectors are the leading sectors in Lesotho.

2.5.3 Selected studies in South Africa

Townsend and McDonald (1997) used the South African SAM for 1988 to do multiplier analysis of the effects of changes in agricultural policies on income distribution. They found that, poorer households will gain proportional benefits (although small) due to the increment of final demand for agricultural products, and a reduction in agricultural price supports. For instance, they found that a 6% reduction in agricultural price supports results in a 7% decline in agricultural prices, but the intersectoral effects are concentrated hence the decline in price supports has a relatively limited impact on the structure of relative commodity prices beyond the food system. They further indicated that benefits of minimum wages in agriculture decline with household incomes, with the higher wages having a limited effect on prices. In their conclusions, they stated that the policies simulations indicate the extent to which agricultural policy reforms can have a positive effect on the production of other sectors and income distribution in South Africa.

Eckert, Liebenberg and Troskie (1997) used fixed-price SAM Leontief multiplier analysis to explore the structure and workings of the Western Cape economy and found that the agricultural sector and the province's poor are bound to each other in several mutually reinforcing ways and that agriculture is particularly labor intensive, largely due to the pre-eminence of horticultural crops and certain livestock enterprises. This therefore implies that agriculture is a major source of income to lower income workers and hence growth in most agricultural commodities will assist in alleviating poverty, creating jobs, and improving provincial income distribution; better than most non-agricultural sectors. They also found that among non-agricultural sectors, the agribusinesses exceed the possible contributions of others due to, in large part, their backward linkages to production agriculture.

McDonald and Punt (2004) applied three categories of SAM multiplier models which are income (accounting), price transmission and mixed multiplier models on a 1993 SAM for Western Cape (it has 24 agricultural commodities and 9 agricultural industries) to assess the impact of a basic income grant, the impact of the agricultural and processed food export growth, the impact of a fuel price increase and the impact of increased agricultural export opportunities in the presence of supply-side constraints on the economy of the Western Cape. From simulations in regard to the impact of agriculture in the Western Cape economy, they found that agricultural export growth lead to a larger increase in the incomes of rural than urban households, hence redistribution takes place from urban to rural households.

Cloete (2010) used the North West SAM database as compiled by Conningarth Economists (2009) and disaggregated the agricultural sector into different agricultural sectors in the province. After that he computed multipliers to quantify the impact of the proposed institutional changes on the different agricultural sectors in the province. The economic multiplier analysis was reported on labour, production and value-added multipliers. Similar to the partial macroeconomic equilibrium model, direct, indirect and induced effects were reported. Results from the multiplier analyses validated the results from the partial macroeconomic equilibrium model, suggesting that the unsuccessful redistribution of agricultural land will have severe ramifications for the North West Province (NWP) economy and its people and without the implementation of such a framework, agricultural development initiatives will have a negative impact on the local economy, which will further depress the socio-economic conditions of the province.

Cloete and Rossouw (2014) used a SAM multiplier model to analyze the relative economic impact of the wildlife ranching sector, as opposed to other land-use options in South Africa. They found that the developments within the wildlife ranching sector are likely to make more impact to the South African economy than other similar land-use options like extensive livestock production.

Conningarth Economists (2015) provided sectoral multipliers (with specific reference to labour multipliers) for the Western Cape and the RSA economies. These multipliers were determined for the periods 2006 and 2014 and they were compiled for 55 sectors for both the Western Cape and RSA economies. The sectoral multipliers were expanded for the manufacturing sector to take into account selected manufacturing subsectors influenced by the Green Cape programmes, which are

food subsectors. This study showed that wine grapes have higher labour multipliers than other sectors in the South African economy.

Gebregiorgis (2015) used a SAM multiplier model to analyze the impact of the production and exportation of bioethanol from surplus maize in South Africa. The database for this model was a disaggregated and updated 2005 SA SAM developed by Stats SA (2010). The results from this model indicated that this particular biofuel policy leads to a moderate increase in domestic industries' production, value-added and foreign exchange earnings. Pertaining the income distribution, the results showed that the income inequality existing among different population groups in South Africa remains unchanged.

Ramigo (2017) used a SAM multiplier model to analyze the agricultural contribution to economic growth and development in rural Limpopo province. The dataset for this model was a 2006 Limpopo SAM developed by Conningarth Economists. The results from this model showed that agricultural sectors contribute less to economic growth in Limpopo than non-agricultural sectors in terms of output, value-added and income generation. However within the agricultural sector subtropical fruit and forestry subsectors performed relatively better in terms of contribution to the output. Finally, he recommended that in order to achieve the significant development within Limpopo province, non-agricultural sectors notably, water and electricity, financial insurance, and community and personal services should of more focus as they have large output, value added and income multipliers respectively than other sectors.

2.6 Conclusion

This chapter laid down the theoretical foundations of SAMs and SAM multiplier models as well as the justifications and the empirical literature of the use of these models. The review of the previous developed SAMs for South Africa reveals the shortage of SAMs which are suitable for the detailed analysis of the agricultural sector.

From the previous studies conducted it is evident that SAM multiplier models as a tool to be used in analysis regarding the true contribution and impact of agriculture on the wider economy is more

popular internationally than in Africa. However, it is noted that most of these studies focused their analysis only on aggregate agriculture as opposed to the disaggregated agricultural sector.

In South Africa, though the application of SAM multiplier models is used in studying the impact of the agricultural sector, it is very limited as only few studies were conducted and were based on provincial level instead of national level. Two studies were based on national level, notably Townsend and McDonald (1997) and Conningarth Economists (2015). The former is dated and only had a single account for agriculture, while the latter presented multipliers for 55 sectors based on a SAM that does not account for secondary production. In filling a substantial gap in the literature, this study examines the economic impact of the disaggregated agricultural sector in South Africa at national level using a quantity model based on detailed SAM accounting for secondary production.

CHAPTER 3: A SAM QUANTITY MODEL

3.1 Introduction

In undertaking this study, the SAM multiplier model named SAM quantity model is employed to examine the economic impact of a disaggregated agricultural sector within the South African economy. This model is the extension of input-output quantity model and belongs to the class of general equilibrium models that assume fixed relative prices in assessing the economic effects of exogenous change in income and demand. It captures the income and household consumption linkages, which makes it possible to appraise the full impacts of specific changes to the economy (Golan, Vogel, Frenzen & Ralstton, 2000).

The datasets from which this model is constructed varies and the datasets that have both commodity and industry accounts lead to a SAM quantity model that has more complicated structures than the ones with either industry accounts or commodity accounts, as the commodity-industry accounting system allows for the explicit accounting of secondary production (Miller & Blair, 2009). The SAM quantity model constructed from a dataset that has only industry accounts or only commodity accounts is called an ordinary SAM quantity model while the one constructed from a dataset that has both commodity and industry accounts is called a complex SAM quantity model. The latter is applicable in this study as the dataset developed for calibration of this model is a SAM which has both commodity and industry accounts.

Section 3.2 presents the detailed description of this model as well as the procedure for developing this model. Section 3.3 concludes this chapter.

3.2 Model description and development

The common distinguishing features of the SAM quantity model include three basic assumptions. First, prices are fixed which implies that markets clear due to adjustments of the quantities only. Second, the model assumes the income elasticities of demand to be equal to one which implies the underestimation of the impact of an increase in household income on the demand for luxury goods

and the overestimation of the impact on demand for necessities. Third, this model is demand-driven which means the supply response is perfectly elastic; this implies that there is an excess capacity in all sectors and that there are always unemployed resources which are enough to meet increases in demand. This assumption also implies that the SAM model treats job gains and losses as permanent and instantaneous. (Golan et al., 2000).

A SAM quantity model can either be an open or a closed model. It is typical in quantity models to have final demand as exogenous. The final demand includes household consumption, government expenditure, private investments and exports, so when the quantity model is exogenous in all these components of the final demand it is called an open quantity model but if some of the components of the final demand are taken out to be made endogenous instead of exogenous, it is called a closed quantity model (Miller & Blair, 2009)

Following Miller and Blair (2009), an ordinary open SAM quantity model can be applied whereby the total output equals total demand, shown as:

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{f} \tag{8}$$

Where (**x**) equals a vector of total output, (**Ax**) equals the sum of endogenous demands, and (**f**) equals exogenous demands. The matrix (**A**) is known as the technical (or input-output, or direct requirements) coefficients matrix. This matrix determines the solution to the model as the solution is depended on whether it is a singular, square or rectangular matrix.

The operational form of an open ordinary SAM quantity model therefore becomes:

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f} = \mathbf{L}\mathbf{f} \tag{9}$$

Where matrix $\mathbf{L}$ is known as the Leontief inverse or the Total Requirements Matrix of the open model, which captures the impact that an exogenous change in demand has on endogenous output.

In a closed ordinary SAM quantity model which assumes household consumption is endogenous,

the operational form of the model is extended to include factor and household accounts, and it becomes:

$$\bar{\mathbf{x}} = (\mathbf{I} - \bar{\mathbf{A}})^{-1}\bar{\mathbf{f}} = \bar{\mathbf{L}}\bar{\mathbf{f}} \tag{10}$$

Where $\bar{\mathbf{x}} = \begin{bmatrix} \mathbf{x} \\ \mathbf{v} \\ \mathbf{y} \end{bmatrix}$ and $\bar{\mathbf{x}}$ is the augmented output vector, **x** is the vector of total interindustry sector outputs, **v** is the vector of total value added inputs by factor, and **y** is the vector of total institutional income by household and enterprise.

$\bar{\mathbf{A}} = \begin{bmatrix} \mathbf{A} & \mathbf{0} & \mathbf{C} \\ \mathbf{V} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{Y} & \mathbf{H} \end{bmatrix}$ and $\bar{\mathbf{A}}$ is the augmented coefficient matrix of the endogenous accounts, **A** is the matrix of interindustry technical coefficients, **C** is the matrix of endogenous final expenditure coefficients, **V** is the matrix of endogenous value-added input shares, **Y** is the matrix of endogenous coefficients distributing factor income to endogenous institutions and **H** is the matrix of endogenous coefficients for inter-institutions income.

$\bar{\mathbf{f}} = \begin{bmatrix} \mathbf{f} \\ \mathbf{w} \\ \mathbf{h} \end{bmatrix}$ where $\bar{\mathbf{f}}$ is the augmented final demand vector, **f** is the vector of exogenously specified final demand, **w** is the vector of value-added inputs that are exogenously specified and **h** is the vector of institutional income, the levels of which are exogenously specified.

$\bar{\mathbf{L}}$ is a Leontief inverse or total matrix requirements of the closed ordinary SAM quantity model.

However, in a complex SAM quantity model, both total industry output (**x**) and total commodity output (**q**) are accounted for and in order to develop this model, the commodity-by-industry approach is used as detailed in Miller and Blair (2009). The commodity-by-industry approach is categorized into two categories namely: The square commodity-by-industry systems approach which is applied when the number of commodity accounts equals the number of industry accounts, and the non-square commodity-by-industry systems approach which is applied when the number

of commodity accounts is not equal to the number of industry accounts. In this study the SAM dataset used has more commodity accounts than industry accounts, as a result the non-square commodity-by-industry systems approach is applied in building the complex SAM quantity model used in this study.

In the commodity-by-industry approach, output per commodity equals intermediate input use per industry plus final demand per commodity, shown as:

$$\mathbf{q} = \mathbf{B}\mathbf{x} + \mathbf{e} \tag{11}$$

Equation (11) is parallel to equation (8) in an open ordinary SAM quantity model. The problem is that, unlike in equation (8), the total requirements matrix ($\mathbf{L}$) cannot be generated, as in equation (9), because the equation (11) contains commodity output (**q**) on the left-hand side and industry output (**x**) on the right hand side. The solution to this problem is to find an expression transforming industry outputs, **x**, to commodity outputs, **q** or, alternatively, to transform commodity outputs and commodity final demand, **e**, into industry terms (Miller & Blair, 2009:188).

In order for transformation to occur, it is necessary to choose the model technology assumption. There are two model technology assumptions under the commodity-by-industry approach which are: commodity-based technology and industry-based technology, however, new variants with mixed technology are also available. A commodity-based technology assumption means that commodities/products produced by more than one industry have the same input structure regardless the industry that produces them while an industry-based technology assumption means that all commodities/products produced by an industry are assumed to have the same input structure (Punt, 2015). Miller and Blair (2009) point out that commodity-based technology models are not able to generate a plausible direct requirements matrix when the number of commodities exceeds that of industries but industry-based technology models present no problem. Based on this, the industry-based technology assumption is chosen over the commodity-based technology assumption in this study.

Table 2: An example of a commodity-by-industry dataset

		Commodities			*Industries*		*Final Demand*	*Total Output*
		1	2	3	1	2		
Commodities	1							
	2							
	3							
					U		**e**	**q**
Industries	1							
	2							
		V						**x**
Value Added								
					v′			
Total Inputs								
		q′			**x′**			

Key: the shaded regions indicate values

The dimensions of the matrices that are the building blocks of the commodity-by-industry model as illustrated from table 2 are **U**, **V**, **e**, **x**, and **q**. Under the industry-based technology assumption this leads to

$$\mathbf{B} = \mathbf{U}\hat{\mathbf{x}}^{-1} \tag{12}$$

And

$$\mathbf{D} = \mathbf{V}\hat{\mathbf{q}}^{-1} \tag{13}$$

Where **U** is the Use Matrix, **V** is the Make Matrix, **D** is the market shares matrix, $\hat{\mathbf{x}}^{-1}$ is the inverse of a diagonal matrix of output by industry and $\hat{\mathbf{q}}^{-1}$ is the inverse of a diagonal matrix of output by commodity.

Using equation (13)

$$\mathbf{D} = \mathbf{V}\hat{\mathbf{q}}^{-1} \Rightarrow \mathbf{D}\hat{\mathbf{q}} = \mathbf{V} \Rightarrow \mathbf{D}\hat{\mathbf{q}}\mathbf{i} = \mathbf{V}\mathbf{i}$$

And since $\mathbf{x} = \mathbf{V}\mathbf{i}$, then

$$\mathbf{Dq = x} \tag{14}$$

Substituting **Dq** for **x** in equation (11), we get

$$\mathbf{q = B(Dq) + e = (BD)q + e}$$

From which

$$\mathbf{q = (I - BD)^{-1}e} \tag{15}$$

$\mathbf{(I - BD)^{-1}}$ in equation (15) is called a *commodity-by-commodity total requirements matrix* and it connects commodity final demand to commodity output. It plays the role of $\mathbf{(I - A)^{-1}}$ in the ordinary open SAM-based quantity model.

Alternatively, when multiplying both sides of equation (11) by **D**, we get

$$\mathbf{x = DBx + De}$$

And since **De = f,** then

$$\mathbf{x = (I - DB)^{-1}f} \tag{16}$$

$\mathbf{(I - DB)^{-1}}$ in equation (16) is called an *industry-by-industry total requirements matrix* and it connects industry demand to industry output.

Using equation (15), and multiplying both sides by **D** and since $\mathbf{Dq = x}$**, then**

$$\mathbf{x = [D(I - BD)^{-1}]e} \tag{17}$$

$\mathbf{D(I - BD)^{-1}}$ in equation (17) is called an *industry-by-commodity total requirements matrix* and it connects commodity final demand to industry output.

Table 3 below gives a summary of the derived total requirements matrices for the open complex SAM quantity model based on non-square commodity-by-industry system approach under the industry technology assumption.

Table 3: A summary of the derived total requirements matrices under the industry based technology assumption

	Industry technology	
Commodity demand driven models	*Commodity-by-Commodity matrix*	$\mathbf{(I-BD)^{-1}}$
	Industry-by-Commodity matrix	$\mathbf{D(I-BD)^{-1}}$
Industry demand driven models	*Industry-by-Industry matrix*	$\mathbf{(I-DB)^{-1}}$

The preceding discussion of the extended model is only in the context of a model that assumes household consumption to be exogenous (i.e. an open model). Therefore the theory is further developed as part of this thesis for application in the context of a closed model that assumes household consumption to be endogenous. Since this study combines both the assumption of non-square supply matrices with secondary production and the assumption of endogenous household consumption, closed complex SAM quantity model is applied in this study. There are three forms of a closed complex SAM quantity model. The first form of a closed complex SAM quantity model is presented as follows:

$$\bar{\mathbf{q}} = (\mathbf{I} - \overline{\mathbf{BD}})^{-1}\bar{\mathbf{e}} = \bar{\mathbf{M}}_{\mathbf{a}}\bar{\mathbf{e}} \qquad (18)$$

Where $\bar{\mathbf{q}} = \begin{bmatrix} \mathbf{q} \\ \mathbf{v} \\ \mathbf{y} \end{bmatrix}$ and $\bar{\mathbf{q}}$ is the augmented commodity output vector.

$\overline{\mathbf{BD}} = \begin{bmatrix} \mathbf{BD} & \mathbf{0} & \mathbf{C} \\ \mathbf{VD} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{Y} & \mathbf{H} \end{bmatrix}$ and $\overline{\mathbf{BD}}$ is the augmented partitioned matrix of the endogenous coefficients (both transformed and untransformed). **BD** is the matrix that plays a role of a technical coefficients matrix, showing commodity inputs per rand's worth of commodity output and **VD** is the matrix of transformed value added coefficients per commodity (instead of by industry as found in the SAM).

$\bar{\mathbf{e}} = \begin{bmatrix} \mathbf{e} \\ \mathbf{w} \\ \mathbf{h} \end{bmatrix}$ and $\bar{\mathbf{e}}$ is the augmented commodity final demand, , **w** is the vector of value-added inputs that are exogenously specified and **h** is the vector of institutional income, that are exogenously specified, i.e. these vectors can be used in the simulations as exogenous changes.

$\bar{\mathbf{M}}_a$ is a matrix of commodity-by-commodity (C-by-C) SAM multipliers.

The second form of a closed complex SAM quantity model is presented as follows:

$$\bar{\mathbf{x}} = (\mathbf{I} - \overline{\mathbf{DB}})^{-1}\bar{\mathbf{f}} = \bar{\mathbf{M}}_b\bar{\mathbf{f}} \qquad (19)$$

Where $\bar{\mathbf{x}} = \begin{bmatrix} \mathbf{x} \\ \mathbf{v} \\ \mathbf{y} \end{bmatrix}$ and $\bar{\mathbf{x}}$ is the augmented output vector, **x** is the vector of total interindustry sector outputs, **v** is the vector of total value added inputs by factor, and **y** is the vector of total institutional income by household and enterprise.

$\overline{\mathbf{DB}} = \begin{bmatrix} \mathbf{DB} & \mathbf{0} & \mathbf{DC} \\ \mathbf{V} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{Y} & \mathbf{H} \end{bmatrix}$ and $\overline{\mathbf{DB}}$ is the augmented matrix of endogenous coefficients (both transformed and untransformed). **DB** is the matrix comparable to technological coefficients matrix **A** in the ordinary industry-by-industry SAM quantity model and it shows inputs from industries per rand's worth of industry production and **DC** is the matrix of transformed consumption coefficients giving consumption per industry (instead of by commodity as found in the SAM).

$\bar{\mathbf{f}} = \begin{bmatrix} \mathbf{f} \\ \mathbf{w} \\ \mathbf{h} \end{bmatrix}$ where $\bar{\mathbf{f}}$ is the augmented final demand vector, **f** is the vector of exogenously specified final demand, **w** is the vector of value-added inputs that are exogenously specified and **h** is the vector of institutional income, the levels of which are exogenously specified, i.e. these vectors can be used in the simulations as exogenous changes.

$\bar{\mathbf{M}}_b$ is a matrix of industry-by-industry (I-by-I) SAM multipliers.

The third form of a closed complex SAM quantity model is presented as follows:

$$\bar{\mathbf{x}} = [\bar{\mathbf{D}}(\mathbf{I} - \overline{\mathbf{BD}})^{-1}]\bar{\mathbf{f}} = \bar{\mathbf{M}}_c\bar{\mathbf{f}} \qquad (20)$$

$\bar{\mathbf{D}} = \begin{bmatrix} \mathbf{D} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{I} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{I} \end{bmatrix}$ and $\bar{\mathbf{D}}$ is the augmented matrix displaying the market shares (D), and identity matrices on the diagonal, i.e. for intra factor transfers and intra endogenous institutional transfers. $\bar{\mathbf{D}}$ is used to transform the industry-by-industry (I-by-I) SAM multipliers to commodity-by-industry (C-by-I) SAM multipliers.

$\bar{\mathbf{M}}_{\mathbf{c}}$ is a matrix of commodity-by-industry (C-by-I) SAM multipliers.

The results in $\bar{\mathbf{M}}_{\mathbf{a}}$ are as a result of a unit increase of commodity demand, in $\bar{\mathbf{M}}_{\mathbf{b}}$ and $\bar{\mathbf{M}}_{\mathbf{c}}$ are a result of a unit increase of industry demand. If the production accounts of matrices $\bar{\mathbf{M}}_{\mathbf{a}}$, $\bar{\mathbf{M}}_{\mathbf{b}}$ and $\bar{\mathbf{M}}_{\mathbf{c}}$ are assumed to represent a sector, then the results in each of these matrices will be due to a unit injection in each sector. In this study, the production accounts of these matrices are assumed to represent sectors, hence the multiplier effects will be due to a unit injection in each sector regardless of the matrix chosen.

The notion of multipliers computed from a SAM quantity model are based on the difference between the initial effect of an exogenous change and the total effects of that change. The definition of the total effects is determined by whether the model is closed or open. The total effects from an open SAM quantity model can be defined as the direct and indirect effects and the multipliers that incorporate these effects are known as simple multipliers or open multipliers. On the other hand, the total effects from a closed SAM quantity model can be defined as direct, indirect and induced effects, and the multipliers that incorporate these effects are known as total multipliers or closed multipliers (Miller & Blair, 2009).

Miller and Blair (2009) point out that the frequently used types of multipliers are those that estimate the effects of exogenous changes on (i) outputs of the sectors in the economy (output multipliers), (ii) income earned by household in each sector because of the new outputs (household income multipliers), (iii) employment, i.e., jobs, in physical terms that is expected to be generated in each sector due to the new outputs (employment multipliers) and (iv) the value added that is

created by each sector in the economy due to new outputs (value added multipliers). In this study, the total multipliers are used to estimate the effects of exogenous changes on (i), (ii), (iv), and consumption (not frequently used). These can be summarized as follows:

Total output multipliers $(\bar{m}(o)_j) = \sum_{i=1}^{n+1} \bar{l}_{ij} \Big/ \Delta f_j = \sum_{i=1}^{n+1} \bar{l}_{ij}$ (21)

Total income multipliers $(\bar{m}(h)_j) = \sum_{i=1}^{n+1} a_{n+1,i} \bar{l}_{ij} \Big/ \Delta f_j = \sum_{i=1}^{n+1} a_{n+1,i} \bar{l}_{ij} = \bar{l}_{n+1,j}$ (22)

Δ symbolizes a change. Equations 21 and 22 hold if Δf_j = 1 which is the exogenous change; and if Δx_i = 1 which is the initial effect. $\bar{l}_{ij}$ is the elements in $\bar{\mathbf{L}}$ (Leontief inverse of a closed quantity model) and $a_{n+1,j}$ is a change in sector j payments to labour. Total value added multipliers equation is equivalent to that of total income multipliers but $a_{n+1,j}$ is replaced with sector j's value added payments. In addition to these multipliers, household consumption multipliers are calculated in this study.

The above equations hold true for SAM quantity model used in this study as $\bar{\mathbf{L}}$ is understood to be the total requirements matrix in a closed SAM quantity model as seen from the preceding discussion of this model.

In this study the first form of a closed complex SAM quantity model which is presented by equation (18) is applied to calculate the output multipliers, gross value added multipliers, household income multipliers and household consumption multipliers, and for the generation of simulations. This form of the model is preferred over the two other forms because the price indices are strictly consistent in the commodity-by-commodity matrices as pointed by 2008 SNA.

3.3 Conclusion

The chapter presented the assumptions and the types of multipliers associated with the SAM quantity model. It further distinguished and discussed two categories of a SAM quantity model as

(a) an ordinary SAM quantity model and (b) a complex SAM quantity model, and presented the total requirements matrices for these models based on whether they are open or closed with respect to institutions (enterprises and households). It outlined the steps of building the complex SAM quantity model applicable in this study using the non-square commodity-by-industry system approach.

Lastly the three forms of a closed complex SAM quantity model were presented in this chapter. The first form is used for computation of output multipliers, value added multipliers, institutional income multipliers and household consumption multipliers, and for generation of policy simulations in Chapter 5.

CHAPTER 4: ACTUAL DATASET

4.1 Introduction

This chapter aims to develop a database that captures all the monetary flows in the South African economy during 2014. This data is presented in SAM format. This SAM is a national one and it is unique from previous national SAMs as it is detailed in agricultural and food processing accounts to provide a tool for policy analysis and policy making of agricultural management and national economic development. It is developed in a similar structure to the one proposed by Pyatt in 1988 as it is detailed in factor and household accounts as well and therefore it is an ideal database for conducting economy-wide impact assessments that include SAM multiplier analysis and CGE modeling. This SAM is constructed from various data sources including national accounts, supply and use tables, previous SAMs, agricultural data and other data sources. The missing information when constructing this SAM is estimated by a Generalised Cross-Entropy Estimation technique. The balanced SAM is then used as dataset for the SAM quantity model in chapter 5.

This chapter is structured as follows: Section 4.2 presents in detail the process followed in the construction of the fully disaggregated 2014 SA SAM. It describes the methodology adopted, data sources used, assumptions made and criteria chosen to disaggregate the SAM accounts. It ends by briefly discussing the balancing procedure followed when estimating the missing information. Section 4.3 presents the findings from the balanced detailed 2014 SA SAM. Finally, Section 4.4 concludes this chapter.

4.2 Development of a 2014 SAM for South Africa with detailed agricultural accounts

4.2.1 Data sources

Table 4: Data sources used for developing a detailed 2014 SA SAM

Data source and publication/accessed year	*Title of the publication*
Animal Feed Manufacturers Association (AFMA, 2015)	Animal Feed Industry Statistics
Computus Management Bureau (CMB, 2012)	Enterprise Budgets 2010/2011
Department of Agriculture, Forestry and Fisheries (DAFF, 2016a)	Abstract of Agricultural Statistics 2016
Department of Agriculture, Forestry and Fisheries (DAFF, 2016b)	Trends in Agricultural Sector 2015
HORTGRO, 2014	Key Deciduous Fruit Statistics 2014
Douglas, Tendai & Patrick (2014)	Enterprise Budgets 2013
KwaZulu-Natal Department of Agriculture, Environmental Affairs and Rural Development (DAER, 2017)	COMBUD Crop Budgets 2010/2011
National Agricultural Marketing Council (NAMC, 2012)	Input cost monitor: The story of meat and wool
South African Cane Growers Association (SACGA, 2017)	Cane Planting Costs 2016/2017 season
South African Grain Industry Services (SAGIS, 2015)	Crop Budgets
South African Poultry Association (SAPA, 2014)	2014 Industry Profile
South African Reserve Bank (SARB, 2016)	Quarterly Bulletins
South African Revenue Services (SARS, 2016a)	Imports and exports data for 2014
South African Revenue Services (SARS, 2016b)	SARS customs and tariffs book from 2012
Statistics South Africa (Stats SA, 2009)	Census of Commercial Agriculture 2007
Statistics South Africa (Stats SA, 2015a)	Agricultural Survey 2014
Statistics South Africa (Stats SA, 2015b)	2010 Supply and Use tables
Statistics South Africa (Stats SA, 2016)	2014 Supply and Use tables (SUTs)
Van Seventer, et al., 2016	2012 RSA SAM

Source: Own compilation

4.2.2 Design of the 2014 SA SAM

In designing the accounts for 2014 SA SAM, the accounts of 2014 macro SAM are taken as a base but the detailed accounts for the industries and commodities are taken from the 2014 SUTs. The resultant SAM is therefore called a primary step SAM and it distinguishes 62 industries, 104 commodities and single accounts for transaction costs, labour, capital, households, enterprises, government, taxes, savings-investment, stock changes and rest of the world. The classification used for these commodities is Central Product Classification (CPC) version 2.1 and for industries it is the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4.

Starting from this base (a primary step SAM), the SAM is further disaggregated using more updated information in many spheres. While the agricultural sector was aggregated into one industry and two commodity accounts in a primary step SAM, it is then disaggregated into 31 accounts (31 industries by 31 products). The CPC and ISIC classifications are used in disaggregating agricultural accounts in order to be consistent with a primary step SAM. The food industry was also a single account in the primary step SAM so it is further disaggregated into 13 industry accounts using shares from 2010 SUTs since 2010 was the most recent year for which the food industry was disaggregated in the published supply tables. The resultant SAM at this stage is an intermediate step SAM.

Starting from the intermediate step SAM, tax is further disaggregated into 4 accounts, labour into 4 accounts by educational attainment level and households into 14 accounts by national per capita expenditure percentiles (that is, 9 expenditure deciles with the top decile split further into 5 more groups, i.e. 2 percentiles each) using shares from the 2012 SA SAM. These shares are taken from the 2012 SA SAM because it is most recent SAM at the time of conducting this study and its supply and use matrix accounts are consistent with the primary step SAM. Capital account is split into land and capital.

The final SAM is called the detailed 2014 SA SAM and it has 268 rows and an equal number of columns, i.e. a 268 by 268. Figure 2 below present the accounts in the detailed 2014 SA SAM.

Figure 2: Accounts in the 2014 SA SAM

Industries (104)

Agriculture, Forestry and Fisheries (33):*1*. Wheat *2*.Maize *3*.Sorghum *4*.Other cereals *5*.Leafy vegetables *6*.Melons *7*.Fruit bearing vegetables *8*.Green leguminous vegetables *9*. Root, bulb & tuberous vegetables, n.e.c. *10*.Other vegetables *11*.Tropical and subtropical fruits *12*.Oranges *13*.Other citrus fruits *14*.Grapes *15*.Apples *16*.Other fruits *17*.Nuts *18*.Oilseeds & oleaginous fruits *19*.Potatoes *20*.Other tubers and edible roots *21*.Stimulant,spice & aromatic crops *22*.Pulses *23*.Sugar crops *24*.Other plants *25*.Cattle *26*.Goats & sheep *27*.Poultry *28*.Pig *29*.Raw milk *30*.Eggs *31*.Other animals *32*.Forestry *33*.Fishing

Mining (4):*1*.Mining of coal &lignite 2.Mining of gold & uranium ore 3.Mining of metal ores 4.Other mining &quarrying

Food processing (13):*1*. Meat *2*.Fish *3*.Fruit, Vegetables *4*.Oils, Fats *5*.Dairy *6*.Grain mill *7*.Starches *8*.Animal feeds *9*.Bakery *10*.Sugar *11*.Cocoa, chocolate *12*.Pastas *13*.Other food

Other manufacturing and industry (29): *1*.Beverages and tobacco *2*.Spinning, weaving and finishing of textiles *3*.Knitted, crouched fabrics, wearing apparel, fur articles *4*.Tanning and dressing of leather *5*.Footwear *6*.Sawmilling, planning of wood, cork, straw *7*.Paper *8*.Publishing, printing, recorded media *9*.Coke oven, petroleum refineries *10*.Nuclear fuel, basic chemicals *11*.Other chemical products, man-made fibres *12*.Rubber *13*.Plastic *14*.Glass *15*.Non-metallic minerals *16*.Basic iron and steel, casting of metals *17*.Basic precious and non-ferrous metals *18*.Fabricated metal products *19*.Machinery and equipment *20*.Electrical machinery and apparatus *21*.Radio, television, communication equipment and apparatus *22*.Medical, precision, optical instruments, watches and clocks *23*.Motor vehicles, trailers, parts *24*.Other transport equipment *25*.Furniture *26*.Manufacturing n.e.c, recycling *27*.Electricity, gas, steam and hot water supply *28*.Collection, purification and distribution of water *29*.Construction

Service (25): *1*.Wholesale trade, commission trade *2*.Retail trade *3*.Sale, maintenance, repair of motor vehicles *4*.Hotels and restaurants *5*.Land transport, transport via pipe lines *6*.Water transport *7*.Air transport *8*.Auxiliary transport *9*. Post and telecommunication *10*.Financial intermediation *11*.Insurance and pension funding *12*.Activities to financial intermediation *13*.Real estate activities *14*.Renting of machinery and equipment *15*.Computer and related activities *16*.Research and experimental development *17*.Other business activities *18*.Government *19*.Education *20*.Health and social work *21*.Sewerage and refuse disposal *22*.Activities of membership organisations *23*.Recreational, cultural and sporting activities *24*.Other activities *25*.Non-observed, informal, non-profit, households

Commodities (134)

Agriculture, Forestry and Fisheries (33)*:* Same as industries ***Mining (5): Food processing (14):*** Same as industries except that processed fruit and vegetables produce fruit and vegetable commodities separately hence 14 accounts.

Other manufacturing and industry (57): *1*.Alcohol, beverages *2*.Soft drinks*3*.Tobacco products *4*.Textile fabrics *5*.Made-up textile, articles *6*.Carpets *7*.Textile n.e.c. *8*.Knitting fabrics *9*.Wearing apparel *10*.Leather products *11*.Footwear *12*.Wood products *13*.Paper products *14*.Printing *15*.Petroleum products *16*.Basic chemicals *17*.Fertilizers, pesticides *18*.Paint, related products *19*.Pharmaceutical products *20*.Soap, cleaning, perfume *21*.Chemical products n.e.c. *22*.Rubber tyres *23*.Other rubber products *24*.Plastic products *25*.Glass products *26*.Non-structural ceramic *27*.Structure non-refractory clay *28*.Plaster, cement *29*.Articles of concrete *30*.Non-metallic products n.e.c. *31*.Furniture *32*.Jewellery *33*.Manufactured products n.e.c. *34*.Wastes, scraps *35*.Iron, steel products *36*.Non-ferrous metals *37*.Structural metal products *38*.Tanks, reservoirs *39*.Other fabricated metal *40*.Engines, turbines *41*.Pumps, compressors *42*.Bearings, gears *43*.Lifting equipment *44*.General machinery *45*.Special machinery *46*.Domestic appliances *47*.Office machinery *48*.Electrical machinery *49*.Radio, television *50*.Medical appliances *51*.Motor vehicles, parts *52*.Ships and boats *53*.Railway and trams *54*.Aircrafts *55*.Other transport equipment *56*.Construction *57*.Construction services

Service (25): *1*.Trade services *2*.Accommodation *3*.Catering services *4*.Passenger transport *5*.Freight transport *6*.Supporting transport services *7*.Postal, courier services *8*.Electricity distribution *9*.Water distribution *10*.Financial services *12*.Insurance, pension *13*.Other financial services *14*.Real estate services *15*.Leasing, Rental services *16*.Research, development *17*.Legal, accounting *18*.Other business services *19*.Telecommunications *20*.Support services *21*.Manufactured services n.e.c. *22*.Public administration *23*.Education services *24*.Health, social services *25*.Other services n.e.c.

Factors (6)

Land (1), Capital (1) Labour (4): Primary or less: workers with some or no primary schooling, i.e. grades 1-7**,** Middle: workers who have completed grade 10**,** Secondary: workers who have completed grade 12**,** Tertiary: this includes workers who have completed at least some post-secondary or higher education

Households (14):

hhd-0 (0-10 percentiles)**,** hhd-1(10-20 percentiles)**,** hhd-2 (20-30 percentiles)**,** hhd-3 (30-40 percentiles)**,** hhd-4 (40-50 percentiles)**,** hhd-5 (50-60 percentiles)**,** hhd-6 (60-70 percentiles)**,** hhd-7 (70-80 percentiles)**,** hhd-8 (80-90 percentiles)**,** hhd-91 (90-92 percentiles)**,** hhd-92 (92-94 percentiles)**,** hhd-93 (94-96 percentiles)**,** hhd-94 (96-98 percentiles)**,** hhd-95 (98-100 percentiles)

Government (5):

Core government account and ***4 tax accounts*** (activity/producer taxes, direct taxes, import tariffs and sales taxes (VAT))

Other accounts (5):

Transaction costs, enterprises, savings-investment, stock changes and rest of the world

4.2.3 Deriving a Macro SAM and primary step SAM

In developing a 2014 SAM for South Africa with detailed agricultural accounts, the initial task is to combine data from the 2014 national accounts (SARB, 2016) and 2014 SUTs (Stats SA, 2016) into a primary step SAM which identifies a single type of labour and a single household. This is done by first deriving the macro SAM which provides the control totals for each of the sub matrices for the detailed SAM of South Africa, the control totals are then disaggregated based on the shares of SUTs. The derived macro SAM is presented in table 5. It is for the base year 2014 and it is derived based on the information drawn from Quarterly Bulletin of June 2016 published by the South African Reserve Bank (SARB, 2016). SARB publishes the national accounts with a relatively small residual which causes an unbalanced macro SAM. However, this residual is absorbed into the capital account in order to balance the macro SAM.

This section therefore explains how each macro SAM entry is derived and how the value of each macro SAM entry is distributed based on the shares of 2014 SUTs to come to disaggregated account entries for the primary step SAM and how factors and households are disaggregated (part of final stage). Each entry in the macro SAM is discussed below. The notation for SAM entries is (row, column) and the values are in millions of 2014 South African Rand. In discussion of the entries, each row is discussed in turn; the code for the accounts in the Quarterly Bulletin is used for cell references at the end of each first discussion followed by the page number in brackets. The second discussion under each macro SAM entry describes how the value is distributed to generate disaggregated entries of the primary step SAM, however this discussion is not provided where there is single SAM entry. Other adjustments are discussed at the end of this section.

First Row: Industries Row

- *(Industries, Commodities)...R7 506 713 million*

This is the value of total marketed output since all output is assumed to be supplied to markets (supply of products by industries at basic prices). This value is equivalent to gross output, where gross output is the sum of intermediate demand and GDP at factor cost. Each industry may produce one product or multi products. 6870J (S-133)

Table 5: 2014 macro SAM for South Africa based on SARB data (in R million)

Receipts \ Payments			1	2	3		4	5	6		7		8	9
			Industries	**Products**	**Factors**		**Enterprises**	**Households**	**Government**		**Capital**		**Rest of World**	**Totals**
					Labour	**Capital**			**Expenditure**	**Taxes**	**Investment**	**Stock changes**		
1	**Industries**			7 506 713										**7 503 713**
2	**Products**		4 086 396					2 283 383	787 455		798 044	9 421	1 188 844	**10 077 550**
3	**Factors**	**Labour**	1 754 396											**1 754 396**
		Capital	1 602 295											**1 602 295**
4	**Enterprises**					1 022 786		109 592	85 603					**1 219 567**
5	**Households**				1 752 432	488 289	333 426		202 380				11 792	**2 775 853**
6	**Government**	**Income**				91 220	8 741			1 013 973				**1 113 934**
		Taxes	63 626	392 290			204 050	354 008						**1 013 973**
7	**Capital**	**Savings**					587 869	28 870	-10 963				201 687	**807 463**
		Stock changes									9 421			**9 421**
8	**Rest of World**			1 254 539	1 964		97 947		47 873					**1 402 323**
9	**Totals**		**7 503 713**	**10 077 550**	**1 754 396**	**1 602 295**	**1 219 567**	**2 775 853**	**1 113 934**	**1 013 973**	**807 463**	**9 421**	**1 402 323**	

Source: Own calculations based on SARB Quarterly Bulletin for June 2016 (SARB, 2016)

Total domestic production of each industry is disaggregated across commodities that they make according to the shares in the supply table.

Second Row: Commodities Row

- *(Commodities, Industries)...R4 086 396 million*

This is the value of intermediate inputs used in the production process (intermediate consumption at purchaser's price). 6871J (S-133)

Disaggregated across industries and products according to the shares in the use table.

- *(Commodities, Households)…R2 283 383 million*

This is payment from households to commodities and it is equal to final consumption expenditure by households at purchaser's prices. 6007J (S-108)

Disaggregated across commodities according to the shares in the use table and across household income classes using shares from 2012 SA SAM.

- *(Commodities, Government)…R787 455 million*

This is payment from government to commodities and it is equal to the final consumption expenditure by general government at purchaser's prices. 6008J (S-108)

Disaggregated across commodities according to the shares in the use table.

- *(Commodities, Investment)…R798 044 million*

This is the value of gross fixed capital formation (GFCF), which is total public and private investment plus the reported residual value. 6009J (S-108) and 6011J (S-108)

Disaggregated across commodities according to the shares in the use table.

- *(Commodities, Stock changes)…R9 421 million*

This is the value for the change in inventories. 6010J (S-108)

Disaggregated across commodities according to the shares in the use table.

- *(Commodities, Rest of the world)…R1 188 844 million*

This is the value of total exports of goods and services (Total export demand). 6013J (S-134)

Disaggregated across commodities according to the shares in the use table.

Third Row: Factors Row

- (*Labour, Industries)…R1 754 396 million*

This is the value of the returns to labour which is compensation to employees. 6000J (S-108)

Labour income is disaggregated across industries according to shares in the use table and subsequently split across four educational groups using shares from 2012 SA SAM.

- *(Capital, Industries)… R1 602 295 million*

This is the value of the returns to capital which is gross operating surplus/mixed income. 6212J (S-133)

Mixed income is disaggregated across industries according to the shares in the use table.

Fourth Row: Enterprises Row

- *(Enterprises, Capital factor)…R1 022 786 million*

This is the payment of gross operating surplus to financial and non-financial enterprises since enterprises earn the returns to capital generated during the production process after they have paid factor taxes and repatriated profits. 6706J (S-129) and 6746J (S-130)

- *(Enterprises, Households)…R109 592 million*

This is the difference between the interest on property income paid and received by households. 6833J and 6828J both on (S-132)

- *(Enterprises, Government expenditure)…R85 603 million*

This is the value for government transfers to enterprises. It is treated as a residual balancing item

in the macro SAM.

Fifth Row: Households Row

- *(Households, Labour factor)…R1 752 432 million*

This value is for labour incomes received directly by Households. 6240J (S-132).

It is disaggregated across types of labour and household income classes according to the shares in 2012 SA SAM.

- *(Households, Capital factor)…R488 289 million*

This is the payment of gross operating surplus/mixed income to households. 6826J (S-132)

This payment is distributed to different household groups based on 2012 SA SAM shares.

- *(Households, Enterprises)…R333 426 million*

This is the payment of indirect capital returns to households by enterprises after they have saved, paid taxes and made other transfers to the government and rest of world. It is treated as a residual balancing item in the macro SAM.

It is disaggregated across household categories based on 2012 SA SAM shares.

- *(Households, Government expenditure)…R202 380 million*

This value is for the social benefits as well as miscellaneous current transfers paid by the government to households. 6798J and 6801J both on (S-131)

Disaggregated across household categories based on the shares in 2012 SA SAM.

- *(Households, Rest of the world)… R11 792 million*

This value is for net miscellaneous current transfers. 6912J and 6909J both on (S-134)

Disaggregated across household income categories using shares in 2012 SA SAM.

Sixth Row: Government Row

- *(Government Income, Capital factor)…R91 220 million*

This is the value of the government's gross operating surplus. 6786J (S-131)

- *(Government income, Enterprises)…R8 741million*

This is the value for the dividends and rent received by the government from the enterprises.6789J and 6790J both on (S-131)

- *(Government income, Government taxes)… R1 013 973 million*

This is transfer from tax accounts to general government. It comprises taxes on production plus other taxes on production less subsidies on products and subsidies on production plus current taxes on income and wealth. 6603J, 6600J, 6604J, 6601J (S-108) and 6251J (S-131)

- *(Government taxes, Industries)… R63 626 million*

This is the net production (activities) tax which is the difference between other taxes on production and other subsidies on production. 6600J and 6601 both on (S-108)

This tax is disaggregated across industries according to the shares in the use table.

- *(Government taxes, Commodities)…R392 290 million*

This is the net commodities tax which is equal to the difference between taxes on commodities and subsidies on commodities. 6603J and 6604J both on (S-108)

This net commodities tax is disaggregated across commodities based on supply table shares.

- *(Government taxes, Enterprises)…R204 050 million*

This is the value for the current taxes on income and wealth paid by both financial and non-financial enterprises to the government. 6717J (S-129) and 6758J (S-130)

- *(Government taxes, Households)…R354 008 million*

This value is for direct taxes (PAYE) paid indirectly by households to the government and it is

recorded as the value of current taxes on income and wealth. 6245J (S-132)

Disaggregated across household income categories using shares in 2012 SA SAM.

Seventh Row: Capital Row

- *(Savings, Enterprises)…R587 869 million*

This is gross saving by financial and non-financial enterprises plus residuals. 6725J (S-129) and 6765J (S-130) plus 6724J (S-129) and 6764J (S-130)

- *(Savings, Households)…R28 870 million*

This is the value of gross saving by households plus residual. 6848J and 6846J both on (S-132)

Disaggregated across household income categories using shares in 2012 SA SAM.

- *(Savings, Government expenditure)…(-)R10 963 million*

This is the value of gross saving (or deficit) by the government. 6803J (S-131)

- *(Savings, Rest of the world)…R201 687 million*

This is the current external balance (balance on current account). 6913J (S-134)

- *(Stock changes, Investment)…R9 421 million*

This is the value of change in inventories. 6010J (S-108)

Eighth Row: Rest of the world Row

- *(Rest of the world, Commodities)…R1 254 539 million*

This is the value of total imports of goods and services. 6014J (S-108). This value is distributed across commodities based on supply table shares.

- *(Rest of the world, Labour factor)…R1 964 million*

This is the compensation of non-residents working in South Africa less the compensation of South

African residents working abroad. 6207J and 6208J both on (S-134)

It is disaggregated across types of labour according to total labour income received by households using the 2012 SA SAM shares.

- *(Rest of the world, Enterprises)…R97 947 million*

These are transfers to the rest of the world by enterprises. It is treated as a residual balancing item in the macro SAM.

- *(Rest of the world, Government expenditure)…R47 873 million*

These are current transfer payments by the central government. 5727Y (S-85)

Additional adjustments that are made to the existing data sources:

From the 2014 SUTs: The household and import adjustments (D1 and D2) in the use and supply tables that are not associated with commodities is what causes most of the discrepancies in the commodity row and column totals. Adjustments were made to exports, household consumption and imports based on household consumption shares, instead of spreading the entire adjustment value proportionately. The residual amount for research and development commodity account is huge and as a result it is absorbed in the capital formation for this account.

Previous SUTs had a single agricultural commodity account but the recent ones, including 2014 SUTs, disaggregated this account into agriculture (crops) and live animals but the agriculture industries account remains single. As a consequence of this disaggregation, the live animal subsector seems to be understated in the published SUT for 2014 as revealed by the lower ratio of its output to agriculture (crops) output than what it is supposed to be, the lack of agricultural industry intermediate demand for live animal commodities, some intermediate inputs by agricultural industry that were understated while others were overstated, and there was lower household consumption for these products (live animals) as compared to crops. Adjustments in these accounts are therefore made using information from the 2014 agricultural survey (Stats SA, 2015a) and from the Abstract of Agricultural Statistics (DAFF, 2016a).

4.2.4 Disaggregating agriculture and agro-processing accounts

Since the objective of developing the SA 2014 SAM is for analysis of the economic impact of the agricultural sectors within the South African economy, the industry and commodity accounts for the agricultural sector are therefore disaggregated considerably within the primary step SAM. They are disaggregated into 31 industries and 31 commodities using CPC version 2.1 and ISIC Rev 4 classifications. The commodities names are the same as industries names. Table 6 indicates the CPC version 2.1 description of these 31 agricultural commodities and their correspondence to ISIC Rev 4 and Harmonized System.

In the primary step SAM, food processing commodity accounts are already disaggregated into 14 commodities but the food processing industries are not. In order to provide the more detailed information about the downstream activities of the food system and its relationship with the primary agricultural sectors, the single food processing industry is therefore disaggregated into 13 industries using shares from the 2010 supply and use tables (Stats SA, 2015b).

Table 6: CPC description of the agricultural commodities in 2014 SA SAM and their corresponding HS and ISIC 4 codes

Agricultural commodity accounts in 2014 SA SAM	***CPC version 2.1 Description***	***Correspondence***	
		Harmonised System (HS) 2012	***ISIC 4***
	Agriculture: CROPS/PLANTS SUBSECTOR		
Wheat	Wheat (seed and other)		
Maize	Maize (seed and other)	1005.10, 1005.90	0111
Sorghum	Rice (seed), Rice paddy, other (not husked)	1006.10	0112
Other cereals	Barley (seed and other), Rye (seed and other), Oats (seed and other), Millet (seed, other), Triticale, Buckwheat, Fonio, Quinoa, Canary seed, Other cereals n.e.c.	1003.10, 1003.90, 1002.10, 1002.90, 1004.10, 1004.90, 1008.21, 1008.29, 1008.60, 1008.10,1008.40, 1008.50,1008.30, 1008.90	0111
Leafy vegetables	Asparagus, Cabbages, Cauliflowers and broccoli, Lettuce and chicory , Spinach Artichokes , Other leafy or stem vegetables	0709.20, 0704.20, 0704.10, 0705,0709.70, 0709.91, 0709.99	0113
Melons	Watermelons, Cantaloupes and other melons	0807.11, 0807.19	0113
Fruit bearing vegetables	Tomatoes, Pumpkins, Squash and Gourds, Cucumbers and gherkins, Eggplants (aubergines), Chillies and peppers, green (Capsicum spp. And Pimenta spp.), Other fruit-bearing vegetables	0702, 0709.93, 0707, 0709.30, 0709.99 0709.60	

Agricultural commodity accounts in 2014 SA SAM	***CPC version 2.1 Description***	***Correspondence***	
		Harmonised System (HS) 2012	***ISIC 4***
Green leguminous vegetables	Green beans, Green peas, Other green leguminous vegetables	0708.20, 0708.10, 0708.90	0111
Root, bulb & tuberous vegetables, n.e.c	Carrots and turnips, Green garlic, Onions, Leeks and other alliaceous vegetables, Other root, bulb and tuberous vegetables	0706.10, 0703.20, 0703.10, 0703.90 0706.90	0113
Other vegetables	Vegetable seeds, except beet seeds, Mushrooms and truffles, Vegetables, fresh, n.e.c.	1209.91, 0709.51 0709.40	0113
Tropical and subtropical fruits	Avocados, Bananas, Plantains and cooking bananas, Dates , Figs, Mangoes, Guavas and mangosteens, Papayas, Pineapples, Other tropical and subtropical fruits, n.e.c.	0804.40, 0803.90, 0803.10 0804.10, 0804.20, 0804.50, 0807.20, 0804.30, 0810.60	0122
Oranges	Oranges	0805.10	0123
Other citrus fruits	Pomelos and grapefruits, Lemons and limes, Tangerines, mandarins, clementines, Other citrus fruit, n.e.c.	0805.40, 0805.50,0805.20 0805.90	0123
Grapes	Grapes	0806.10	0121
Apples	Apples	0808.10	0124
Other fruits	Pears and quinces, Apricots, Cherries, Peaches and nectarines, Plums and sloes, Other pome fruits and stone fruits, Berries and other fruits, Currants and gooseberries, Kiwi fruit Raspberries, blackberries, mulberries and loganberries, Other berries; fruits of the genus, Vaccinium , Other fruits, n.e.c., Fruit seeds	0808.30, .40, 0809.10, 0809.21, .29, 0809.30, 0809.40, 0810.90, 0810.30, 0810.50, 0810.20, 0810.10, 0810.40, 0810.70, 1209.99	
Nuts	Almonds (in shell),Cashew nuts (in shell), Chestnuts (in shell), Hazelnuts (in shell), Pistachios (in shell), Walnut (in shell) Brazil nuts (in shell), Other nuts (excluding wild edible nuts and groundnuts), in shell	0802.11, 0801.31, 0802.41, 0802.21, 0802.51, 0802.31, 0801.21, 0802.61, .70,.80, .90	0125
Oilseeds & oleaginous fruits	Soya beans (seed and other), Groundnuts (excluding shelled), Groundnuts, (seed and in shell) Cottonseed (seed and other), Linseed, Mustard seed, Rape or colza seed, Sesame seed, Sunflower seed, Safflower seed, Castor oil seeds, Poppy seed, Other oilseeds, n.e.c, Olives, Coconuts (in shell), Other oleaginous fruits, Palm nuts and kernels, Copra, Other oleaginous fruits, n.e.c.	1201.10, 1201.90, 1202.30, 1202.41, 1207.21, 1207.29, 1204, 1207.50, 1205, 1207.40, 1206, 1207.60, 1207.30, 1207.91	0111
Potatoes	Potatoes	0701	0113
Other tubers and edible toots	Cassava, Sweet potatoes, Yams, Taro, Other edible roots and tubers with high starch or inulin content, Yautia, Other edible roots and tubers with high starch or inulin content, n.e.c.	0714.10, 0714.20, 0714.30, 0714.50, 0714.90	0113
Stimulant, spice & aromatic crops	Coffee, green Tea leaves, Maté leaves, Cocoa beans, Raw spice and aromatic crops, Raw pepper (Piper spp.), Dry chillies and peppers (Capsicum spp., Pimenta spp.)(raw), Nutmeg, mace, cardamoms (raw), Anise, badian, coriander, cumin, caraway, fennel and juniper berries (raw), Cinnamon and cinnamon-tree flowers (raw). Raw cloves (whole stems), Raw ginger, Raw vanilla, Hop cones, Chicory roots, Other stimulant, spice and aromatic crops n.e.c.	0901.11, 0902.20, 0903, 1801, 0904.11, 0904.2, 0908.11, 0909.21, .31, .61, 0906.11, .19, 0907.10, 0910.11, 0905.10, 1210, 1212.94, 0910.20, .30, .91, .99, 1212.99	
Pulses	Dry beans, Dry lentils, Dry chick peas, Dry peas, Dry cow peas, Dry pigeon peas, Dry Bambara beans, Pulses, n.e.c.	0713.31 - .33, 0713.50,0713.20, 0713.40, 0713.10, 0713.35, 0713.60,0713.34, 0713.90	0111
Sugar crops	Sugar cane, Sugar beet, Sugar beet seeds, Other sugar crops n.e.c.	1212.93, 1212.91, 1209.10, 1212.99	

Agricultural commodity accounts in 2014 SA SAM	***CPC version 2.1 Description***	***Correspondence***	
		Harmonised System (HS) 2012	***ISIC 4***
Other plants	Maize for forage and silage, Alfalfa for forage and silage, Cereal straw, husks, unprepared, ground, pressed, or in the form of pellets, Forage products, n.e.c. Cotton, whether or not ginned, Other fibre crops, Plants and parts of plants used primarily in perfumery, in pharmacy, or for insecticidal, fungicidal or similar purposes, Seeds of forage plants, Natural rubber in primary forms or in plates, sheets or strip, Living plants; cut flowers and flower buds; flower seeds, Unmanufactured tobacco, Other raw vegetable materials, n.e.c.	1214.90 5201, 5303.10, 5301.10, 5302.10, 5305.00, 1211, 1302.11, 1209.21 - .29, 4001.10 - .29, 0601, 0602.10 -.40, .90, 0603, 1209.30 2401.10, 1209.99, 1212.99	0119 0111 0116 0128 0129 0230 0130 0115
Agriculture: LIVE ANIMALS AND THEIR PRODUCTS SUBSECTOR			
Cattle	Cattle, Raw hides and skins of cattle	0102.21, .29, 4101.20, .50 .90	0141 1010
Goats & sheep	Sheep, Goats , Raw hides and skins of sheep or lambs, Raw hides and skins of goats or kids, Shorn wool, greasy, including fleece-washed shorn Wool, Pulled wool, greasy, including fleece-washed pulled wool; coarse animal hair, Fine animal hair, not carded or combed	0104.10, 0104.20, 4103.90,5101.11, 5101.19, 5102.20, 5102.11	0144 1010
Poultry	Chickens, Turkeys, Geese, Ducks, Guinea fowls, Ostriches and emus, Other bird, Eggs from other birds in shell, fresh, for hatching, Other eggs from other birds in shell, fresh, Silk-worm cocoons suitable for reeling	0105.11, .94, 0105.12, 0105.14, 0105.13, 0105.15, 0106.33, 4103.20, .30, .90	0146 0149
Pig	Swine / pigs, Raw furskins	0103, 4301	0145 1010
Raw milk	Raw milk of cattle	0401.20, .40,.50,	
Eggs	Fresh hen eggs (in shell for hatching), Other fresh hen eggs (in shell).	0407.11, 0407.21	
Other animals	Rabbits and hares, Other mammals, Reptiles, Bees, Other live animals, n.e.c. Embryos, Natural honey, Snails, Edible products of animal origin n.e.c Raw skins of other animals, Insect waxes and spermaceti, whether or not refined or coloured	0106.14, 0106.11, .12, .19, 0106.31, .32, .39, 0106.20, 0106.49, .90, 0407.19, 0407.29,0511.99,0409 0307.60, 1605.58, 0410, 5001, 1521.90	0170 0141

Source: Own compilation based on CPC version 2.1 (UN, 2015)

The detailed SA SAM developed in this study is based on the 2014 calendar year, so some of the data in South Africa is published by fiscal years. For instance, the output values of agricultural sectors in the abstract of agricultural statistics and production cost structures of agricultural industries are published by fiscal years, running from July of one year until the end of June of the next year. If the data is available for two fiscal years i.e., 2013/2014 and 2014/2015, it is then converted to 2014 calendar year by calculating the mean of the two fiscal years. However, if the data is available for one fiscal year, it is assumed to represent a calendar year and used as it is.

Estimating the output structure of the agricultural sectors

The information on the values of the outputs of the agricultural industries is obtained from the Abstract of Agricultural Statistics 2016 published by DAFF (2016a). The detailed output share matrix was calculated for all agricultural industries. The value of outputs pertaining the sectors where data is unavailable is estimated by subtracting the sum of output values of the sectors where the data is available from the total output value of the aggregate sector. Each industry produces one commodity, generating a one to one relation between the SAM agricultural sectors. The only exceptions are: raw milk industry which does not only produce milk but also produce calves and cull cows, and the egg industry which does not only produce eggs but also produce chicks and cull hens. This means that calves and cull cows form a link between raw milk industry and cattle industry while chicks and cull hens form a link between egg industry and poultry industry.

Estimating the intermediate consumption of the agricultural sectors

The intermediate consumption is the only submatrix that requires the disaggregation of both industries and commodities. Agricultural industries' intermediate consumption is disaggregated first in a SAM, while agricultural commodities' followed afterwards.

The primary step SAM provides information of the control totals of products (including a single crop product and a single live animal) used as intermediate inputs by the agricultural industry. This expenditure is distributed across the different agricultural industries based on the cost data of different crops and live animals. SAGIS (2016) provides data on cost structure of cereals and oilseeds. HORTGRO (2014) provides data on cost structure of deciduous fruits but it is also extended to other fruits and nuts as they are assumed to have more or less the same cost structure. CMB (2012), Douglas et al. (2014) and DAER (2017) provide data on the cost structure of vegetables; potatoes; melons; pulses; stimulant, spice and aromatic crops; and other crops. The cost structure of sugar crops is informed by SACGA (2017). For livestock, the cost structure is informed by NAMC (2012), CMB (2012) and also by AFMA (2015), but for poultry and egg industries, it is informed by SAPA (2015) and by AFMA (2015). In some instances, the classification used for agricultural commodities in the 2014 SAM does not match the compilation

of the agricultural commodities in the data sources, while in other instances, other component sectors' cost structure is unavailable. In these instances, the available cost structure of the dominant sub-industry in the aggregated industry is used. For instance, for leafy vegetables, the cost structure of cabbage is used because cabbage is the largest production item within the leafy vegetables' sector. In other instances, the average cost is computed for major subsectors in the aggregated sector.

The cost structure of the crop subsectors is given for each crop per hectare in the data sources used, so the total input cost for each crop subsector is derived by multiplying the given average input cost per hectare by its total cultivated area (in hectares). Information regarding the cultivated area in hectares for each crop in 2014 is obtained from Trends in Agricultural Sector 2015 by DAFF (2016b). For the crops whose data regarding their cultivated area is unavailable for 2014, the estimations were made for their 2014 cultivated area (in hectares) using inverse proportion based on the cultivated area and production volume (in tons) of each crop subsector for 2007 (Stats SA, 2009) and also their corresponding production volume (in tons) for 2014 (DAFF, 2016a). Once the input costs are calculated, a share is then derived for each of the crops to total costs and these shares are multiplied by total costs listed in the primary step SAM to disaggregate these total costs among the different crop subsectors in the detailed SA SAM. The main crop production inputs are seeds, fertilizers and pesticides, fuel and lubricants while others include repairs and maintenance, packaging, marketing and transport costs. The cost structure of the animal subsectors is given by percentages which are multiplied by total costs listed in the primary step SAM to disaggregate them among the different animal subsectors in the detailed SA SAM. The main animal production inputs are feedstuff (fodder crops and processed animal feeds), pharmaceutical products (medicine and remedies), fuel, and electricity while others include repairs and maintenance, marketing and transport costs.

The second stage of disaggregation involves the estimation of the intermediate use of agricultural products by the non-agricultural industries, which is a very difficult process due to unavailability of data. However, this is a very crucial part of disaggregation as the inter-industry transactions of a SAM encapsulate the concept of interdependence of industries. Liu et al. (2005) state that the magnitude of the interdependence among industries is dependent on the shares of the transactions

and therefore the accurate representation of such relationships is fundamental. They argue that although it is very difficult to establish the intermediate input demand, it is possible to detect whether a transaction is accurate or not in that some products are primarily produced to become inputs into the processing sector while other products can be sold to almost all industries. They validate their argument with the example that it is typical for a very large share of cotton sales flow to textile milling industries and almost none to other industries, but the sale of chemical products typically flows to almost all industries. Based on this principle, care is taken of the key inputs of each industry to avoid distributing agricultural products in larger proportions to the industries that are lesser users of them to help in providing better interdependence of industries in order to minimize distortion in the inter-industry transactions, hence improved analytical results.

The two agricultural commodity accounts (crop subsector and animal subsector) provided the control total for intermediate use of agricultural commodities by non-agricultural industries. Table 7 illustrates how the intermediate demand control totals of agricultural commodities are distributed across the non-agricultural industries and the assumptions made.

Table 7: Distribution of the intermediate use of agricultural commodities by non-agricultural industries in the 2014 SA SAM

	Distribution of crop subsector commodities' intermediate use		***Distribution of animal subsector commodities' intermediate use***	
Non-agricultural industries in a 2014 SA SAM	***Control total (R million)***	***How it is distributed and assumptions***	***Control total (R million)***	***How it is distributed and assumptions***
Forestry	0		0	
Fishing	0		0	
Mining of coal and lignite	12	This industry is assumed to use other plants as main crop inputs	0	
Mining of gold and uranium ore	1		0	
Mining of metal ores	4		0	
Other mining and quarrying	5		0	
Meat	139	This industry is assumed to use stimulant, spice and aromatic crops as main crop inputs	23 704	This industry is assumed to use all animals and their products as inputs. The control total is distributed across these commodities according to the shares of their output value.

	Distribution of crop subsector commodities' intermediate use		***Distribution of animal subsector commodities' intermediate use***	
Fish	3		0	
Fruit, Vegetables	1 096	This industry uses fruits and vegetables, nuts, and Stimulant, spice and aromatic crops. The control total is distributed across each of these commodities subsectors using output shares of these commodities.	4	This industry is assumed to use other animal products as inputs.
Oils, Fats	621	This industry is assumed to consume oilseeds in larger quantities, other vegetables, tropical and subtropical fruits (avocadoes in particular), and nuts in lesser quantities. 98% of the control total is distributed to oilseeds while the remaining 2% is distributed equally across these 3 commodities used in lesser quantities.	0	
Dairy	229	This industry is assumed to use fruits (except grapes), nuts, oilseeds (soya beans in particular). The control total is distributed across these commodities according to the share of their outputs.	8 775	This industry is assumed to use raw milk so the whole of control total is allocated to this commodity alone.
Grain mill	10 630	This industry is assumed to use wheat, maize, sorghum, and other cereals. The control total is distributed across these commodities according to the share of their outputs.	0	
Starches	4 166	This industry is assumed to use wheat, maize, sorghum, other cereals, potatoes, and other tubers. The control total is distributed across these commodities according to the share of their outputs.	0	
Animal feeds	162	According to AFMA (2015) feed raw material usage for 2014, maize, wheat, sorghum, other cereals, oilseeds, and other plants are ingredients in this industry. In 2014, out of these crop inputs, 95.75% is maize, 2.35% is contributed by other plants, while wheat, other cereals, oilseeds and sorghum account for	9	This industry is assumed to use other animal products.

	Distribution of crop subsector commodities' intermediate use		***Distribution of animal subsector commodities' intermediate use***	
		1.14%, 0.61%, 0.17% and 0.03% respectively. The control total is distributed across these commodities using these percentages.		
Bakery	11 820	This industry is assumed to use all the crops except sugar crops and other crops. Wheat, oilseeds, potatoes and nuts are the major crop ingredients in this industry. 35% of the control total is distributed to wheat, the other 35% to oilseeds, 10% to potatoes, 3% to nuts and the remaining 17% is distributed to all the remaining crops (except sugar crops and other crops) according to their share of output value.	33	From the animal sector, it is assumed that this industry uses raw milk, eggs and other animal products like honey as its inputs. The control total is distributed across these 3 commodities based on their output value shares.
Sugar	8 124	Sugar crops are the main inputs in this industry.	0	
Cocoa, chocolate	40	Stimulant, spice and aromatic crops (cocoa beans in particular) are the main inputs in this industry.	1 765	From the animal subsector, raw milk and other animal products are the main inputs in this industry. The control total is distributed between these two commodities according to their share of output value.
Pastas	0		0	
Other food	261	It is assumed that this industry uses all crop commodities for its production. The control total is shared amongst these commodities according to their share of output value.	28	It is assumed that this industry uses all animal commodities for its production. The control total is shared amongst these commodities according to their share of output value.
Beverages and tobacco	10 553	This industry uses grapes (wine grapes more) mostly, all other fruits, wheat, other cereals, and other plants (unmanufactured tobacco in particular). 60% of the control total is distributed to grapes, 15% to other plants and the remaining 25% is distributed equally to the remaining fruits, wheat and other cereals.	218	It is assumed that this industry consumes raw milk from the animal subsector.

	Distribution of crop subsector commodities' intermediate use		Distribution of animal subsector commodities' intermediate use	
Spinning, weaving and finishing of textiles	1 831	Other plants (cotton in particular) are the main crop inputs in this industry.	3 833	It is assumed that all animal products (excluding cattle products and eggs) are used as inputs in this industry. The control total is distributed based on the output value shares of these products.
Knitted, crouched fabrics, wearing apparel, fur articles	42	Other plants are the main crop inputs in this industry.	0	
Tanning and dressing of leather	1		4 255	It is assumed that all animal products (excluding eggs) are used as inputs in this industry. The control total is distributed based on the output value shares of these products.
Footwear	81		879	
Sawmilling, planing of wood, cork, straw	29		0	
Paper	146		0	
Publishing, printing, recorded media	70		0	
Coke oven, petroleum refineries	114		0	
Nuclear fuel, basic chemicals	104		0	
Other chemical products, man-made fibres	339		405	It is assumed that other animal products are the main animal inputs in this industry.
Rubber	997	Other plants (particularly natural rubber) are the main crop inputs in this industry.	0	
Plastic	10	Other plants are the main crop inputs.	0	
Glass	14		0	
Non-metallic minerals	60		0	
Basic iron and steel, casting of metals	12		0	
Basic precious and non-ferrous metals	89		0	
Fabricated metal products	56		0	
Machinery and equipment	152		0	
Electrical machinery and apparatus	117		0	
Radio, television, communication equipment and apparatus	0		0	

	Distribution of crop subsector commodities' intermediate use		Distribution of animal subsector commodities' intermediate use	
Medical, precision, optical instruments, watches and clocks	28	Other plants are the main crop inputs.	0	
Motor vehicles, trailers, parts	120		0	
Other transport equipment	76		0	
Furniture	25		0	
Manufacturing n.e.c, recycling	422	It is assumed that all the crops are used as the inputs in this industry. The control total is distributed across all the crop commodities according to their share of output value.	1 363	It is assumed that all animal products are used as inputs in this industry. The control total is distributed based on the output value shares of these products.
Electricity, gas, steam and hot water supply	29		0	
Collection, purification and distribution of water	0		0	
Construction	6	Other plants are the main crop inputs.	0	
Wholesale trade, commission trade	23		0	
Retail trade	7		0	
Sale, maintenance, repair of motor vehicles	0		0	
Hotels and restaurants	318	It is assumed that all the crops (excluding maize, wheat, sorghum, other cereals, and sugar crops) are used as the inputs in this industry. The control total is distributed across these crop commodities according to their share of output value.	0	
Land transport, transport via pipe lines	2		0	
Water transport	0.04		0	
Air transport	0.44		0	
Auxiliary transport	0.45		0	
Post and telecommunication	0.04		0	
Financial intermediation	0		0	
Insurance and pension funding	0		0	
Activities to financial intermediation	0		0	
Real estate activities	65	It is assumed that all the crops (excluding sugar crops) are used as the inputs in this industry. The control total is distributed across these crop commodities according to their share of output value.	0	
Renting of machinery and equipment	6		0	
Computer and related activities	19		0	
Research and experimental development	2		0	
Other business activities	83		0	
Government	311		0	

	Distribution of crop subsector commodities' intermediate use		Distribution of animal subsector commodities' intermediate use	
Education	60		0	
Health and social work	203		0	
Sewerage and refuse disposal	1		0	
Activities of membership organisations	3		0	
Recreational, cultural and sporting activities	61		0	
Other activities	6		0	
Non-observed, informal, non-profit, households,	957		2 842	It is assumed that all animal products are used as inputs in this industry. The control total is distributed based on the output value shares of these products.

Source: Own compilation

The disaggregation of the agricultural sectors' value added

The primary step SAM provides control totals for single agriculture industry labour value added and capital value added. The task is to distribute the labour value across 31 agriculture industries, disaggregate capital control total into land and capital and then distribute the land control total across 24 crop subsectors (it is assumed that land is used only in the crop subsectors) and capital control total across 31 agriculture industries.

The labour control total is distributed across 31 agriculture industries in the same way as distribution of intermediate inputs across the agricultural industries which is based on the cost data of different crops and live animals. For crops, labour cost is given per hectare so this value is multiplied by area planted for each crop. Finally labour under each of agriculture industries is disaggregated into four labour categories using the 2012 SA SAM shares of the disaggregated labour under aggregated agriculture industry.

The capital control total is broken down for land and capital using land and capital (livestock and other capital) value ratios calculated from the 2007 agricultural census (Stats SA, 2009). Land rental value is now distributed across all crops according to their cultivated area (in hectares) in

2014. The livestock capital control total is distributed to cattle, sheep and goats, pig, raw milk, and other animals industries based on their output value shares. Other capital control total is assigned to all agricultural industries as a residual per industry. The income from land and capital is distributed across households using the distribution ratio of the aggregate capital (land and capital) from the 2012 SA SAM.

The disaggregation of imports, taxes and subsidies

Imports of agricultural commodities: Imports of agricultural commodities are derived from the unpublished 2014 agricultural import data for South Africa from the South African Revenue Services (SARS, 2016a). This data is given in six-digit HS codes.

Import tariffs: Agricultural products which have certain tariffs levied to them when imported are first identified using the SARS customs and tariffs book from 2012 (SARS, 2016b). All crops imported (except: maize, other cereals, leafy vegetables, nuts, and sugar crops) have certain tariffs levied to them. The control total of crops import tariffs is allocated to these crops based on their shares of the total import value. There are no tariffs levied on the imported live animals and their related products except for other animal products, therefore the control total of animals import tariffs goes to other animal products.

Sales taxes: Agricultural products which are charged sales taxes are first identified. It is found that only nuts; oilseeds; stimulant, spice and aromatic crops; sugar crops; and other plants are charged sales tax while the rest of the crops are exempted from this kind of a tax. The control total crops sales tax is distributed across the crops which are charged sales tax based on these crops' output value shares. All animals and their products (except raw milk and eggs) are charged the sales tax and the sales tax control total for these products is distributed according their output value shares.

Activity/producer taxes: The control total for the agricultural producer taxes is distributed across the agricultural industries based on their output shares as there is no better information available for disaggregation.

Estimating the final demand of the agricultural sectors

Final demand of agricultural commodities by the households: There is lack of specific data to map the household consumption of the detailed agricultural commodities used in this SAM, as a result, this was calculated as a residual. This is done by calculating the difference between column total of each agricultural commodity and its intermediate consumption plus final demand in a detailed 2014 SA SAM. It is important to note that this approach bears some risk as the overstating or understating of the total demand of intermediate inputs and final demand will lead to the overstating or understating of the household consumption in turn.

Stock changes: the primary step SAM provided control totals for crops and animals stock changes respectively. Stock changes for wheat, maize, sorghum, other cereals, and oilseeds are derived from agricultural supply and demand data for 2014 obtained from South African Grain Industry Services (SAGIS, 2016). For the remaining crops, there is no available data on stock changes so the remaining value is distributed across the remaining crops according their shares of output values. There is no available data on the stock changes for animals and their products so the control total for animal stock changes is distributed across these commodities based on the shares of their output values.

Exports of agricultural commodities: Exports of agricultural commodities are derived from the unpublished 2014 agricultural export data for South Africa from the South African Revenue Service (SARS, 2016).

4.2.5 The Generalised Cross Entropy (GCE) estimation method for balancing a SAM

The 2014 detailed SA SAM is constructed using diverse data sources, such as national accounts, SUTs, a 2012 SAM, different sources of agricultural data, etc. These sources have different base years, different classification and disaggregation of industries and commodities, and different methods of data collection. As a result, putting this data within the SAM framework show some inconsistencies between the receipts and payments of each account. There are various statistical estimation techniques or SAM balancing techniques which are presented in section 2.2.2 to ensure

that the SAM balances. The Generalised Cross Entropy (GCE) estimation is preferred over other techniques. This technique uses an information metric called entropy in estimating the best fitting SAM subject to the prior data and the necessary constraints. It is coded in GAMS with the data being imported from an Excel sheet in GDX format.

The balancing procedure takes place in three stages. First, a primary step SAM was constructed using the macro SAM and SUTs. At this stage, the SAM contains aggregate entries for labour, capital, households, taxes, food processing industries, and agricultural industries and commodities. This SAM is balanced using GCE. After being balanced, it was then disaggregated across food processing industries, and agricultural industries and commodities to generate intermediate step SAM. Since the primary step SAM is balanced, the imbalances only occurred in these disaggregated accounts which were again balanced using GCE. Third, the intermediate step SAM is further disaggregated across labour, households and taxes to generate the final detailed 2014 SA SAM. This SAM is balanced using GCE. In order to keep the consistency with the overall structure of the SA macro-economy, a number of constraints were introduced on the model based on the data that is deemed reliable and some values that appeared in the primary step and macro SAMs were maintained.

4.3 South African economic structure: observations from the detailed 2014 SA SAM

Table 8 portrays the South African production structure and foreign trade in 2014. South African agriculture and, forestry and fisheries account for 2.11% and 0.36% of the total GDP respectively. Agro-processing accounts for 4.75% of the total GDP. Mining contributes about 8.42%, while the combination of other manufacturing, utilities and construction contribute about 15.86%. The largest sector in the South African economy is the service sector contributing 68.5% and 57.11% to the total GDP and total output respectively. In terms of foreign exchange earnings, the secondary sector is the one leading comprising 80.34% of total exports and 83.95% of total imports, with manufacturing being the largest subsector. South Africa imported about 14.32% of goods and services needed for domestic consumption and exported on average 15.84% of its domestic output of goods and services in 2014.

The agriculture, forestry and fisheries sectors continue to play an important role in the South African economy even though their relative positions in the economy have been declining due to the growth of industrial and service sectors. This happens as a result of economic development and therefore indicates the normal pattern of the structural change. These sectors comprise the lowest share of total GDP which is about 2.47% and the lowest share of total output which is about 2.82%. The agriculture sector is the biggest among the three, comprising 2.11% and 2.49% of total GDP, and total output respectively. The most important subsectors within agriculture in terms of contribution to total GDP are: maize and cattle (0.27% each), poultry (0.17%), raw milk (0.16%), grapes (0.12%), oilseeds (0.12%), sugar crops (0.07%), oranges and potatoes (0.06% each).

With regard to South African export trade in 2014, the primary agricultural sector exported 15.16% of total domestic agricultural production and its share of total exports is only 2.38%. However, it is important to note that the oilseeds and sugar crops are further processed and partly exported as agro-processing goods, that is the reason their export intensities are very low and their export shares equal to zero. The most export oriented industries within the South African agricultural sector in 2014 in terms of exports as share of total domestic output (export intensities following Al-Riffai et al., 2016) are: stimulant, spice and aromatic crops (223.49%), oranges (63.38%), other citrus fruits (72.55%), nuts (103.16%), other fruits (59.76%) and other animals (55.47%). However the agricultural industries which contribute largely to the export earnings are: oranges and other citrus fruits (0.60%), maize (0.31%), grapes (0.27%) and apples (0.20%).

In terms of South African import trade in 2014, the primary agricultural sector imported 7.14% of total domestic consumption. This means that South Africa is able to satisfy most of its domestic demand for agricultural products using the domestically produced products. The share of agriculture in total imports is only 1.2% and this indicates that South Africa's economy does not depend much on agricultural product imports. The most import oriented industries within the South African agricultural sector in 2014 in terms of imports as share of domestic consumption (import intensities following Al-Riffai et al., 2016) are: stimulant, spice and aromatic crops (81.74%) and wheat (55.48%). These two agricultural industries also account for large shares of total import value with wheat leading (0.46% share), followed by stimulant, spice and aromatic crops (0.13% share).

Within the manufacturing sector, "agro-processing is a subsector that processes raw materials and intermediate products derived from the agricultural sector" (FAO, 1997). This sector in general plays a critical role for development, especially in developing countries. In South Africa, the agro-processing industry has been identified by the New Growth Path as a key candidate for creating jobs and spurring growth due to its strong linkages with primary agriculture.

The South African agro-processing industry in 2014 accounts for 4.75%, and 7.52% of total GDP and total output respectively. The largest subsector within agro-processing is the food industry and the important food subsectors within agro-processing in terms of contribution to total GDP are: bakery (0.58%), meat (0.28%), dairy (0.27%), sugar (0.26%) and grain mill products (0.20%).

The trade patterns within the South African agro-processing industry in 2014 according to table 8 shows that this industry exported 17.45% of total domestic agro-processing output and its share of total exports is only 8.29%. The most export oriented food subsectors within this industry in terms of export intensity are: fish (39.20%), fruit and vegetables (32.82%) and oils and fats (27.56%). However food subsectors which contribute largely to the export earnings are: fruits and vegetables (0.57%), fish (0.45%), meat (0.32%) and bakery products (0.27%). These food subsectors may provide real potential for rural economic growth in South Africa due to their strong backward linkages to the agricultural sector and their export earning potential. The agro-processing sector imported 18.48% of total domestic consumption, of which the largest import oriented food subsector is pasta with 80.32% import intensity.

Table 8: 2014 SA production and trade structure

Sectors	*Share of total GDP (%)*	*Share of total Production (%)*	Imports		Exports	
			Share in Imports (%)	*Import Intensity (%)*	*Share in Exports (%)*	*Export Intensity (%)*
Agriculture	2.11	2.49	1.15	7.14	2.38	15.16
Crops/plants	1.21	1.34	1.02	11.32	2.08	24.70
Wheat	0.05	0.06	0.46	55.48	0.06	16.12
Maize	0.27	0.30	0.03	1.87	0.31	16.42
Sorghum	0.01	0.01	0.00	10.29	0.01	14.51
Other cereals	0.01	0.01	0.04	36.99	0.01	9.21
Leafy vegetables	0.02	0.02	0.00	2.82	0.01	9.79

Sectors	Share of total GDP (%)	Share of total Production (%)	Imports		Exports	
			Share in Imports (%)	Import Intensity (%)	Share in Exports (%)	Export Intensity (%)
Melons	0.00	0.00	0.00	4.48	0.00	19.63
Fruit bearing vegetables	0.04	0.05	0.00	1.63	0.02	6.51
Green leguminous vegetables	0.00	0.00	0.00	18.33	0.00	30.88
Root, bulb and tuberous veg, n.e.c.	0.04	0.04	0.00	1.61	0.02	8.17
Other vegetables	0.02	0.02	0.03	22.99	0.00	2.95
Tropical and subtropical fruits	0.03	0.04	0.03	9.37	0.08	27.49
Oranges	0.06	0.08	0.00	0.33	0.33	63.38
Other citrus fruits	0.04	0.06	0.00	0.66	0.27	72.55
Grapes	0.12	0.12	0.01	1.21	0.27	35.53
Apples	0.05	0.07	0.00	0.00	0.20	47.61
Other fruits	0.04	0.05	0.01	4.27	0.20	59.76
Nuts	0.01	0.02	0.01	6.44	0.13	103.16
Oilseeds and oleaginous fruits	0.12	0.11	0.12	15.71	0.00	0.61
Potatoes	0.06	0.08	0.00	0.02	0.03	6.04
Other tubers and edible roots	0.00	0.00	0.00	3.05	0.00	5.61
Stimulant, spice and aromatic crops	0.01	0.01	0.13	81.74	0.07	223.49
Pulses	0.01	0.01	0.06	46.84	0.01	8.63
Sugar crops	0.07	0.09	0.00	0.00	0.00	0.04
Other plants	0.12	0.08	0.05	10.23	0.06	11.04
Live animals & products	0.90	1.16	0.13	1.79	0.30	4.12
Cattle	0.27	0.26	0.03	1.85	0.01	0.33
Goats and sheep	0.11	0.10	0.01	2.32	0.00	0.22
Poultry	0.17	0.37	0.01	0.36	0.01	0.26
Pig	0.05	0.05	0.03	7.53	0.02	6.11
Raw milk	0.16	0.17	0.01	0.56	0.02	1.79
Eggs	0.06	0.13	0.00	0.01	0.01	1.71
Other animals	0.08	0.07	0.04	9.65	0.23	55.47
Forestry and Fisheries	0.36	0.33	0.04	1.83	0.18	8.77
Mining	8.42	7.17	10.05	18.99	33.27	87.50
Agro-processing	4.75	7.52	10.20	18.48	8.29	17.45
Food	2.35	3.70	3.56	13.84	3.17	13.57
Meat	0.28	0.55	0.42	11.41	0.32	9.15
Fish	0.12	0.18	0.15	11.84	0.45	39.20
Fruit, Vegetables	0.18	0.28	0.23	6.46	0.57	32.81
Oils, Fats	0.10	0.12	1.29	13.24	0.21	27.56
Dairy	0.27	0.49	0.19	30.82	0.20	6.42
Grain mill	0.20	0.37	0.25	7.84	0.18	7.88
Starches	0.13	0.15	0.12	21.88	0.10	10.04
Animal feeds	0.08	0.09	0.09	19.10	0.07	12.07
Bakery	0.58	0.97	0.17	1.48	0.27	4.47
Sugar	0.26	0.28	0.12	9.19	0.16	9.18
Cocoa, chocolate	0.07	0.13	0.15	13.93	0.11	13.12
Pastas	0.01	0.01	0.02	80.32	0.01	23.49
Other food	0.09	0.10	0.35	3.86	0.53	82.51
Non-food (including beverages)	2.40	6.97	6.64	22.51	5.12	21.21
Other manufacturing, utilities and construction	15.86	25.39	63.70	29.54	38.78	24.19
Service	68.50	57.11	14.88	4.17	17.09	4.74
All sectors	**100**	**100**	**100**	**14.32**	**100**	**15.84**

Source: Own calculations based on 2014 SA SAM

Table 9 indicates the utilization of each production factor across all sectors within the South African economy in 2014. The largest sector in the South African economy is the service sector contributing 70.04% to the total labour value added. Agriculture contributed 1.20%, forestry and fisheries contributed 0.26% while agro-processing contributed 5.08% to the South African total value added in 2014. The most important subsectors within agriculture in terms of contribution to total labour value added are: grapes (0.15%), maize and poultry (0.11% each), oranges and cattle (0.07% each), sugar crops, potatoes and apples (0.06% each).The most important food subsectors within agro-processing in terms of contribution to total labour valued added are: bakery (0.74%), sugar (0.30%), dairy (0.28%), grain mill (0.20%), and fruit and vegetables (0.19%).

In the 2014 SA SAM, land is only assumed to be utilized in crop subsectors of the agricultural sector. Within this sector, land is used mostly for production of maize (34.23%), other plants (26.56%), oilseeds and oleaginous fruits (16.37%) and sugar crops (4.91%) sectors.

In terms of the contribution to total capital value added, the tertiary sector is still ranking number one in South Africa with 67.31%. It is followed by manufacturing sectors. Agriculture contributes less to the total capital value added as the significance of capital in this sector is relatively lower in comparison to the non-agricultural sectors.

Table 9: 2014 SA factor utilization across sectors

	Share of labour value added (%)	*Share of land value added (%)*	*Share of capital value added (%)*
Agriculture	1.20	100.00	2.39
Crops/plants	0.90	100.00	0.82
Wheat	0.02	6.06	0.04
Maize	0.11	34.23	0.19
Sorghum	0.00	1.06	0.00
Other cereals	0.00	2.16	0.01
Leafy vegetables	0.02	0.10	0.01
Melons	0.00	0.07	0.00
Fruit bearing vegetables	0.05	0.42	0.03
Green leguminous vegetables	0.00	0.03	0.00
Root, bulb and tuberous veg, n.e.c.	0.05	0.44	0.03
Other vegetables	0.02	0.73	0.01
Tropical and subtropical fruits	0.04	0.52	0.03
Oranges	0.07	0.53	0.05
Other citrus fruits	0.05	0.29	0.03
Grapes	0.15	1.59	0.07

	Share of labour value added (%)	Share of land value added (%)	Share of capital value added (%)
Apples	0.06	0.29	0.04
Other fruits	0.05	0.32	0.03
Nuts	0.02	0.22	0.01
Oilseeds and oleaginous fruits	0.05	16.37	0.07
Potatoes	0.06	0.97	0.05
Other tubers and edible roots	0.00	0.05	0.00
Stimulant, spice and aromatic crops	0.00	1.27	0.00
Pulses	0.01	0.87	0.01
Sugar crops	0.06	4.91	0.06
Other plants	0.01	26.50	0.05
Live animals & products	0.30	0.00	1.57
Cattle	0.07	0.00	0.49
Goats and sheep	0.03	0.00	0.19
Poultry	0.11	0.00	0.23
Pig	0.01	0.00	0.10
Raw milk	0.03	0.00	0.31
Eggs	0.04	0.00	0.08
Other animals	0.01	0.00	0.16
Forestry and Fisheries	0.26	0.00	0.46
Mining	7.25	0.00	9.78
Agro-processing	5.08	0.00	4.42
Food	2.36	0.00	2.35
Meat	0.18	0.00	0.38
Fish	0.13	0.00	0.12
Fruit, Vegetables	0.19	0.00	0.17
Oils, Fats	0.04	0.00	0.16
Dairy	0.28	0.00	0.26
Grain mill	0.20	0.00	0.19
Starches	0.12	0.00	0.14
Animal feeds	0.03	0.00	0.14
Bakery	0.74	0.00	0.40
Sugar	0.30	0.00	0.21
Cocoa, chocolate	0.08	0.00	0.05
Pastas	0.00	0.00	0.01
Other food	0.07	0.00	0.10
Non-food (including beverages)	2.72	0.00	2.07
Other manufacturing, utilities and construction	16.17	0.00	15.64
Service	70.04	0.00	67.31
All sectors	**100**	**100**	**100**

Source: Own calculations based on 2014 SA SAM

Table 10 shows the utilization of each of the production factors in each sector's production of goods and services within the South African economy in 2014. The overall South African production of goods and services is labour intensive as labour accounts for 52.26% of total factor employment. Within all the sectors, agro-processing is the most labour intensive sector. The most labour intensive food subsectors within the agro-processing industry are: bakery (67.03%), cocoa

and chocolate (62.86%) and sugar (61.22%). Within the agriculture sector, the most labour intensive subsectors are: grapes (67.06%), root, bulb and tuberous vegetables, n.e.c (65.63%), fruit bearing vegetables (64.46%), leafy vegetables (62.51%), apples (61.75%), oranges (60.29%) and other citrus fruits (60.70%).

The land intensive crop sectors are: other plants (74.16%), other cereal (63.54%), stimulant, spice and aromatic crops (60.57%), sorghum (54.52%), and oilseeds and oleaginous fruits (49.27%).

The most capital intensive sector is mining, followed by the forestry and fishery sector. Within the agricultural sector, livestock subsectors are the most capital intensive with the pig and raw milk industries leading.

Table 10: 2014 SA factor utilization within each sector

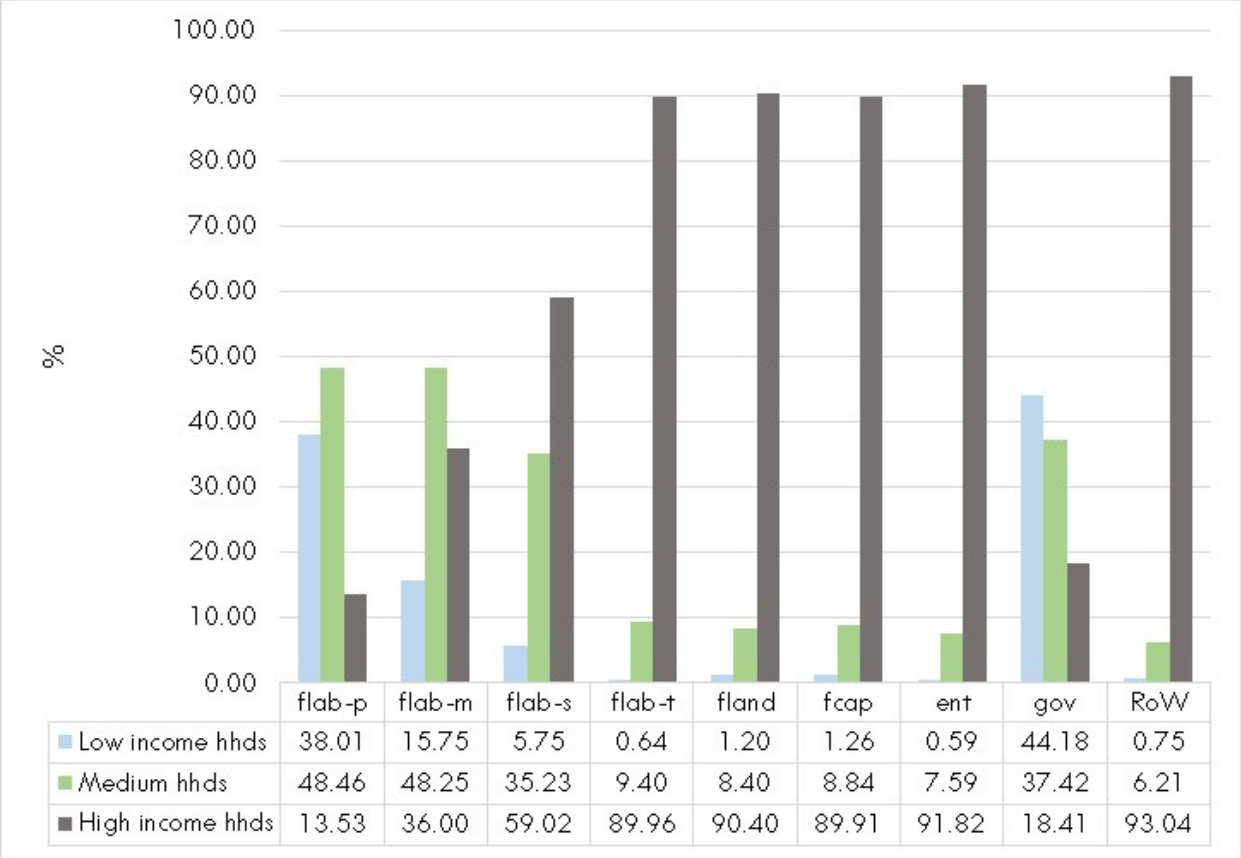
Sectors	*Share of labour within each sector (%)*	*Share of land within each sector (%)*	*Share of capital within each sector (%)*	*All factors (%)*
Agriculture	29.75	16.49	53.76	100.00
Crops/plants	38.98	28.78	32.24	100.00
Wheat	21.04	42.18	36.78	100.00
Maize	21.59	44.32	34.09	100.00
Sorghum	15.46	54.52	30.02	100.00
Other cereals	10.65	63.54	25.81	100.00
Leafy vegetables	62.51	2.17	35.32	100.00
Melons	57.72	8.79	33.49	100.00
Fruit bearing vegetables	64.46	3.59	31.96	100.00
Green leguminous vegetables	59.64	6.52	33.84	100.00
Root, bulb and tuberous veg, n.e.c.	65.63	3.72	30.65	100.00
Other vegetables	53.01	15.06	31.93	100.00
Tropical and subtropical fruits	58.53	5.30	36.17	100.00
Oranges	60.29	2.98	36.73	100.00
Other citrus fruits	60.70	2.30	37.00	100.00
Grapes	67.06	4.65	28.30	100.00
Apples	61.75	2.04	36.21	100.00
Other fruits	60.33	2.80	36.88	100.00
Nuts	58.55	5.18	36.27	100.00
Oilseeds and oleaginous fruits	21.18	49.27	29.55	100.00
Potatoes	54.31	6.07	39.63	100.00
Other tubers and edible roots	51.88	9.31	38.80	100.00
Stimulant, spice and aromatic crops	19.22	60.57	20.21	100.00
Pulses	30.37	31.26	38.38	100.00
Sugar crops	41.01	22.85	36.14	100.00
Other plants	6.25	74.16	19.59	100.00
Live animals & products	17.36	0.00	82.64	100.00
Cattle	13.71	0.00	86.29	100.00
Goats and sheep	14.19	0.00	85.81	100.00

Sectors	Share of labour within each sector (%)	Share of land within each sector (%)	Share of capital within each sector (%)	All factors (%)
Poultry	33.13	0.00	66.87	100.00
Pig	9.33	0.00	90.67	100.00
Raw milk	10.46	0.00	89.54	100.00
Eggs	35.53	0.00	64.47	100.00
Other animals	6.88	0.00	93.12	100.00
Forestry and Fisheries	38.62	0.00	61.38	100.00
Mining	44.99	0.00	55.01	100.00
Agro-processing	55.89	0.00	44.11	100.00
Food	52.53	0.00	47.47	100.00
Meat	34.72	0.00	65.28	100.00
Fish	53.83	0.00	46.17	100.00
Fruit, Vegetables	54.16	0.00	45.84	100.00
Oils, Fats	21.40	0.00	78.60	100.00
Dairy	54.03	0.00	45.97	100.00
Grain mill	53.54	0.00	46.46	100.00
Starches	48.58	0.00	51.42	100.00
Animal feeds	16.17	0.00	83.83	100.00
Bakery	67.03	0.00	32.97	100.00
Sugar	61.22	0.00	38.78	100.00
Cocoa, chocolate	62.86	0.00	37.14	100.00
Pastas	16.45	0.00	83.55	100.00
Other food	45.31	0.00	54.69	100.00
Non-food (including beverages)	59.17	0.00	40.83	100.00
Other manufacturing, utilities and construction	53.27	0.00	46.73	100.00
Service	53.43	0.00	46.57	100.00
All sectors	**52.26**	**0.35**	**47.39**	100.00

Source: Own calculations based on 2014 SA SAM

Figure 3 illustrates the South African distribution of income from different income sources across its households in 2014 as portrayed by the SAM. See the discussion in section 5.1 on how the three income groups were derived from the original 14 household categories in the SAM. Low income households receive the largest part of the total government transfers to households, about 44.18%. They also earn the largest part (48.46%) of the total distribution of labour (primary school or less) income to households. Medium income households earn most (48.25%) of the labour (completed middle school) income. A greater share of the distribution of labour (completed secondary school, and some tertiary education) income, land income and capital income, about 59.02%, 89.96%, 90.40% and 89.91% respectively accrues to high income households. Enterprise surplus and remittances from the rest of the world are almost entirely (91.82% and 93.04% respectively) earned by high income households.

Figure 3: 2014 SA distribution of income sources across households

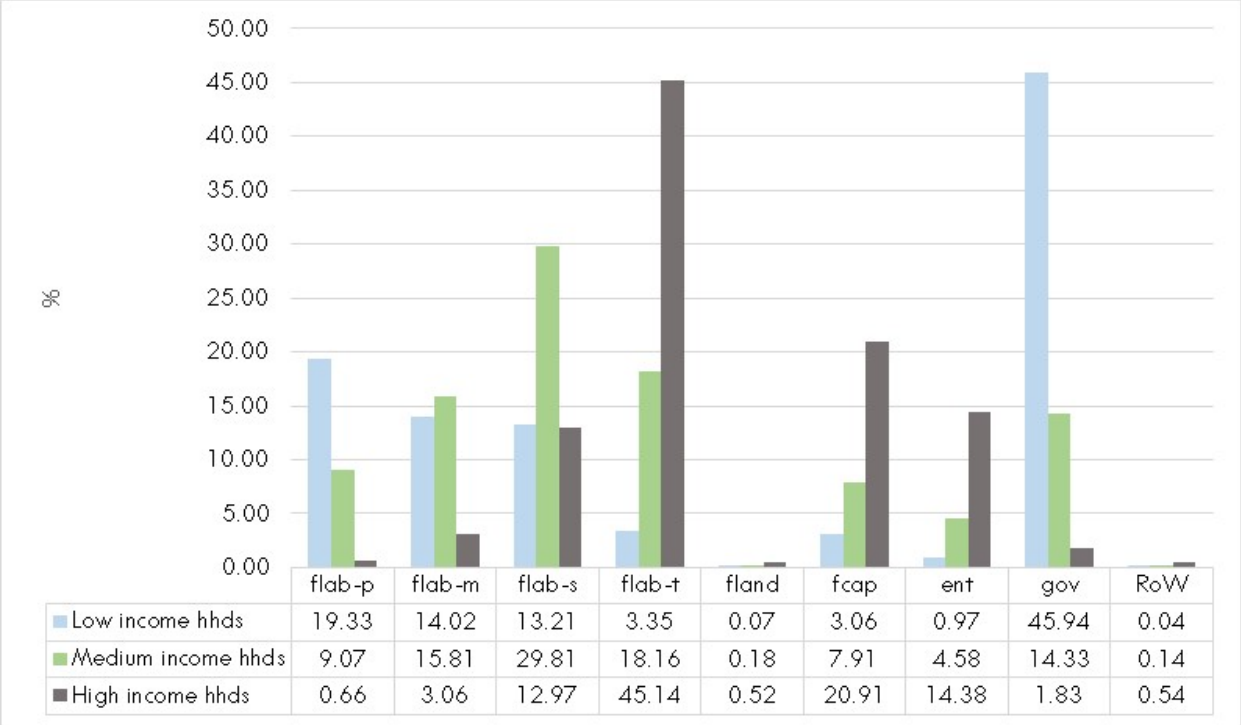


	flab-p	flab-m	flab-s	flab-t	fland	fcap	ent	gov	RoW
Low income hhds	38.01	15.75	5.75	0.64	1.20	1.26	0.59	44.18	0.75
Medium hhds	48.46	48.25	35.23	9.40	8.40	8.84	7.59	37.42	6.21
High income hhds	13.53	36.00	59.02	89.96	90.40	89.91	91.82	18.41	93.04

Source: Own calculations based on 2014 SA SAM

Figure 4 shows the South African distribution of income from different income sources within each household category in 2014. The major sources of income to low income households are the government transfer payments and labour (primary school or less) income which account for 45.94% and 19.33% of their total income respectively. However, medium income households rely on labour (completed secondary school, and some tertiary education) for most of their income, about 29.81% and 18.16%. Finally, high income households depend on a variety of income sources for most of their income and they are: labour (some tertiary education) (45.14%), capital (20.91%) and enterprises (14.38%).

Figure 4: 2014 SA distribution of income sources within a household category



	flab-p	flab-m	flab-s	flab-t	fland	fcap	ent	gov	RoW
Low income hhds	19.33	14.02	13.21	3.35	0.07	3.06	0.97	45.94	0.04
Medium income hhds	9.07	15.81	29.81	18.16	0.18	7.91	4.58	14.33	0.14
High income hhds	0.66	3.06	12.97	45.14	0.52	20.91	14.38	1.83	0.54

Source: Own calculations based on 2014 SA SAM

Table 11 shows the South African distribution of household consumption expenditure across broad commodity categories according to the CPC version 2.1 in 2014. On average 28.69% of South African total household consumption expenditure in 2014 was on food, beverages and tobacco. This is the largest commodity category on which South African households spent their money. It is followed by other transportable goods except wood products (15.90%); trade, accommodation, food, transport, electricity and water distribution services (13.77%); financial, real estate, rental and leasing services (13.76%); community, social and personal services (10.31%); other agro-processed products (7.23%) and agriculture, forestry and fishery products (5.55%). When combined, all agriculture related categories (namely agriculture, forestry and fishery products; food, beverages and tobacco category; and other agro-processed products) account for 41.47% of total household consumption expenditure in the country in 2014.

Table 11: 2014 SA household consumption expenditure

Broad expenditure categories	Aggregate household Consumption (%)	Low income household consumption (%)	Middle income household consumption (%)	High income household consumption (%)
Agriculture, forestry and fishery products	5.55	9.20	5.05	2.42
Mining products	0.44	0.67	0.53	0.10
Food products, beverages and tobacco	28.69	40.25	31.75	14.06
Other agro-processed products	7.23	8.59	8.35	4.77
Other transportable goods, except wood products	15.90	11.59	13.52	22.59
Constructions and construction services	0.08	0.04	0.07	0.13
Trade, accommodation, food ,transport, electricity and water distribution services	13.77	13.77	17.16	10.37
Financial, real estate, rental and leasing services	13.76	7.15	10.98	23.15
Business and production services	4.26	2.26	3.35	7.19
Community, social and personal services	10.31	6.49	9.24	15.22

Source: Own calculations based on 2014 SA SAM

As illustrated from Table 11, aggregate households are broken into three categories, namely low income households, medium income households and high income households based on expenditure deciles. Low income households spent 40.25% of their total expenditure on food, beverages and tobacco in 2014. However, this spending proportion decreases when moving up the decile ladder. Medium income households and high income households spent 31.75% and 14.06% of their total expenditure respectively, on food, beverages and tobacco. High income households spent a higher proportion of their budget, about 23.15% on financial, real estate, rental and leasing services in 2014. The second higher proportion of the high income households' budget in 2014, about 22.59% is spent on other transportable goods, except wood products while the third higher proportion, about 15.22% is spent on community, social and personal services.

Table 12 shows the government income and expenditure of South Africa in 2014. South African government income is generated through its tax receipts. The most important of these are direct taxes and sales taxes (VAT), which contribute 50.12% and 31.98% respectively to the total government revenue. Import tariffs and savings-investment contribute less to the government

revenue, about 3.12% and 0.78% respectively. South African government expenditure is dominated by consumption spending, which accounts for 70.60% of the total government expenditure. Transfers to households, mostly in the form of grants also form the larger component of the government expenditure with the share of 18.27%. South African government did not save any of its income in 2014, instead it spent 0.98% more than its total income of the year. Transfers to the rest of the world form the least component of the government expenditure with the share of only 4.29%.

Table 12: 2014 SA government income and expenditure

Income	*Value (R million)*	*Share (%)*	*Expenditure*	*Value (R million)*	*Share (%)*
Activity/producer taxes	63 628	5.71	Consumption spending	786 892	70.60
Direct taxes	558 692	50.12	Transfers to enterprises	87 150	7.82
Import tariffs	35 831	3.21	Transfers to households	203 681	18.27
Sales taxes (VAT)	356 471	31.98	Transfers to RoW	47 863	4.29
Savings-investment	8 741	0.78	LESS: Savings	10 964	0.98
Capital	91 259	8.19			
Total	1 114 622	100	**Total**	1 114 622	100

Source: Own calculations based on 2014 SA SAM

With regard to South African savings and investment in 2014 as portrayed by table 13, total savings is heavily dependent on the enterprises' savings inflows, which account for 72.81%. Total savings received from abroad are also significant as they form the larger part of total savings with the share of 24.98%. Households contributed less to the total savings while government used 1.36% of the total savings in 2014. Net savings is moved to gross fixed capital formation, which represents the total of public and private investments within the South African economy.

Table 13: 2014 SA savings and investment

Savings	*Value (R million)*	*Share (%)*	*Investment*	*Value (R million)*	*Share (%)*
Enterprises	587 886	72.81	Fixed capital formation	807 455	100
Households	28 871	3.58			
Rest of the world	201 662	24.98			
LESS: Government	10 964	1.36			
Total	**807 455**	**100**	**Total**	**807 455**	**100**

Source: Own calculations based on 2014 SA SAM

Table 14 presents the final account in the 2014 SA SAM which is the current account. This account recorded a foreign deficit of R201.7 billion, which account for 14.38% of the total foreign receipts. This deficit is as a result of a trade deficit (value of imports exceeding the value of exports), and substantial enterprise and government payments to the rest of the world.

Table 14: 2014 SA current account

Receipts	*Value (R million)*	*Share (%)*	*Payments*	*Value (R million)*	*Share (%)*
Exports	1 188 877	84.78	Imports	1 254 550	89.46
Household remittances	11 792	0.84	Factor remittances	1 964	0.14
Deficit	201 662	14.38	Enterprises	97 953	6.99
			Government	47 863	3.41
Total	**1 402 330**	**100**	**Total**	**1 402 330**	**100**

Source: Own calculations based on 2014 SA SAM

4.4 Conclusion

The purpose of this chapter was to develop an updated SAM for South Africa with detailed agricultural accounts, which can be used in SAM-based models for policy analysis and policy making of agricultural management and national economic development. The data sources used, methodology adopted, assumptions made and criteria chosen to compile and disaggregate the SAM's accounts are fully explained as well as the balancing of the SAM using the GCE estimation technique.

The major data sources used to develop a detailed 2014 SA SAM are: National accounts, SUTs, the abstracts of agricultural statistics, trends in agricultural sector documents, 2012 SAM, agricultural import and export data for 2014, production cost statistics, etc. Most of the data was available for development of this SAM for the year 2014. However, data from intermediate inputs by non-agricultural industries is lacking, also, in some instances data for disaggregating some agriculture accounts is only available in older surveys (2007 agriculture surveys) not in the recent ones. Data in stock changes for agricultural commodities is scarce as it is only available for cereals and oilseeds. Data for household consumption of primary agricultural commodities is also lacking.

The final 2014 detailed SA SAM has 268 accounts: 104 industries of which 46 are for agriculture, forestry, fisheries and food processing, 134 commodities, 6 factors, 14 households, 4 tax accounts, one account for transaction costs, core government, savings-investment, stock changes, enterprises, and rest of the world. This SAM highlights a series of relevant characteristics of the South African economy. The tertiary sector is the largest contributor to total GDP accounting for 68.5%. The agro-processing sector is the most labour intensive within all the sectors accounting for 52.26% of the total factor utilization while mining, and forestry and fisheries are the most capital intensive sectors. Low income households are dependent on government grants for their income and they spend a higher percentage of their income on food, beverages and tobacco. High income households depend on variety of income sources for most of their income which are skilled labour, capital and enterprises and they spend the higher proportion of their budget on financial, real estate, rental and leasing services. Finally, the developed 2014 SA SAM is used as dataset in calibrating the SAM quantity model in chapter 5.

CHAPTER 5: RESULTS AND DISCUSSIONS

5.1 Introduction

This chapter presents the results and discussions of the analysis of the economic impact of the disaggregated agricultural sector to the South African economy by means of multipliers and simulations from a SAM quantity model. The purpose of the multipliers computed and reported in this chapter serves to highlight the impact of agricultural sectors on the output, value added, household incomes, and household consumption in the national economy in comparison with other sectors. The purpose of the simulations is to highlight the impact that can be induced by the increased export growth of the key agricultural, and food and beverages products (those generating the higher foreign exchange earnings) on the South African economic sectors and the household income distribution. The SAM used to calibrate the model in this chapter was developed in chapter 4. However, minor modifications are made: 14 household accounts from this SAM are aggregated to 3 household accounts and this reduces the SAM accounts used for the model to 257. The 3 household accounts are categorized as low, medium and high income household accounts. The low income household covers deciles 0 to 2 (1^{st} to 3^{rd} household accounts). The medium income household covers deciles 3 to 6 (4^{th} to 7^{th} household accounts). Finally, the high income household covers deciles 7 to 9 (8^{th} to 14^{th} household accounts).

This chapter is structured as follows: Section 5.2 presents the actual SAM quantity model used for computation of multipliers and simulations in this chapter, which is a closed complex SAM quantity model, i.e. it is commodity-by-industry SAM with households assumed to be endogenous. Section 5.3 and 5.4 presents the SAM multipliers and their discussions, and simulation results and their discussions respectively. Finally, section 5.5 concludes this chapter.

5.2 A closed complex SAM quantity model

A SAM is not a model but provides a basis for modeling, the transition from a SAM dataset to a SAM quantity model therefore requires the partitioning of a SAM dataset into endogenous and exogenous accounts (the description is given in section 2.4.2.1). SAM multipliers therefore refer

to changes in the endogenous accounts generated by changes in any of the exogenous accounts. It is the common practice that accounts beyond the control of domestic institutions are made exogenous. Following this practice, five sets of accounts of the detailed 2014 SA SAM are made endogenous and these are: industries, commodities, factors, enterprises and households; while three sets of accounts are made exogenous, which include: government (including taxes), consolidated capital and rest of the world accounts.

The computation of multipliers and the generation of simulations in this chapter are performed by Microsoft Excel, using the first form of a closed complex SAM quantity model which is presented by equation (18) in chapter 3. The 2014 SA SAM multipliers based on a model presented by equation (18) are found in $\bar{\mathbf{M}}_a$ which has 143 by 143 dimensions [133 commodity accounts, 6 factor accounts (4 labour accounts, one land account and one capital account) and 4 institutional accounts (one enterprise account and 3 household accounts)]. Following standard practice, the first dimension refers to the row accounts and the second dimension refers to the column accounts.

The partitioning of $\bar{\mathbf{M}}_a = \begin{bmatrix} \mathbf{M}_{a11}(133\times133) & \mathbf{M}_{a12}(133\times6) & \mathbf{M}_{a13}(133\times4) \\ \mathbf{M}_{a21}(6\times133) & \mathbf{M}_{a22}(6\times6) & \mathbf{M}_{a23}(6\times4) \\ \mathbf{M}_{a31}(4\times133) & \mathbf{M}_{a32}(4\times6) & \mathbf{M}_{a33}(4\times4) \end{bmatrix}$.

Four of the submatrices of $\bar{\mathbf{M}}_a$ namely $\mathbf{M}_{a11}$, $\mathbf{M}_{a21}$, $\mathbf{M}_{a31}$ and $\mathbf{M}_{a13}$ present output, gross value added (GVA), income, and consumption multipliers respectively. The interpretation of the multiplier values in the $\bar{\mathbf{M}}_a$ submatrices is straightforward. The column total of each account in submatrix $\mathbf{M}_{a11}$ indicates total impact on output due to an increase in exogenous demand in each sector. The column total of each account in submatrix $\mathbf{M}_{a21}$ indicates total impact on GVA due to an increase in exogenous demand in each sector. The column total of each account in submatrix $\mathbf{M}_{a31}$ indicates the total impact on income due to an increase in exogenous demand in each sector. The column total of each account in submatrix $\mathbf{M}_{a13}$ indicates total multiplier impact on consumption due to increase in exogenous transfers into each endogenous institution. The results of these four matrices are discussed in more detail in section 5.3. The other five submatrices of $\bar{\mathbf{M}}_a$ which are $\mathbf{M}_{a12}$, $\mathbf{M}_{a22}$, $\mathbf{M}_{a32}$, $\mathbf{M}_{a23}$ and $\mathbf{M}_{a33}$ are however also generated because of the inclusion of factors and institutions as endogenous accounts to capture not only the production effects but also consumption (induced) effects.

5.3 SAM multipliers

This section presents the results and discussions of output multipliers, gross value added multipliers, institution (enterprise and household) income multipliers, and household consumption multipliers computed from the C-by-C SAM multiplier matrix ($\bar{\mathbf{M}}_a$).

Table 15: Total multiplier impact on output, gross value added and income due to R1 million injection in each sector

Sectors	Total output		Total GVA		Enterprise and household income	
	Output multipliers	Rank	GVA multipliers	Rank	Income multipliers	Rank
Wheat	1.7268	119	0.3197	111	0.3489	110
Maize	2.5720	39	0.7266	42	0.7923	44
Sorghum	2.4164	57	0.7263	43	0.7912	45
Other cereals	2.0508	89	0.5785	68	0.6292	68
Leafy vegetables	2.6341	30	0.7331	39	0.7979	42
Melons	2.6006	35	0.7617	37	0.8297	37
Fruit bearing vegetables	2.6378	29	0.7721	34	0.8390	35
Green leguminous vegetables	2.3779	62	0.6522	58	0.7105	58
Root, bulb and tuberous vegetables, n.e.c.	2.6146	32	0.7688	35	0.8346	36
Other vegetables	2.2766	69	0.6043	64	0.6572	65
Tropical and subtropical fruits	2.4914	49	0.6460	59	0.7034	60
Oranges	2.6440	27	0.7050	49	0.7678	50
Other citrus fruits	2.6381	28	0.7011	51	0.7636	51
Grapes	2.6024	34	0.7784	33	0.8435	34
Apples	2.6477	25	0.7111	48	0.7742	48
Other fruits	2.5776	38	0.6764	54	0.7367	54
Nuts	2.5280	45	0.6631	56	0.7221	57
Oilseeds and oleaginous fruits	2.3182	67	0.6746	55	0.7343	55
Potatoes	2.7002	21	0.7212	46	0.7869	47
Other tubers and edible roots	2.6444	26	0.7236	45	0.7897	46
Stimulant, spice and aromatic crops	1.2969	132	0.1879	127	0.2037	127
Pulses	1.8528	106	0.3713	99	0.4052	99
Sugar crops	2.6074	33	0.6987	52	0.7614	52
Other plants	2.3864	61	0.9236	19	1.0015	19
Cattle	2.4430	54	0.8248	27	0.9198	26
Goats and sheep	2.4070	58	0.8015	30	0.8944	28

Sectors	Total output		Total GVA		Enterprise and household income	
	Output multipliers	Rank	GVA multipliers	Rank	Income multipliers	Rank
Poultry	2.7861	16	0.6017	65	0.6634	64
Pig	2.3206	66	0.7260	44	0.8122	39
Raw milk	2.4375	55	0.7950	31	0.8883	30
Eggs	2.7997	15	0.6199	62	0.6830	61
Other animals	2.1392	86	0.7685	36	0.8613	32
Forestry	2.5593	41	0.7811	32	0.8572	33
Fishing	2.1637	82	0.8904	21	0.9833	21
Coal and lignite	2.4685	51	0.9706	17	1.0734	17
Metal ores	2.8318	14	1.0498	10	1.1498	10
Other minerals	1.8606	105	0.5074	79	0.5584	78
Electricity and gas	2.6636	22	1.0806	9	1.1957	9
Natural water	3.0454	2	1.1749	4	1.3027	4
Meat	2.5491	43	0.6392	60	0.7069	59
Fish	2.4194	56	0.7032	50	0.7725	49
Vegetables	2.2051	79	0.5390	73	0.5912	73
Fruit and nuts	2.6579	24	0.6927	53	0.7597	53
Oils and fats	1.3425	128	0.1586	129	0.1757	128
Dairy products	2.2558	70	0.5053	80	0.5555	80
Grain mill products	2.3388	65	0.5332	74	0.5828	74
Starches products	2.5586	42	0.7524	38	0.8238	38
Animal feeding	1.9692	96	0.4613	86	0.5084	86
Bakery products	2.4916	48	0.6220	61	0.6797	62
Sugar	2.2186	76	0.5758	69	0.6281	69
Confectionary products	2.1220	87	0.4249	92	0.4658	92
Pasta products	1.9560	98	0.4701	85	0.5190	85
Food n.e.c.	2.0055	92	0.4174	93	0.4566	93
Alcohol, beverages	1.7480	116	0.3303	109	0.3613	109
Soft drinks	2.3575	63	0.5983	66	0.6544	66
Tobacco products	1.5821	124	0.2570	120	0.2811	120
Textile fabrics	2.4541	52	0.5221	76	0.5706	76
Made-up textile, articles	1.8098	110	0.2907	116	0.3180	116
Carpets	2.3143	68	0.5665	70	0.6216	70
Textile n.e.c.	1.9372	102	0.3372	107	0.3684	107
Knitting fabrics	1.7845	112	0.2796	119	0.3032	119
Wearing apparel	1.7461	117	0.3175	112	0.3464	112
Leather products	2.1551	84	0.5418	72	0.5999	72
Footwear	1.6751	120	0.2210	125	0.2410	125
Wood products	2.5366	44	0.7304	41	0.7981	41

Sectors	Total output		Total GVA		Enterprise and household income	
	Output multipliers	Rank	GVA multipliers	Rank	Income multipliers	Rank
Paper products	2.3419	64	0.5112	78	0.5596	77
Printing	2.2426	72	0.5132	77	0.5567	79
Petroleum products	1.7275	118	0.3115	114	0.3453	113
Basic chemicals	2.1620	83	0.4108	94	0.4510	94
Fertilizers, pesticides	1.9803	94	0.3451	104	0.3764	104
Paint, related products	2.2349	74	0.4420	90	0.4805	90
Pharmaceutical products	1.9386	101	0.3416	105	0.3711	106
Soap, cleaning, perfume	2.2365	73	0.4480	89	0.4867	89
Chemical products, n.e.c.	1.5172	126	0.1928	126	0.2120	126
Rubber tyres	1.9044	103	0.3583	102	0.3924	101
Other rubber products	2.0227	91	0.4049	97	0.4432	96
Plastic products	1.9770	95	0.4107	95	0.4443	95
Glass products	2.2142	78	0.5281	75	0.5709	75
Non-structural ceramic	1.9512	99	0.4329	91	0.4770	91
Structure non-refractory clay	2.0775	88	0.4906	84	0.5406	83
Plaster, cement	1.7702	114	0.3494	103	0.3850	103
Articles of concrete	2.2227	75	0.5563	71	0.6130	71
Non-metallic products n.e.c.	1.7619	115	0.3409	106	0.3762	105
Furniture	2.1830	81	0.4548	87	0.4936	88
Jewellery	1.8915	104	0.4536	88	0.5025	87
Manufactured products n.e.c.	1.6153	121	0.2887	117	0.3167	117
Wastes, scraps	2.2443	71	0.6047	63	0.6701	63
Iron, steel products	2.5116	46	0.4935	83	0.5409	82
Non-ferrous metals	2.0030	93	0.3592	101	0.3913	102
Structural metal products	2.4026	59	0.5020	81	0.5426	81
Tanks, reservoirs	2.3984	60	0.5000	82	0.5404	84
Other fabricated metal	2.1398	85	0.4086	96	0.4417	97
Engines, turbines	1.1875	133	0.0625	133	0.0677	133
Pumps, compressors	1.7973	111	0.3201	110	0.3476	111
Bearings, gears	1.5931	123	0.2311	123	0.2508	123
Lifting equipment	1.5967	122	0.2402	121	0.2609	121
General machinery	1.8468	107	0.3360	108	0.3649	108
Special machinery	1.7801	113	0.3065	115	0.3326	115
Domestic appliances	1.4056	127	0.1610	128	0.1749	129
Office machinery	1.3017	131	0.1215	131	0.1320	131
Electrical machinery	1.9512	100	0.2880	118	0.3128	118
Radio, television	1.5507	125	0.2263	124	0.2474	124
Medical appliances	1.3388	129	0.1493	130	0.1640	130

Sectors	Total output		Total GVA		Enterprise and household income	
	Output multipliers	Rank	GVA multipliers	Rank	Income multipliers	Rank
Motor vehicles, parts	1.8446	108	0.2321	122	0.2518	122
Ships and boats	1.9655	97	0.3655	100	0.3952	100
Railway and trams	2.0287	90	0.3850	98	0.4165	98
Aircrafts	1.8248	109	0.3158	113	0.3417	114
Other transport equipment	1.3151	130	0.1184	132	0.1280	132
Construction	2.9922	4	0.8123	28	0.8902	29
Construction services	2.8740	11	0.9320	18	1.0228	18
Trade services	2.8517	13	1.0945	6	1.2003	8
Accommodation	2.1931	80	0.5941	67	0.6529	67
Catering services	2.2147	77	0.6581	57	0.7233	56
Passenger transport	2.5013	47	0.8755	22	0.9684	22
Freight transport	2.5793	37	0.9736	16	1.0762	16
Supporting transport services	2.7359	19	1.0131	12	1.1130	13
Postal, courier services	2.7436	17	0.8030	29	0.8847	31
Electricity distribution	2.5813	36	1.0881	7	1.2071	6
Water distribution	2.9381	7	1.0847	8	1.2019	7
Financial services	2.8733	12	1.2459	2	1.3659	2
Insurance, pension	2.8846	10	1.1467	5	1.2597	5
Other financial services	3.5208	1	1.3771	1	1.4959	1
Real estate services	2.6159	31	1.0029	15	1.1148	12
Leasing, Rental services	3.0158	3	0.8634	24	0.9464	24
Research, development	2.7422	18	1.0038	13	1.0988	14
Legal, accounting	2.4735	50	0.7331	40	0.7999	40
Other business services	2.9219	8	0.9029	20	0.9855	20
Telecommunications	2.5676	40	0.7209	47	0.7941	43
Support services	2.9007	9	1.0032	14	1.0968	15
Manufactured services n.e.c.	2.6609	23	0.8263	26	0.9016	27
Public administration	2.9773	5	1.2356	3	1.3330	3
Education services	2.9556	6	1.0208	11	1.1222	11
Health, social services	2.7214	20	0.8681	23	0.9504	23
Other services n.e.c.	2.4513	53	0.8425	25	0.9251	25

Source: Own calculations - 2014 SA SAM quantity model outcomes

Table 15 above illustrates how R1 million increase in the exogenous demand for each of the sectors leads to the total output, GVA and income in the South African economy. The first set of results in Table 15 presents column totals of submatrix $\mathbf{M_{a11}}$ and it shows how R1 million increase in the exogenous demand for each of the sectors leads to the total output. For example, R1 million

injection in the wheat sector leads to R1.73 million of output increase in the economy, *vis-à-vis* R2.57 million of output increase when injection occurs in the maize sector and so on. The top five agricultural sectors with the rankings in terms of generating highest gross output multipliers within South African economy are: eggs (15); poultry (16); potatoes (21); apples (25); and other tubers and edible roots (26).

The detailed gross output multipliers of submatrix $\mathbf{M_{a11}}$, shown in appendix 1, reveal that the higher percentage of gross output multiplier generated by eggs and poultry sectors is derived from animal feeding, fish, petroleum products, maize, and pharmaceutical products sectors which indicate their high integration with these sectors. On the other hand, the higher percentage of gross output multipliers generated by potatoes, apples, and other tubers and edible roots is derived from petroleum products, fertilizers and pesticides, other minerals, freight transport, motor vehicles and parts, other fabricated metal, basic chemicals, and plastic products sectors which indicate their high integration with these sectors.

The bottom five agricultural sectors with their rankings, in terms of generating lowest gross output multipliers within South African economy are: stimulant, spice, and aromatic crops (132); wheat (119); pulses (106); other cereals (89); and other animals (86), which indicate low integration with other sectors.

The second set of results in Table 15 presents the column totals of submatrix $\mathbf{M_{a21}}$ and it illustrates how R1 million increase in the exogenous demand for each of the sectors leads to the total gross value added (GVA) in the South African economy. For example, a R1 million injection in the wheat sector leads to R319 700 of GVA increase in the economy, *vis-à-vis* R726 600 of GVA increase when injection occurs in the maize sector, and so on. The top five agricultural sectors with their ranks, that generate the highest GVA multipliers are: other plants (19); cattle (27); goats and sheep (30); raw milk (31); and grapes (33). The bottom five agricultural sectors that produce the smallest GVA multipliers are: stimulant, spice and aromatic crops (101); wheat (98); pulses (90); other cereals (85); and poultry (84). The observation from these GVA multipliers indicate that the sectors that produce high (low) gross output multipliers do not automatically generate high

(low) GVA multipliers accordingly (observation similar to that of Husain, 2006) except for import intensive sectors like stimulant, spice and aromatic crops; wheat; and pulses.

The detailed GVA multipliers of submatrix $\mathbf{M_{a21}}$ as presented in appendix 2, indicate that other plants sector's highest percentage of its GVA comes from land (ranking the 1st) as it is land intensive while cattle, goats and sheep, and raw milk sectors' highest percentage of their GVA comes from capital (ranking 11th, 13th and 12th respectively) as they are capital intensive. The grapes sector's highest percentage of its GVA comes from labour (ranking the 14th) as it is labour intensive. The top agricultural sectors with their ranks, in terms of generating highest labour multiplier values as shown in appendix 2 are: grapes (14); root, bulb and tuberous vegetables, n.e.c (15); fruit bearing vegetables (16); leafy vegetables (22); and melons (24). Even though the agricultural sectors do not have a greater impact in the generation of aggregate labour multipliers compared to other sectors in SA economy, the further disaggregation of labour in table 16 below indicates that the impact of agricultural sectors in generating labour income for unskilled and low skilled workers (workers with primary school or less) is outstanding and unmatched, as from the top 20 sectors in generating the highest flap-p multipliers, 17 of them are agricultural sectors holding 1st, 3rd to 8th, 10th to 18th, and 20th positions while the 2nd, 9th and 19th positions are held by forestry, construction, and wood products sectors, respectively.

Table 16: Disaggregated GVA multipliers across labour categories

Sectors (commodities)	Flab-p		Flab-m		Flab-s		Flab-t	
	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank
Wheat	0.0112	94	0.0143	121	0.0264	123	0.0607	124
Maize	0.0264	33	0.0325	54	0.0581	73	0.1329	68
Sorghum	0.0225	42	0.0282	66	0.0511	88	0.1182	82
Other cereals	0.0146	74	0.0191	108	0.0367	111	0.0866	107
Leafy vegetables	0.0566	5	0.0605	8	0.0864	30	0.1813	31
Melons	0.0548	6	0.0594	9	0.0847	33	0.1766	33
Fruit bearing vegetables	0.0629	4	0.0661	5	0.0925	23	0.1930	28
Green leguminous vegetables	0.0485	13	0.0523	19	0.0735	52	0.1524	53
Root, bulb and tuberous vegetables, n.e.c.	0.0641	3	0.0669	4	0.0933	22	0.1958	27
Other vegetables	0.0423	18	0.0455	28	0.0659	62	0.1395	63
Tropical and subtropical fruits	0.0460	17	0.0506	21	0.0750	51	0.1583	48
Oranges	0.0510	10	0.0561	12	0.0830	38	0.1749	34

Sectors (commodities)	Flab-p		Flab-m		Flab-s		Flab-t	
	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank
Other citrus fruits	0.0509	11	0.0560	13	0.0828	39	0.1744	37
Grapes	0.0680	1	0.0701	2	0.0963	18	0.2029	25
Apples	0.0527	8	0.0577	11	0.0846	34	0.1777	32
Other fruits	0.0490	12	0.0539	14	0.0796	43	0.1678	42
Nuts	0.0472	16	0.0520	20	0.0770	48	0.1622	47
Oilseeds and oleaginous fruits	0.0248	36	0.0296	64	0.0511	87	0.1170	83
Potatoes	0.0479	14	0.0532	16	0.0799	41	0.1701	39
Other tubers and edible roots	0.0476	15	0.0530	17	0.0779	45	0.1635	44
Stimulant, spice and aromatic crops	0.0069	115	0.0080	129	0.0129	132	0.0292	132
Pulses	0.0170	61	0.0200	101	0.0332	118	0.0738	120
Sugar crops	0.0398	20	0.0444	31	0.0689	58	0.1502	57
Other plants	0.0174	59	0.0233	87	0.0469	94	0.1147	85
Cattle	0.0235	39	0.0272	73	0.0450	102	0.1032	94
Goats and sheep	0.0238	38	0.0274	70	0.0450	101	0.1025	95
Poultry	0.0270	32	0.0322	55	0.0533	83	0.1143	86
Pig	0.0169	63	0.0209	96	0.0371	110	0.0835	109
Raw milk	0.0203	51	0.0244	82	0.0421	107	0.0957	100
Eggs	0.0287	29	0.0340	49	0.0556	77	0.1205	80
Other animals	0.0143	77	0.0175	113	0.0314	120	0.0742	119
Forestry	0.0670	2	0.0481	23	0.0712	57	0.1511	55
Fishing	0.0369	22	0.0390	41	0.1085	12	0.1455	61
Coal and lignite	0.0213	49	0.0329	52	0.0889	26	0.2175	20
Metal ores	0.0365	23	0.0577	10	0.1403	3	0.2689	15
Other minerals	0.0113	93	0.0205	98	0.0519	86	0.1366	65
Electricity and gas	0.0156	69	0.0280	68	0.0772	47	0.2833	12
Natural water	0.0318	25	0.0421	32	0.0902	25	0.2300	19
Meat	0.0212	50	0.0309	58	0.0569	75	0.1169	84
Fish	0.0260	34	0.0401	38	0.0850	32	0.1557	50
Processed vegetables	0.0203	52	0.0336	51	0.0646	66	0.1265	71
processed fruit and nuts	0.0224	43	0.0403	37	0.0841	35	0.1707	38
Oils and fats	0.0033	128	0.0061	131	0.0137	131	0.0296	131
Dairy products	0.0139	80	0.0266	75	0.0583	72	0.1214	78
Grain mill products	0.0163	66	0.0295	65	0.0649	65	0.1378	64
Starches products	0.0229	40	0.0407	36	0.0875	27	0.1857	29
Animal feeding	0.0126	84	0.0218	95	0.0472	93	0.0976	98
Bakery products	0.0214	48	0.0380	44	0.0798	42	0.1642	43
Sugar	0.0216	47	0.0366	46	0.0756	50	0.1562	49
Confectionary products	0.0119	88	0.0234	85	0.0527	85	0.1104	91
Pasta products	0.0106	98	0.0202	100	0.0455	98	0.0979	97

Sectors (commodities)	Flab-p		Flab-m		Flab-s		Flab-t	
	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank
Food n.e.c.	0.0118	89	0.0231	90	0.0528	84	0.1139	87
Alcohol, beverages	0.0127	83	0.0168	117	0.0359	112	0.0965	99
Soft drinks	0.0228	41	0.0305	61	0.0652	63	0.1747	35
Tobacco products	0.0098	101	0.0131	124	0.0279	122	0.0751	116
Textile fabrics	0.0137	81	0.0298	63	0.0714	55	0.1334	67
Made-up textile, articles	0.0078	111	0.0172	116	0.0395	109	0.0731	121
Carpets	0.0219	44	0.0351	47	0.0667	60	0.1205	79
Textile n.e.c.	0.0089	106	0.0196	102	0.0465	97	0.0868	106
Knitting fabrics	0.0108	97	0.0246	80	0.0453	100	0.0805	113
Wearing apparel	0.0150	72	0.0268	74	0.0435	104	0.0755	115
Leather products	0.0180	57	0.0277	69	0.0546	81	0.0814	112
Footwear	0.0060	121	0.0172	115	0.0311	121	0.0605	125
Wood products	0.0410	19	0.0670	3	0.0993	16	0.1488	59
Paper products	0.0146	75	0.0272	71	0.0589	71	0.1503	56
Printing	0.0120	86	0.0244	81	0.0679	59	0.2113	22
Petroleum products	0.0048	125	0.0095	126	0.0247	124	0.0680	122
Basic chemicals	0.0067	117	0.0191	107	0.0550	78	0.1076	92
Fertilizers, pesticides	0.0065	118	0.0174	114	0.0490	89	0.1131	89
Paint, related products	0.0096	103	0.0229	93	0.0619	69	0.1632	46
Pharmaceutical products	0.0077	113	0.0178	112	0.0476	92	0.1281	69
Soap, cleaning, perfume	0.0098	102	0.0232	88	0.0626	68	0.1687	41
Chemical products, n.e.c.	0.0033	129	0.0084	128	0.0233	125	0.0499	127
Rubber tyres	0.0069	116	0.0209	97	0.0540	82	0.0834	110
Other rubber products	0.0079	110	0.0239	83	0.0614	70	0.0949	101
Plastic products	0.0094	105	0.0369	45	0.0831	37	0.1267	70
Glass products	0.0103	99	0.0396	39	0.1337	4	0.1501	58
Non-structural ceramic	0.0146	73	0.0233	86	0.0427	106	0.0945	102
Structure non-refractory clay	0.0165	65	0.0264	76	0.0486	90	0.1072	93
Plaster, cement	0.0117	90	0.0188	110	0.0347	114	0.0766	114
Articles of concrete	0.0187	56	0.0300	62	0.0549	79	0.1215	77
Non-metallic products n.e.c.	0.0100	100	0.0165	118	0.0322	119	0.0748	117
Furniture	0.0241	37	0.0455	29	0.0864	29	0.1008	96
Jewellery	0.0109	95	0.0193	106	0.0431	105	0.0818	111
Manufactured products n.e.c.	0.0115	91	0.0195	103	0.0352	113	0.0646	123
Wastes, scraps	0.0114	92	0.0232	89	0.0580	74	0.1134	88
Iron, steel products	0.0140	78	0.0326	53	0.0629	67	0.1226	75
Non-ferrous metals	0.0087	107	0.0195	105	0.0482	91	0.1232	74
Structural metal products	0.0190	55	0.0479	26	0.0954	20	0.1528	51
Tanks, reservoirs	0.0190	54	0.0480	25	0.0955	19	0.1520	54

Sectors (commodities)	Flab-p		Flab-m		Flab-s		Flab-t	
	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank
Other fabricated metal	0.0153	70	0.0387	43	0.0773	46	0.1247	73
Engines, turbines	0.0013	133	0.0047	133	0.0092	133	0.0242	133
Pumps, compressors	0.0077	112	0.0182	111	0.0447	103	0.1204	81
Bearings, gears	0.0061	120	0.0146	120	0.0342	115	0.0843	108
Lifting equipment	0.0057	124	0.0135	123	0.0333	117	0.0907	104
General machinery	0.0080	109	0.0190	109	0.0466	96	0.1265	72
Special machinery	0.0081	108	0.0195	104	0.0454	99	0.1116	90
Domestic appliances	0.0039	127	0.0092	127	0.0224	126	0.0604	126
Office machinery	0.0029	130	0.0068	130	0.0168	129	0.0459	128
Electrical machinery	0.0095	104	0.0236	84	0.0403	108	0.0941	103
Radio, television	0.0043	126	0.0154	119	0.0217	127	0.0746	118
Medical appliances	0.0023	132	0.0056	132	0.0159	130	0.0440	129
Motor vehicles, parts	0.0060	122	0.0137	122	0.0334	116	0.0882	105
Ships and boats	0.0064	119	0.0313	57	0.0549	80	0.1427	62
Railway and trams	0.0071	114	0.0337	50	0.0568	76	0.1480	60
Aircrafts	0.0059	123	0.0253	79	0.0468	95	0.1226	76
Other transport equipment	0.0026	131	0.0104	125	0.0190	128	0.0432	130
Construction	0.0288	28	0.0503	22	0.1009	15	0.2019	26
Construction services	0.0522	9	0.0703	1	0.1023	14	0.1848	30
Trade services	0.0374	21	0.0644	6	0.1334	5	0.2718	13
Accommodation	0.0133	82	0.0272	72	0.0712	56	0.1525	52
Catering services	0.0278	30	0.0414	33	0.0765	49	0.1363	66
Passenger transport	0.0217	45	0.0411	34	0.0839	36	0.1693	40
Freight transport	0.0320	24	0.0533	15	0.0940	21	0.1747	36
Supporting transport services	0.0173	60	0.0319	56	0.1111	10	0.3069	10
Postal, courier services	0.0120	87	0.0256	78	0.0721	53	0.2338	17
Electricity distribution	0.0145	76	0.0229	94	0.0664	61	0.2705	14
Water distribution	0.0299	27	0.0407	35	0.0866	28	0.2160	21
Financial services	0.0311	26	0.0390	42	0.1331	6	0.4010	3
Insurance, pension	0.0176	58	0.0259	77	0.1169	8	0.3744	4
Other financial services	0.0124	85	0.0203	99	0.2904	1	0.5061	2
Real estate services	0.0139	79	0.0229	92	0.0715	54	0.2060	24
Leasing, Rental services	0.0251	35	0.0468	27	0.1051	13	0.2316	18
Research, development	0.0167	64	0.0481	24	0.0916	24	0.3516	5
Legal, accounting	0.0150	71	0.0309	59	0.0966	17	0.2543	16
Other business services	0.0199	53	0.0392	40	0.1141	9	0.3124	8
Telecommunications	0.0108	96	0.0231	91	0.0649	64	0.2104	23
Support services	0.0216	46	0.0453	30	0.1330	7	0.3153	7
Manufactured services n.e.c.	0.0170	62	0.0348	48	0.1089	11	0.2866	11

Sectors (commodities)	Flab-p		Flab-m		Flab-s		Flab-t	
	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank
Public administration	0.0276	31	0.0524	18	0.2162	2	0.5486	1
Education services	0.0156	68	0.0280	67	0.0784	44	0.3471	6
Health, social services	0.0158	67	0.0306	60	0.0851	31	0.3081	9
Other services n.e.c.	0.0528	7	0.0640	7	0.0821	40	0.1632	45

Source: Own calculations-2014 SA SAM quantity model outcomes

The third set of results in Table 15 presents the column totals of each account of submatrix $\mathbf{M_{a31}}$ and it shows the increase in total institutional (enterprise and household) income due to R1 million injection into each of the sectors. For instance, R1 million injection in wheat sector leads to R348 900 of institutional income increase in the SA economy, *vis-à-vis* R792 300 of income increase when injection takes place in the maize sector, and so on. The leading five agricultural sectors (with their rankings) in generating higher income for the institutions are: other plants (19); cattle (26); goats and sheep (28); raw milk (30); and other animals (32). The least contributing agricultural sectors towards income generation for institutions are: stimulant, spice and aromatic crops; wheat; pulses; other cereals; and other vegetables. These agricultural sectors are the same that contributed to higher (lower) factor income, which indicate the strong correlation between institutional income and factor income.

Table 17 presents the detailed submatrix $\mathbf{M_{a31}}$ and it illustrates the distribution of the total increases in institutional income across enterprises and different categories of households, therefore the multiplier values in this table indicate the increase of income of enterprises and that of the different household categories due to R1 million increase in the corresponding sectoral exogenous demand. For instance, reading from the rows, R1 million increase in the exogenous demand for wheat increases enterprises' income by R104 300, low income households' income by R9 800, middle income households' income by R38 400, and high income households' income by R196 500, which result in an increment of total institutional income of R348 900 (column 6 of table 15).

Agricultural sectors (particularly animal subsectors) play a crucial role in generating higher income for enterprises in SA, as they feature in the top 20 sectors in generating higher income for enterprises. These are: other animals (10^{th}), cattle (11^{th}), raw milk (12^{th}), goats and sheep (14^{th}) and pigs (21^{st}). The contribution of agricultural sector to low income households' income is

outstanding as 14 sectors out of the top 20 sectors in generating higher income to this household category are all agricultural sectors with grapes (1st), root, bulb and tuberous vegetables (2nd) and fruit bearing vegetables (3rd) sectors leading. The top 5 agricultural sectors which contribute to the high income households' income are: other plants (5th), sorghum (24th), maize (29th), grapes (33rd) and oilseeds and oleaginous fruits sectors (34th). These are land intensive sectors (except grapes sector which is labour intensive) and since households obtain their income from factors they own, it implies that high income households in SA are the owners of land. Finally, it is observed that there are only two agricultural sectors featuring in the top 10 sectors generating higher income to the medium income households and these are grapes, and root, bulb and tuberous vegetables, n.e.c sectors as shown in Table 17.

Table 17: Disaggregated institutional income multipliers across enterprises and different household categories

Sectors	Enterprises		Lower income households		Medium income households		Higher income households	
	Income multiplier	Rank	Income multiplier	Rank	Income multiplier	Rank	Income multiplier	Rank
Wheat	0.1043	109	0.0098	114	0.0384	118	0.1965	109
Maize	0.2308	56	0.0227	42	0.0875	54	0.4514	29
Sorghum	0.2216	62	0.0206	53	0.0829	57	0.4662	24
Other cereals	0.1666	84	0.0146	83	0.0629	83	0.3850	51
Leafy vegetables	0.2399	49	0.0389	6	0.1185	14	0.4006	41
Melons	0.2521	43	0.0382	7	0.1185	15	0.4209	37
Fruit bearing vegetables	0.2435	47	0.0427	3	0.1282	10	0.4247	35
Green leguminous vegetables	0.2164	64	0.0335	19	0.1029	35	0.3576	58
Root, bulb and tuberous vegetables, n.e.c.	0.2373	52	0.0433	2	0.1293	8	0.4246	36
Other vegetables	0.1908	76	0.0297	26	0.0932	47	0.3435	63
Tropical and subtropical fruits	0.2121	67	0.0324	21	0.1014	38	0.3575	59
Oranges	0.2326	54	0.0358	12	0.1116	25	0.3877	48
Other citrus fruits	0.2319	55	0.0357	13	0.1112	26	0.3848	52
Grapes	0.2302	57	0.0455	1	0.1344	6	0.4335	33
Apples	0.2334	53	0.0368	9	0.1139	20	0.3901	47
Other fruits	0.2235	61	0.0344	16	0.1071	31	0.3718	55
Nuts	0.2181	63	0.0333	20	0.1041	33	0.3666	56
Oilseeds and oleaginous fruits	0.2038	69	0.0212	50	0.0811	60	0.4283	34
Potatoes	0.2465	46	0.0342	17	0.1088	29	0.3974	44
Other tubers and edible roots	0.2487	45	0.0340	18	0.1080	30	0.3991	42
Stimulant, spice & aromatic crops	0.0500	129	0.0059	126	0.0226	127	0.1252	126
Pulses	0.1229	100	0.0135	89	0.0481	103	0.2208	100
Sugar crops	0.2271	60	0.0295	27	0.0984	40	0.4064	40

Sectors	Enterprises		Lower income households		Medium income households		Higher income households	
	Income multiplier	Rank	Income multiplier	Rank	Income multiplier	Rank	Income multiplier	Rank
Other plants	0.2379	51	0.0201	55	0.0940	44	0.6495	5
Cattle	0.4114	11	0.0196	61	0.0759	64	0.4129	39
Goats and sheep	0.4057	14	0.0195	62	0.0745	66	0.3947	45
Poultry	0.2507	44	0.0210	51	0.0737	67	0.3180	70
Pig	0.3802	21	0.0151	80	0.0621	84	0.3548	60
Raw milk	0.4094	12	0.0176	69	0.0702	74	0.3912	46
Eggs	0.2549	42	0.0221	46	0.0770	62	0.3290	68
Other animals	0.4116	10	0.0137	87	0.0595	88	0.3765	54
Forestry	0.3055	28	0.0402	5	0.1128	23	0.3986	43
Fishing	0.3837	17	0.0300	25	0.1111	27	0.4585	27
Coal and lignite	0.4189	9	0.0227	41	0.1025	36	0.5292	19
Metal ores	0.3813	19	0.0354	14	0.1423	5	0.5908	14
Other minerals	0.1991	73	0.0128	95	0.0581	90	0.2883	80
Electricity and gas	0.4656	5	0.0199	57	0.1021	37	0.6081	10
Natural water	0.5334	1	0.0291	28	0.1205	12	0.6197	6
Meat	0.2795	34	0.0190	64	0.0731	68	0.3354	65
Fish	0.2727	35	0.0240	35	0.0926	48	0.3832	53
Processed vegetables	0.2031	71	0.0189	65	0.0726	69	0.2966	78
processed fruit and nuts	0.2583	41	0.0226	43	0.0913	49	0.3875	49
Oils and fats	0.0703	124	0.0037	130	0.0166	132	0.0851	130
Dairy products	0.1966	75	0.0150	81	0.0631	82	0.2809	81
Grain mill products	0.1826	79	0.0170	71	0.0706	73	0.3126	72
Starches products	0.2682	38	0.0236	37	0.0972	42	0.4348	32
Animal feeding	0.1879	78	0.0130	91	0.0542	95	0.2532	88
Bakery products	0.2143	66	0.0214	49	0.0858	55	0.3582	57
Sugar	0.1905	77	0.0208	52	0.0817	58	0.3351	66
Confectionary products	0.1564	85	0.0130	90	0.0552	93	0.2411	94
Pasta products	0.1971	74	0.0119	99	0.0525	97	0.2575	87
Food n.e.c.	0.1464	87	0.0130	92	0.0552	92	0.2420	93
Alcohol, beverages	0.1154	101	0.0110	102	0.0430	113	0.1919	110
Soft drinks	0.2091	68	0.0199	56	0.0778	61	0.3476	62
Tobacco products	0.0898	116	0.0085	119	0.0334	121	0.1493	121
Textile fabrics	0.1790	82	0.0163	74	0.0706	72	0.3046	74
Made-up textile, articles	0.1024	110	0.0092	118	0.0393	117	0.1671	117
Carpets	0.2149	65	0.0201	54	0.0759	63	0.3107	73
Textile n.e.c.	0.1149	102	0.0106	107	0.0459	107	0.1970	108
Knitting fabrics	0.0815	120	0.0117	100	0.0456	109	0.1644	118
Wearing apparel	0.1081	108	0.0137	86	0.0491	100	0.1755	114
Leather products	0.2433	48	0.0166	72	0.0636	81	0.2764	83

Sectors	Enterprises		Lower income households		Medium income households		Higher income households	
	Income multiplier	Rank	Income multiplier	Rank	Income multiplier	Rank	Income multiplier	Rank
Footwear	0.0732	123	0.0077	120	0.0323	123	0.1278	125
Wood products	0.2603	39	0.0346	15	0.1163	17	0.3869	50
Paper products	0.1818	81	0.0154	78	0.0656	79	0.2968	77
Printing	0.1433	89	0.0146	84	0.0695	76	0.3293	67
Petroleum products	0.1399	93	0.0062	125	0.0302	124	0.1690	116
Basic chemicals	0.1546	86	0.0105	109	0.0510	98	0.2350	96
Fertilizers, pesticides	0.1125	104	0.0095	117	0.0459	108	0.2085	104
Paint, related products	0.1318	97	0.0128	96	0.0604	86	0.2755	85
Pharmaceutical products	0.1006	112	0.0100	113	0.0469	106	0.2137	102
Soap, cleaning, perfume	0.1316	98	0.0130	93	0.0614	85	0.2808	82
Chemical products, n.e.c.	0.0748	122	0.0047	128	0.0229	126	0.1096	127
Rubber tyres	0.1285	99	0.0106	108	0.0485	102	0.2048	105
Other rubber products	0.1445	88	0.0120	98	0.0551	94	0.2316	99
Plastic products	0.1118	105	0.0157	77	0.0699	75	0.2469	90
Glass products	0.1411	92	0.0197	60	0.0933	46	0.3168	71
Non-structural ceramic	0.1774	83	0.0135	88	0.0526	96	0.2335	97
Structure non-refractory clay	0.2009	72	0.0153	79	0.0597	87	0.2647	86
Plaster, cement	0.1429	90	0.0109	103	0.0425	114	0.1886	112
Articles of concrete	0.2279	59	0.0174	70	0.0677	77	0.3000	75
Non-metallic products n.e.c.	0.1424	91	0.0097	116	0.0396	116	0.1844	113
Furniture	0.1397	94	0.0229	39	0.0816	59	0.2494	89
Jewellery	0.2034	70	0.0116	101	0.0495	99	0.2380	95
Manufactured products n.e.c.	0.1092	107	0.0106	106	0.0398	115	0.1570	119
Wastes, scraps	0.2716	36	0.0140	85	0.0639	80	0.3206	69
Iron, steel products	0.1820	80	0.0161	75	0.0667	78	0.2760	84
Non-ferrous metals	0.1135	103	0.0107	105	0.0487	101	0.2184	101
Structural metal products	0.1352	95	0.0221	47	0.0879	52	0.2973	76
Tanks, reservoirs	0.1343	96	0.0221	45	0.0879	53	0.2961	79
Other fabricated metal	0.1104	106	0.0179	67	0.0713	71	0.2421	92
Engines, turbines	0.0168	133	0.0020	133	0.0094	133	0.0395	133
Pumps, compressors	0.0930	115	0.0098	115	0.0448	110	0.2000	106
Bearings, gears	0.0663	126	0.0076	121	0.0337	119	0.1432	123
Lifting equipment	0.0699	125	0.0073	123	0.0335	120	0.1503	120
General machinery	0.0978	113	0.0102	111	0.0469	105	0.2100	103
Special machinery	0.0879	117	0.0101	112	0.0448	111	0.1898	111
Domestic appliances	0.0469	130	0.0049	127	0.0226	128	0.1005	128
Office machinery	0.0354	131	0.0037	131	0.0169	130	0.0760	131
Electrical machinery	0.0859	118	0.0108	104	0.0440	112	0.1721	115
Radio, television	0.0776	121	0.0063	124	0.0286	125	0.1348	124

Sectors	Enterprises		Lower income households		Medium income households		Higher income households	
	Income multiplier	Rank	Income multiplier	Rank	Income multiplier	Rank	Income multiplier	Rank
Medical appliances	0.0566	128	0.0034	132	0.0169	131	0.0872	129
Motor vehicles, parts	0.0656	127	0.0074	122	0.0333	122	0.1455	122
Ships and boats	0.0949	114	0.0121	97	0.0563	91	0.2318	98
Railway and trams	0.1015	111	0.0129	94	0.0593	89	0.2428	91
Aircrafts	0.0838	119	0.0103	110	0.0478	104	0.1998	107
Other transport equipment	0.0314	132	0.0042	129	0.0188	129	0.0736	132
Construction	0.2993	30	0.0281	29	0.1102	28	0.4526	28
Construction services	0.3606	22	0.0405	4	0.1337	7	0.4880	23
Trade services	0.4087	13	0.0366	10	0.1455	3	0.6095	8
Accommodation	0.2285	58	0.0160	76	0.0723	70	0.3361	64
Catering services	0.2591	40	0.0242	34	0.0884	51	0.3517	61
Passenger transport	0.3831	18	0.0233	38	0.0983	41	0.4637	26
Freight transport	0.4240	8	0.0301	24	0.1157	18	0.5065	20
Supporting transport services	0.3810	20	0.0226	44	0.1138	21	0.5956	13
Postal, courier services	0.3189	26	0.0165	73	0.0841	56	0.4652	25
Electricity distribution	0.4894	2	0.0181	66	0.0956	43	0.6040	11
Water distribution	0.4866	3	0.0276	30	0.1135	22	0.5742	15
Financial services	0.4501	6	0.0313	22	0.1444	4	0.7401	3
Insurance, pension	0.4282	7	0.0228	40	0.1221	11	0.6865	4
Other financial services	0.3971	15	0.0305	23	0.1881	1	0.8802	1
Real estate services	0.4697	4	0.0177	68	0.0900	50	0.5374	17
Leasing, Rental services	0.3171	27	0.0267	32	0.1120	24	0.4907	22
Research, development	0.3492	23	0.0239	36	0.1168	16	0.6090	9
Legal, accounting	0.2388	50	0.0194	63	0.0938	45	0.4479	30
Other business services	0.2961	31	0.0243	33	0.1151	19	0.5500	16
Telecommunications	0.2858	33	0.0148	82	0.0756	65	0.4179	38
Support services	0.3439	24	0.0274	31	0.1287	9	0.5969	12
Manufactured services n.e.c.	0.2692	37	0.0219	48	0.1057	32	0.5049	21
Public administration	0.2930	32	0.0366	11	0.1825	2	0.8209	2
Education services	0.3854	16	0.0198	58	0.1037	34	0.6133	7
Health, social services	0.3021	29	0.0198	59	0.0987	39	0.5298	18
Other services n.e.c.	0.3308	25	0.0382	8	0.1201	13	0.4360	31

Source: Own calculations - 2014 SA SAM quantity model outcomes

Table 18 below shows the details of submatrix $\mathbf{M_{a13}}$ indicating the increase in the aggregate (column 1) and disaggregated (columns 2, 3 and 4) household consumption due to a R1 million external income transfer to households. For instance, R1 million injection in aggregate household

income leads to R98 600 of household consumption increase of agriculture, forestry and fishery products in the SA economy. The increase in the household income lead to an increase in the household consumption of the following items: other transportable goods, except wood products (R465 600); financial, real estate, rental and leasing services (R371 400); and food products, beverages and tobacco (R301 400)

The consumption multipliers across different categories of households as portrayed by columns 2, 3 and 4 of table 18 show that the low income households as a result of R1 million increase in their income, spend more on the food products, beverages and tobacco (R567 300) expenditure group than any household category. In contrast, the high income households spend more of their increased income on the other transportable goods (R466 700); and financial, real estate, rental and leasing services (R399 500) than low income households and middle income households.

Table 18: Total multiplier impact on household consumption due to a R1 million injection to households

Broad expenditure categories	Aggregate households consumption multipliers	Low income households consumption multipliers	Medium income households consumption multipliers	High income households consumption multipliers
Agriculture, forestry and fishery products	0.0986	0.2112	0.1421	0.0728
Mining products	0.0624	0.0737	0.0722	0.0583
Food products, beverages and tobacco	0.3014	0.5673	0.4571	0.2252
Other agro-processed products	0.1141	0.1615	0.1544	0.0969
Other transportable goods, except wood products	0.4656	0.4652	0.4620	0.4667
Constructions and construction services	0.0024	0.0020	0.0024	0.0025
Trade, accommodation, food ,transport, electricity and water distribution services	0.2015	0.2540	0.2763	0.1738
Financial, real estate, rental and leasing services	0.3714	0.2701	0.3154	0.3995
Business and production services	0.1498	0.1241	0.1378	0.1563
Community, social and personal services	0.1887	0.1498	0.1737	0.1976

Source: Own calculations-2014 SA SAM quantity model outcomes

5.4 Simulations

In order for the agricultural policy to be sustainable, Eckert et al., (1997) advises that the strong economic growth is a necessity and for long run economic strength, policy management of such growth must emphasize the agricultural sectors whose growth is balance of payments friendly. The South African foreign trade structure as observed from a detailed 2014 SA SAM reveals that in regard to South African export trade in 2014, primary agricultural sector exported 15.16% of total domestic agricultural production and the agricultural industries which contribute largely to the export earnings are: oranges, other citrus fruits, maize, grapes, apples, and other animals. In the food industry, food subsectors which contribute largely to the export earnings are: processed fruit & nuts, fish, meat, bakery, and alcohol & beverages. This section therefore presents the results and discussions of simulations of the 20% increase in export demand of these products. The simulations are performed using the SAM quantity model presented in section 5.2. The level of the increase in exports (20 percent) is chosen arbitrarily, but due to the linearity of the model used it does not matter what percentage level is chosen, as the impact of a shock of 40% would be twice as large as the impact of 20% shock. The results are presented for 12 simulations for 12 sectors of the SAM, one simulation is carried out at a time while other sectors are kept constant.

Table 19: The impact of the 20% simulation on output, GVA and institution income

Sectors	Gross output			
	2014 Base output *value* *(Million Rand)*	**Post-simulation output increase** *(Million Rand)*	**Post-simulation output increase** *(%)*	**Post-simulation output *value*** *(Million Rand)*
Maize	26 743	1 911	7.15	28 654
Oranges	6 852	2 073	30.26	8 925
Other citrus fruits	4 835	1 664	34.42	6 500
Grapes	10 224	1 684	16.47	11 908
Apples	5 392	1 234	22.89	6 626
Other animals	6 497	1 195	18.39	7 692
Meat	72 502	1 911	2.64	74 413
Fish	24 685	2 578	10.44	27 263
Processed fruit and nuts	29 930	2 975	9.94	32 904
Bakery	88 051	1 617	1.84	89 667
Other food	44 959	2 527	5.62	47 486
Alcohol & beverages	111 349	4 862	4.37	116 211
	Gross value added			

Sectors	2014 Base income (Million Rand)	Post-simulation income increase (Million Rand)	Post-simulation income increase (%)	Post-simulation income (Million Rand)
Maize	3 356 134	540	0.0161	3 356 674
Oranges		553	0.0165	3 356 687
Other citrus fruits		442	0.0132	3 356 576
Grapes		504	0.0150	3 356 638
Apples		331	0.0099	3 356 465
Other animals		429	0.0128	3 356 563
Meat		479	0.0143	3 356 613
Fish		749	0.0223	3 356 883
Processed fruit and nuts		775	0.0231	3 356 909
Bakery		404	0.0120	3 356 538
Other food		526	0.0157	3 356 660
Alcohol & beverages		919	0.0274	3 357 053
Sectors	**Endogenous institution income**			
	2014 Base income (Million Rand)	**Post-simulation income increase** (Million Rand)	**Post-simulation income increase** (%)	**Post-simulation income** (Million Rand)
Maize	3 996 007	589	0.0147	3 996 595
Oranges		602	0.0151	3 996 609
Other citrus fruits		482	0.0121	3 996 488
Grapes		546	0.0137	3 996 553
Apples		361	0.0090	3 996 367
Other animals		481	0.0120	3 996 488
Meat		530	0.0133	3 996 537
Fish		823	0.0206	3 996 830
Processed fruit and nuts		850	0.0213	3 996 857
Bakery		441	0.0110	3 996 448
Other food		575	0.0144	3 996 582
Alcohol & beverages		1 005	0.0251	3 997 012

Source: Own calculations-2014 SA SAM quantity model simulation results

The results of the impact on aggregate output, GVA and income due to a 20% simulation of export demand increase of the 12 sectors are depicted by Table 19 above and the impact on disaggregated output by appendix 3 and they are interpreted for each sector as follows:

20% increase in maize exports

The R742.98 million increase in exogenous export demand for maize leads to an increase in output by R1 911 million, value added by R540 million and income by R589 million. R766 million of the

increase in total output is generated within the maize sector, followed by the fertilizers and pesticides sector (R173 million), and petroleum products (R105 million).

20% increase in oranges exports

R784.05million increase in exogenous export demand for oranges leads to an increase in output by R2 073 million, value added by R553 million and income by R602 million. R787 million of the increase in total output is generated within the oranges sector, followed by the petroleum products (R110 million), fertilizers and pesticides (R85 million), motor vehicles (R60 million) and freight transport (R49 million).

20% increase in other citrus fruits exports

R630.94 million increase in exogenous export demand for other citrus fruits leads to an increase in output by R1 664 million, value added by R442 million and income by R482 million. R633 million of the increase in total output is generated within the other citrus sector, while R89 million and R69 million are generated within the petroleum products, and fertilizers and pesticides respectively.

20% increase in grapes exports

R647.18 million increase in exogenous export demand for grapes leads to an increase in output by R1 684 million, value added by R504 million and income by R546 million. R650 million of the increase in total output is generated within the grape sector, R93 million within petroleum products while R54 million is generated within fertilizers and pesticides.

20% increase in apples exports

R466.10 million increase in exogenous export demand for apples leads to an increase in output by R1 234 million, value added by R331 million and income by R361 million. R468 million of the increase in total output is generated within the apples sector, while R68 million and R41 million are generated within the petroleum products, and fertilizers and pesticides respectively.

20% increase in other animals exports

R558.45 million increase in exogenous export demand for other animals leads to an increase in output by R1 195 million, value added by R429 million and income by R481 million. R686 million of the increase in total output is generated within the other animals sector, while R48 million, R28.4 million, R28.3 million and R19 million are generated within the animal feeding, real estate, other plants, and pharmaceutical products sectors respectively.

20% increase in meat exports

R749.88 million increase in exogenous export demand for meat causes an output to increase by R1 911 million, value added by R479 million and income by R530 million. R795 million of the increase in total output is generated within the meat sector, while R134 million, R123 million, and R68 million are generated within the cattle, poultry, and animal feeding sectors respectively.

20% increase in fish exports

R1 065.40 million increase in exogenous export demand for fish causes an output to increase by R2 578 million, value added by R749 million and income by R823 million. R1219 million of the increase in total output is generated within the fish sector, while R197 million, R65 million, and R60 million are generated within the fishing, real estate, and financial sectors respectively.

20% increase in processed fruits and nuts exports

R1 119.25 million increase in exogenous export demand for processed fruits and nuts causes an output to increase by R2 975 million, value added by R775 million and income by R850 million. R1 279 million of the increase in total output is generated within the fruits and nuts sector, while R74 million is generated within the plastic products sector.

20% increase in bakery products exports

R648.97 million increase in exogenous export demand for bakery products causes an output to increase by R1 617 million, value added by R404 million and income by R441 million. R659

million of the increase in total output is generated within the bakery sector, R44 million is generated within real estate services and R43 million is generated within the grain mill sector.

20% increase in other food products exports

R1 259.81 million increase in exogenous export demand for other food products causes an output to increase by R2 527 million, value added by R526 million and income by R575 million. R1 307 million of the increase in total output is generated within the other food sector, R55 million is generated within oils and fats and R36 million is generated within the grain mill sector.

20% increase in alcohol and beverages exports

R2 781.37 million increase in exogenous export demand for beverages causes an output to increase by R4 862 million, value added by R919 million and income by R1 005 million. R2 989 million of the increase in total output is generated within the alcohol and beverages sector, while R91 million, R89 million and R79 million are generated within other services, real estate and grapes sectors respectively.

The observations from Table 19 show that amongst these 12 simulated sectors, other citrus (34.42%), oranges (30.26%), apples (22.89%), and other animals (18.39%) are the top four in terms of their greater percentage increases in total output. In terms of value addition, alcohol & beverages, processed fruit & nuts, fish and oranges sectors have greater impact and these sectors are also the leaders in generating income to the institutions.

Table 20: The impact of the 20% simulation on the income of the disaggregated endogenous institutions

Sectors	Enterprises			
	2014 Base income *(Million Rand)*	**Post-simulation income increase** *(Million Rand)*	**Post-simulation income increase** *(%)*	**Post-simulation income** *(Million Rand)*
Maize	1 219 626	171	0.0141	1 219 751
Oranges		182	0.0150	1 219 760
Other citrus fruits		146	0.0120	1 219 734
Grapes		149	0.0122	1 219 726
Apples		109	0.0089	1 219 705
Other animals		230	0.0188	1 219 876
Meat		210	0.0172	1 219 849
Fish		290	0.0238	1 219 901

Processed fruit and nuts		289	0.0237	1 219 864
Bakery		139	0.0114	1 219 740
Other food		184	0.0151	1 219 926
Alcohol & beverages		321	0.0263	1 220 191
Sectors	**Low Income Households**			
	2014 Base income *(Million Rand)*	**Post-simulation income increase** *(Million Rand)*	**Post-simulation income increase** *(%)*	**Post-simulation income** *(Million Rand)*
Maize	195 863	17	0.0086	195 880
Oranges		28	0.0143	195 891
Other citrus fruits		23	0.0115	195 886
Grapes		29	0.0150	195 893
Apples		17	0.0088	195 880
Other animals		8	0.0039	195 871
Meat		14	0.0073	195 877
Fish		26	0.0131	195 889
Processed fruit and nuts		25	0.0129	195 888
Bakery		14	0.0071	195 877
Other food		16	0.0083	195 879
Alcohol & beverages		31	0.0156	195 894
Sectors	**Medium Income Households**			
	2014 Base income *(Million Rand)*	**Post-simulation income increase** *(Million Rand)*	**Post-simulation income increase** *(%)*	**Post-simulation income** *(Million Rand)*
Maize	531 932	65	0.0101	531 986
Oranges		88	0.0147	532 011
Other citrus fruits		70	0.0119	531 995
Grapes		87	0.0150	532 012
Apples		53	0.0089	531 980
Other animals		33	0.0053	531 961
Meat		55	0.0092	531 981
Fish		99	0.0189	532 033
Processed fruit and nuts		102	0.0189	532 033
Bakery		56	0.0107	531 989
Other food		70	0.0199	532 038
Alcohol & beverages		120	0.0436	532 164
Sectors	**High Income Households**			
	2014 Base income *(Million Rand)*	**Post-simulation income increase** *(Million Rand)*	**Post-simulation income increase** *(%)*	**Post-simulation income** *(Million Rand)*
Maize	2 048 586	335	0.0164	2 048 921
Oranges		304	0.0148	2 048 890
Other citrus fruits		243	0.0119	2 048 828
Grapes		281	0.0137	2 048 866
Apples		182	0.0089	2 048 767
Other animals		210	0.0103	2 048 796
Meat		251	0.0123	2 048 837
Fish		408	0.0199	2 048 994
Processed fruit and nuts		434	0.0212	2 049 019
Bakery		232	0.0113	2 048 818
Other food		305	0.0149	2 048 890
Alcohol & beverages		534	0.0261	2 049 119

Source: Own calculations-2014 SA SAM quantity model simulation results

The impact of the 20% simulation, on the income of the disaggregated endogenous institution as presented in Table 20 reveal the following results:

The sectors that contribute the most to enterprises income due to the increase in exports are: other animals (0.0188% income increase), processed fruit & nuts (0.0237% income increase), fish (0.0238% income increase), and alcohol and beverages (0.0263% income increase)

The top four sectors amongst the 12 simulated sectors, that contribute to low income households livelihoods in terms of highest income generation are: alcohol and beverages (0.0156% income increase), grapes (0.0150% income increase), oranges (0.0143% increase), and fish (0.0131% income increase).

The top four sectors amongst the 12, which contribute in improving the income for the middle income households: alcohol and beverages (0.0436% income increase), other food (0.0199% income increase), processed fruit & nuts, and fish, each with 0.0189% income increase.

Due to export increase, high income households' income accrues much more from alcohol and beverages (0.0261%), processed fruit & nuts (0.0212%), fish (0.0199%), and maize (0.0164

The results also indicate that even though all institutions benefit from the income increase due to 20% simulation of export demand of 12 key agriculture and food products, the institutions do not benefit in the same way: for instance, increases in maize, other animals, meat, fish, and bakery products exports generate the highest income for high income households and enterprises compared to middle and low income households. In contrast an increase in grape exports generates the highest income increase for middle and low income households compared to their high income counterparts.

With regard to the improvement of equity amongst the institutions, increase in exports of apples, other citrus fruits, grapes and oranges generates income to low, middle and high income households, and enterprises in a more or less the same in magnitude.

5.5 Conclusion

This chapter presented the results and discussions of the analysis of the economic impact of the disaggregated agricultural sector to the South African economy by means of multipliers and simulations from a SAM quantity model.

The multiplier results revealed that agricultural sectors contribute less to total output and total gross value added within South African economy compared to other sectors as only few of these sectors notably eggs and poultry sectors feature in the top 20 in terms of output multipliers while in terms of value added multipliers only other plants sector features in the top 20. However, the results indicate that the impact of agricultural sectors in generating labour income for unskilled and low skilled workers (workers with primary school or less) is outstanding, as from the top 20 sectors, 17 of them are agricultural sectors holding 1st, 3rd to 8th, 10th to 18th, and 20th positions. In addition, the agricultural sector excels in generating high income and hence improving the livelihoods of the low income households since 14 sectors out of the top 20 in generating higher income to this household category are all agricultural sectors with the leaders in descending order being the grapes; root, bulb & tuberous vegetables; and fruit bearing vegetables. The implication from these results is that growth in most agricultural sectors will therefore assist in eradicating poverty, creating jobs and improving income distribution better than most non-agricultural sectors.

It is however important to note that though low income households benefit immensely from agricultural sectors, high income households also benefit mostly from the land intensive sectors such as other plants; sorghum; maize; and oilseeds and oleaginous fruits sectors since they are the owners of the largest portion of land in South Africa. The importance of livestock subsectors is on the generation of income to enterprises as four of these subsectors feature in the top 20 and they are other animals; cattle; raw milk; and goats and sheep sectors.

These multiplier results agree with one of the conclusions drawn from the study by Eckert, Liebenberg and Troskie (1997) that the agricultural sector and the poor households are bound to each other in several mutually reinforcing ways and that agriculture is particularly labor intensive,

due largely to the pre-eminence of horticultural crops and hence a major source of income to lower income workers.

The 20% simulation results of export demand increase of 12 key agricultural and food products indicate that increase in maize, other animals, meat, fish, and bakery products exports generate the highest income for high income households and enterprises rather than middle and low income households, while grape exports increase generates the highest income for medium and low income households rather than their high income counterparts. With regard to the improvement of equity amongst the institutions, increase in exports of apples, other citrus fruits, grapes and oranges will reduce inequality amongst the low, medium and high income households, and enterprises.

CHAPTER 6: SUMMARY AND CONCLUDING REMARKS

6.1 Summary

The news headlines and policy agendas for international development agencies including World Bank, and United Nations, show that agriculture is back on the agenda again. This is reflected in the most influential development report 2008 of the World Bank and its successor, 2030 agenda for Sustainable Development report of the United Nations. These reports advocate that focus be on food and agriculture in order to reduce poverty, hunger and malnutrition. The central commitment of the South African government to economic development has been well established. Employment and improved income distribution are high on the agenda and therefore the significance of the South African agricultural sector is largely for its potential to create jobs and improve equity as evidenced by various policy documents including the NDP vision 2030.

The South African economy is maturing and moving towards the tertiary sectors as indicated by the decline of the agricultural sector's contribution to GDP in the past years. However, South African agricultural statistical reports still reflect the importance of this sector in economic development based on GDP, direct employment and production value only, which is a traditional and too narrow definition of economic contribution as it neglects the important indirect and induced economic impact of this sector and its main subsectors.

The main objective of this study is to quantify the economic impact of the agricultural sectors within the South African economy. The quantification is done by using a SAM multiplier model named SAM quantity model which is a useful methodology to examine the direct, indirect and induced impacts of the agricultural sectors within the entire economy. In South Africa, though SAM multiplier models are used in studying the impact of the agricultural sector, it is very limited as only few studies have been conducted and these were based on provincial level instead of national level. Two studies have been based on national level, notably Townsend and McDonald (1997) and Conningarth Economists (2015). The former is dated and only had a single account for

agriculture, the latter presented multipliers for 55 sectors based on a SAM that has detailed agricultural sector accounts but that does not account for secondary production. This document is also not readily available in the public domain. In filling a substantial gap in the literature, this study examines the economic impact of the disaggregated agricultural sector in South Africa at national level using a quantity model based on detailed SAM accounting for secondary production. The highly disaggregated SAM with regard to agricultural, food and non-agricultural sectors, which account for secondary production, is developed in this study for 2014 to calibrate the closed complex SAM quantity model.

Chapter 2 laid down the theoretical foundations of SAMs and SAM multiplier models as well as the justifications and the empirical literature of the use of these models. The review of the previous developed SAMs for South Africa revealed the shortage of recent SAMs which are suitable for the detailed analysis of the agricultural sector. The review of previous studies show that the application of SAM multiplier models in analyzing the contribution and impact of the agricultural sector is more prevalent outside Africa and that the analysis is often based on aggregate agriculture instead of a detailed agricultural sector due to shortages of disaggregated agriculture accounts in SAM datasets.

Chapter 3 presented the assumptions and the types of multipliers associated with the SAM quantity model. It further distinguished and discussed two categories of a SAM quantity model as ordinary SAM quantity model and complex SAM quantity model, and presented the total requirements matrices for the models based on whether they are open or closed with respect to institutions (enterprises and households). It outlined the steps of building the complex SAM quantity model applicable in this study using the non-square commodity-by-industry system approach. The first form of a closed complex SAM quantity model presented in this chapter was used for computation of output multipliers, value added multipliers, institutional income multipliers and household consumption multipliers, and for generation of policy simulations in Chapter 5.

Chapter 4 presented the discussion of the process followed in developing a 2014 SA SAM with detailed agriculture accounts, as well as the discussion of the findings from this SAM. The major data sources used to develop this detailed SAM are: National accounts, supply and use tables,

Abstract of Agricultural Statistics, Trends in Agricultural Sector, 2012 SAM, agricultural import and export data for 2014, production cost statistics etc. These data sources have different base years, different classification and disaggregation of industries and commodities, and different methods of data collection. As a result, putting this data within the SAM framework show some inconsistencies between the receipts and payments of each account. These inconsistences were rectified using the Generalised Cross Entropy (GCE) balancing technique. The developed detailed 2014 SA SAM has 268 accounts: 104 industries (of which 46 are for agriculture, forestry, fisheries and food processing), 134 commodities, 6 factors, 14 households, 4 tax accounts, one account for transaction costs, core government, savings-investment, stock changes, enterprises, and rest of the world. The findings from this SAM revealed that the service sector is the largest contributor to total GDP, agro-processing sector is the most labour intensive while mining, and forestry and fisheries are the most capital intensive sectors. Furthermore, the findings showed that low income households are dependent on government grants for their income and they spend higher percentage of their income on food, beverages and tobacco. In contrast, the high income households depend on variety of income sources for most of their income which are skilled labour, capital and enterprises and they spend the higher proportion of their budget on financial, real estate, rental and leasing services. Finally, the developed 2014 SA SAM was used as dataset in computing the multipliers and simulations from SAM quantity model in chapter 5. However, minor modifications were made to the developed SAM for calibration: 14 household accounts from this SAM were aggregated to 3 household accounts and this reduced the SAM accounts used for the model to 257.

Chapter 5 presented the results and discussions of the analysis of the economic impact of the disaggregated agricultural sector to the South African economy by means of multipliers and simulations from a SAM quantity model. The multiplier results revealed that agricultural sectors contribute less to total output and total gross value added within the South African economy compared to other sectors as only few of these sectors, notably eggs and poultry sectors feature in the top 20 in terms of output multipliers, while in terms of value added multipliers only other plants sector features in the top 20. However, the results indicated that the impact of agricultural sectors in generating labour income for unskilled and low skilled workers (workers with primary school or less) is outstanding, as from the top 20 sectors, 17 of them are agricultural sectors holding 1st, 3rd to 8th, 10th to 18th, and 20th positions. In addition, the agricultural sector excels in generating

high income for the low income households since 14 sectors out of the top 20 in generating higher income to this household category are all agricultural sectors with the leaders in descending order being the grapes; root, bulb and tuberous vegetables; and fruit bearing vegetables. High income households also benefit in terms of income from the land intensive sectors such as other plants; sorghum; maize; and oilseeds and oleaginous fruits sectors since they are the owners of the largest portion of land in South Africa. Enterprises on the other hand benefit from the capital intensive agricultural sectors such as livestock subsectors in terms of income generation. The 20% simulation results of export demand increase of 12 key agricultural and food products indicated that increases in exports of maize, other animals, meat, fish, and bakery products generate the highest income for high income households and enterprises rather than medium and low income households, while grape exports increase generates the highest income increase for medium and low income households rather than their counterparts.

6.2 Policy implications

The results of this study have underlined the impact of agricultural sectors particularly fruits and vegetable subsectors as South African key sectors in generating higher labour income for unskilled and low skilled workers and in generating high income and hence improving the livelihoods of the low income households. These results agree with one of the conclusions drawn from the study by Eckert, Liebenberg and Troskie (1997) that the agricultural sector and the poor households are bound to each other in several mutually reinforcing ways and that agriculture is particularly labor intensive, due largely to the pre-eminence of horticultural crops and hence a major source of income to lower income workers. The implication from these results is that growth in most agricultural sectors will therefore assist in lowering poverty, creating jobs and improving income distribution better than most non-agricultural sectors in South Africa.

In order to realize the full impact of these agricultural sectors, subsidies and investments should be directed to high foreign earning agricultural sectors such as the ones simulated in this study as this will result in export growth of these sectors. Since the distribution of income is skewed towards high income households rather than low income households in South Africa, the export growth of

these sectors, particularly of apples, other citrus fruits, grapes and oranges sectors, will result in improvement of the equity amongst the households.

6.3 Conclusions

The contributions made by this study are as follows:

- It provided a recent 2014 SA SAM with detailed agricultural accounts. This SAM was used as a dataset for a SAM-based multiplier model in this study and it can also be used as database in other SAM-based models like CGE models for future studies concerned with policy analysis and policy making of agricultural management and national economic development in South Africa.
- It provided the detailed description of the practical way of developing a detailed SAM and the data sources used. This will therefore contribute towards the future attempts to develop SAMs.
- It developed the theoretic framework to extend the open input-output model based on a commodity-by-industry SAM proposed by Miller and Blair (2009) to a closed input-output model based on a commodity-by-industry SAM, i.e. allowing for the assumption of endogenous household consumption in the model while using a SAM that captures secondary production in its (non-square) supply matrix.
- It provided the disaggregated SAM multipliers of agricultural, food and non-agricultural sectors at a national level in South Africa. Agricultural based simulation results from SAM multiplier model are also provided. All the outcomes of this SAM multiplier model are helpful in contributing to the existing debate on the role and impact of the agricultural sector as well as other national policy debates. These results are also useful for guiding the policy makers in detecting promising agricultural subsectors for investments or subsidies.

6.4 Limitations of the study and suggestions for future research

This study has provided an updated database (SAM) which is very detailed in all the accounts, from agriculture, food, other non-agriculture, factors and households' accounts and therefore it

will be very useful in other SAM-based models like CGE models for future studies concerned with policy analysis and policy making of agricultural management and national economic development in South Africa. However, this SAM is not disaggregated across the regions in South Africa, so it is not suitable for capturing the socio-economic differences per province and as a result region-specific policies cannot be designed based on this SAM. A future study could consider disaggregating this SAM further across the nine provinces of South Africa.

Another limitation of this database is that, there is no distinction made in the households between the rural and urban households, although this SAM makes possible for the analysis of the impact of agriculture in improving livelihoods of the poor households, it was not possible to analyse the impact of disaggregated agricultural sector on rural development due to lack of this distinction. This distinction is therefore recommended for a future study. This SAM made it possible to analyse the impact on the labour income but not on the employment generation as the employment data was not augmented as a satellite account in this SAM.

The SAM quantity model used in this study has been useful in considering the significance of impact of a disaggregated agricultural sector within the South African economy. However, this methodology has its limitations which arise from the model assumptions. First, prices are fixed which implies that markets clear due to adjustments of the quantities only. Second, the model assumes the income elasticities of demand to be equal to one which implies the underestimation of the impact of an increase in household income on the demand for luxury goods and the overestimation of the impact on demand for necessities. Third, the model assumes that there is an excess capacity in all sectors and that the factors of production are unemployed. This assumption is not realistic especially in the agricultural sector as there is competition for resources like land amongst different crops and therefore a change in the demand for one of these crops may influence the output of other crops.

It should be noted that although it is possible to relax some of these assumptions in this model, other assumptions including that of fixed relative prices cannot be relaxed and need to be explored using other models like CGE models.

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APPENDICES

Appendix 1: The disaggregated top 12 agricultural sectors' output multipliers

Sectors	*Leafy vegetables*	*Fruit bearing vegetables*	*Root, bulb & tuberous vegetables*	*Oranges*	*Other citrus fruits*	*Grapes*	*Apples*	*Potatoes*	*Other tubers and edible roots*	*Sugar crops*	*Poultry*	*Eggs*
Wheat	0.0022	0.0024	0.0024	0.0021	0.0021	0.0025	0.0021	0.0021	0.0021	0.0019	0.0048	0.0045
Maize	0.0034	0.0036	0.0036	0.0032	0.0032	0.0037	0.0032	0.0031	0.0032	0.0029	0.0540	0.0603
Sorghum	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0003	0.0003
Other cereals	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0002	0.0002	0.0002	0.0002	0.0008	0.0008
Leafy vegetables	1.0437	0.0004	0.0004	0.0003	0.0003	0.0004	0.0003	0.0003	0.0003	0.0003	0.0002	0.0003
Melons	0.0001	0.0001	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Fruit bearing vegetables	0.0008	1.0272	0.0009	0.0008	0.0007	0.0009	0.0008	0.0007	0.0007	0.0007	0.0005	0.0006
Green leguminous vegetables	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Root, bulb and tuberous vegetables, n.e.c.	0.0008	0.0008	1.0063	0.0007	0.0007	0.0009	0.0008	0.0007	0.0007	0.0007	0.0005	0.0005
Other vegetables	0.0004	0.0005	0.0005	0.0004	0.0004	0.0005	0.0004	0.0004	0.0004	0.0004	0.0003	0.0003
Tropical and subtropical fruits	0.0007	0.0007	0.0007	0.0007	0.0006	0.0008	0.0007	0.0006	0.0006	0.0006	0.0005	0.0005
Oranges	0.0007	0.0007	0.0007	1.0031	0.0006	0.0008	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005
Other citrus fruits	0.0004	0.0004	0.0004	0.0004	1.0029	0.0004	0.0004	0.0004	0.0004	0.0003	0.0003	0.0003
Grapes	0.0013	0.0014	0.0014	0.0013	0.0012	1.0039	0.0013	0.0013	0.0013	0.0012	0.0010	0.0010
Apples	0.0007	0.0007	0.0007	0.0006	0.0006	0.0008	1.0032	0.0006	0.0006	0.0006	0.0005	0.0005
Other fruits	0.0005	0.0005	0.0005	0.0004	0.0004	0.0005	0.0004	0.0004	0.0004	0.0004	0.0003	0.0003

Sectors	Leafy vegetables	Fruit bearing vegetables	Root, bulb & tuberous vegetables	Oranges	Other citrus fruits	Grapes	Apples	Potatoes	Other tubers and edible roots	Sugar crops	Poultry	Eggs
Nuts	0.0001	0.0002	0.0002	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Oilseeds and oleaginous fruits	0.0021	0.0023	0.0023	0.0020	0.0020	0.0024	0.0020	0.0020	0.0020	0.0019	0.0016	0.0017
Potatoes	0.0012	0.0013	0.0013	0.0011	0.0011	0.0014	0.0012	1.0690	0.0011	0.0011	0.0008	0.0009
Other tubers and edible roots	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0619	0.0000	0.0000	0.0000
Stimulant, spice and aromatic crops	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002	0.0002
Pulses	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0004	0.0004	0.0004	0.0003	0.0003	0.0003
Sugar crops	0.0017	0.0019	0.0019	0.0016	0.0016	0.0019	0.0016	0.0017	0.0017	1.0732	0.0220	0.0190
Other plants	0.0018	0.0018	0.0019	0.0021	0.0021	0.0021	0.0022	0.0019	0.0018	0.0017	0.0019	0.0022
Cattle	0.0044	0.0046	0.0046	0.0043	0.0043	0.0048	0.0044	0.0042	0.0043	0.0040	0.0032	0.0033
Goats and sheep	0.0017	0.0018	0.0018	0.0018	0.0018	0.0020	0.0018	0.0017	0.0017	0.0016	0.0012	0.0012
Poultry	0.0063	0.0067	0.0067	0.0061	0.0060	0.0069	0.0061	0.0061	0.0062	0.0059	1.2551	0.2586
Pig	0.0009	0.0009	0.0009	0.0009	0.0009	0.0010	0.0009	0.0009	0.0009	0.0008	0.0006	0.0006
Raw milk	0.0025	0.0026	0.0026	0.0024	0.0024	0.0027	0.0024	0.0024	0.0024	0.0023	0.0019	0.0019
Eggs	0.0020	0.0022	0.0022	0.0020	0.0019	0.0022	0.0020	0.0020	0.0020	0.0020	0.0104	1.0049
Other animals	0.0007	0.0008	0.0008	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007
Forestry	0.0036	0.0037	0.0038	0.0036	0.0036	0.0039	0.0037	0.0034	0.0034	0.0031	0.0023	0.0024
Fishing	0.0012	0.0012	0.0012	0.0011	0.0011	0.0012	0.0011	0.0011	0.0012	0.0011	0.0120	0.0104
Coal and lignite	0.0093	0.0092	0.0099	0.0090	0.0090	0.0106	0.0090	0.0098	0.0094	0.0087	0.0067	0.0080
Metal ores	0.0055	0.0052	0.0057	0.0073	0.0072	0.0068	0.0075	0.0057	0.0055	0.0050	0.0021	0.0026
Other minerals	0.0708	0.0682	0.0721	0.0832	0.0831	0.0794	0.0856	0.0739	0.0700	0.0809	0.0334	0.0376
Electricity and gas	0.0242	0.0221	0.0280	0.0191	0.0191	0.0319	0.0176	0.0288	0.0267	0.0145	0.0192	0.0301
Natural water	0.0051	0.0047	0.0061	0.0095	0.0095	0.0061	0.0086	0.0061	0.0057	0.0054	0.0015	0.0016
Meat	0.0138	0.0147	0.0148	0.0131	0.0131	0.0152	0.0133	0.0131	0.0133	0.0125	0.0107	0.0109

Sectors	Leafy vegetables	Fruit bearing vegetables	Root, bulb & tuberous vegetables	Oranges	Other citrus fruits	Grapes	Apples	Potatoes	Other tubers and edible roots	Sugar crops	Poultry	Eggs
Fish	0.0036	0.0038	0.0039	0.0034	0.0034	0.0040	0.0035	0.0034	0.0035	0.0032	0.0721	0.0620
Processed vegetables	0.0022	0.0024	0.0024	0.0021	0.0021	0.0025	0.0022	0.0021	0.0021	0.0020	0.0015	0.0016
Processed fruit and nuts	0.0044	0.0047	0.0047	0.0042	0.0042	0.0049	0.0043	0.0042	0.0043	0.0041	0.0033	0.0034
Oils and fats	0.0077	0.0082	0.0081	0.0071	0.0070	0.0079	0.0070	0.0074	0.0073	0.0071	0.0065	0.0065
Dairy products	0.0095	0.0101	0.0101	0.0090	0.0090	0.0104	0.0091	0.0091	0.0091	0.0088	0.0074	0.0076
Grain mill products	0.0083	0.0090	0.0091	0.0078	0.0078	0.0094	0.0080	0.0077	0.0077	0.0070	0.0085	0.0083
Starches products	0.0037	0.0039	0.0040	0.0034	0.0034	0.0041	0.0035	0.0034	0.0034	0.0031	0.0024	0.0025
Animal feeding	0.0043	0.0046	0.0046	0.0042	0.0042	0.0048	0.0043	0.0042	0.0043	0.0041	0.4480	0.3826
Bakery products	0.0166	0.0178	0.0179	0.0158	0.0157	0.0185	0.0160	0.0156	0.0157	0.0147	0.0123	0.0126
Sugar	0.0052	0.0055	0.0055	0.0048	0.0048	0.0056	0.0048	0.0049	0.0048	0.0046	0.0045	0.0045
Confectionary products	0.0025	0.0026	0.0026	0.0024	0.0024	0.0027	0.0024	0.0024	0.0024	0.0023	0.0019	0.0020
Pasta products	0.0003	0.0004	0.0004	0.0003	0.0003	0.0004	0.0003	0.0003	0.0003	0.0003	0.0002	0.0003
Food n.e.c.	0.0072	0.0078	0.0078	0.0069	0.0068	0.0080	0.0070	0.0068	0.0069	0.0065	0.0070	0.0069
Alcohol, beverages	0.0192	0.0206	0.0206	0.0184	0.0183	0.0211	0.0186	0.0185	0.0186	0.0179	0.0138	0.0143
Soft drinks	0.0075	0.0080	0.0078	0.0071	0.0071	0.0077	0.0072	0.0073	0.0078	0.0067	0.0052	0.0055
Tobacco products	0.0109	0.0116	0.0115	0.0104	0.0104	0.0115	0.0105	0.0106	0.0110	0.0100	0.0077	0.0081
Textile fabrics	0.0055	0.0056	0.0058	0.0061	0.0061	0.0063	0.0062	0.0055	0.0054	0.0050	0.0032	0.0034
Made-up textile, articles	0.0088	0.0085	0.0094	0.0118	0.0118	0.0114	0.0123	0.0091	0.0086	0.0080	0.0033	0.0039
Carpets	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0003	0.0003
Textile n.e.c.	0.0017	0.0018	0.0017	0.0017	0.0016	0.0017	0.0016	0.0017	0.0018	0.0016	0.0011	0.0012
Knitting fabrics	0.0005	0.0005	0.0006	0.0005	0.0005	0.0006	0.0005	0.0005	0.0005	0.0005	0.0004	0.0004
Wearing apparel	0.0159	0.0170	0.0171	0.0152	0.0151	0.0176	0.0154	0.0152	0.0152	0.0146	0.0112	0.0116
Leather products	0.0024	0.0025	0.0025	0.0025	0.0025	0.0027	0.0026	0.0024	0.0023	0.0022	0.0015	0.0016

Sectors	Leafy vegetables	Fruit bearing vegetables	Root, bulb & tuberous vegetables	Oranges	Other citrus fruits	Grapes	Apples	Potatoes	Other tubers and edible roots	Sugar crops	Poultry	Eggs
Footwear	0.0051	0.0055	0.0055	0.0050	0.0049	0.0057	0.0050	0.0049	0.0049	0.0047	0.0035	0.0037
Wood products	0.0114	0.0113	0.0117	0.0127	0.0127	0.0124	0.0129	0.0117	0.0114	0.0107	0.0076	0.0081
Paper products	0.0136	0.0141	0.0140	0.0135	0.0134	0.0138	0.0135	0.0136	0.0135	0.0127	0.0112	0.0115
Printing	0.0080	0.0084	0.0084	0.0079	0.0079	0.0085	0.0080	0.0080	0.0081	0.0076	0.0058	0.0061
Petroleum products	0.1334	0.1295	0.1342	0.1408	0.1405	0.1432	0.1461	0.1374	0.1300	0.1850	0.0813	0.0884
Basic chemicals	0.0550	0.0557	0.0544	0.0529	0.0528	0.0474	0.0501	0.0574	0.0542	0.0569	0.0253	0.0276
Fertilizers, pesticides	0.1480	0.1537	0.1386	0.1092	0.1091	0.0830	0.0890	0.1564	0.1443	0.1596	0.0224	0.0256
Paint, related products	0.0057	0.0056	0.0057	0.0064	0.0063	0.0061	0.0065	0.0058	0.0059	0.0051	0.0031	0.0035
Pharmaceutical products	0.0212	0.0219	0.0213	0.0198	0.0197	0.0204	0.0195	0.0216	0.0207	0.0214	0.0510	0.0566
Soap, cleaning, perfume	0.0121	0.0129	0.0129	0.0115	0.0115	0.0131	0.0116	0.0116	0.0116	0.0111	0.0083	0.0087
Chemical products, n.e.c.	0.0056	0.0056	0.0057	0.0060	0.0060	0.0058	0.0060	0.0059	0.0056	0.0055	0.0036	0.0040
Rubber tyres	0.0067	0.0067	0.0067	0.0077	0.0076	0.0070	0.0079	0.0070	0.0068	0.0058	0.0034	0.0039
Other rubber products	0.0167	0.0152	0.0177	0.0254	0.0254	0.0231	0.0268	0.0179	0.0164	0.0151	0.0036	0.0051
Plastic products	0.0334	0.0316	0.0351	0.0461	0.0459	0.0426	0.0478	0.0353	0.0333	0.0308	0.0132	0.0154
Glass products	0.0039	0.0041	0.0041	0.0038	0.0038	0.0040	0.0038	0.0039	0.0039	0.0038	0.0028	0.0029
Non-structural ceramic	0.0015	0.0015	0.0016	0.0019	0.0019	0.0019	0.0020	0.0016	0.0016	0.0015	0.0007	0.0008
Structure non-refractory clay	0.0011	0.0012	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0010	0.0008	0.0008
Plaster, cement	0.0041	0.0039	0.0042	0.0056	0.0056	0.0051	0.0058	0.0043	0.0042	0.0036	0.0014	0.0017
Articles of concrete	0.0014	0.0014	0.0014	0.0014	0.0014	0.0013	0.0014	0.0014	0.0017	0.0012	0.0010	0.0011
Non-metallic products n.e.c.	0.0018	0.0017	0.0019	0.0023	0.0023	0.0021	0.0024	0.0019	0.0019	0.0016	0.0008	0.0009
Furniture	0.0047	0.0050	0.0050	0.0045	0.0045	0.0052	0.0046	0.0045	0.0046	0.0044	0.0034	0.0035
Jewellery	0.0014	0.0015	0.0015	0.0014	0.0014	0.0015	0.0014	0.0014	0.0014	0.0014	0.0012	0.0012
Manufactured products n.e.c.	0.0029	0.0031	0.0031	0.0028	0.0028	0.0031	0.0028	0.0028	0.0029	0.0027	0.0021	0.0022

Sectors	Leafy vegetables	Fruit bearing vegetables	Root, bulb & tuberous vegetables	Oranges	Other citrus fruits	Grapes	Apples	Potatoes	Other tubers and edible roots	Sugar crops	Poultry	Eggs
Wastes, scraps	0.0027	0.0027	0.0029	0.0033	0.0033	0.0033	0.0034	0.0028	0.0027	0.0025	0.0024	0.0024
Iron, steel products	0.0219	0.0208	0.0229	0.0294	0.0293	0.0275	0.0306	0.0231	0.0221	0.0199	0.0081	0.0099
Non-ferrous metals	0.0101	0.0097	0.0106	0.0134	0.0133	0.0126	0.0139	0.0106	0.0102	0.0093	0.0040	0.0048
Structural metal products	0.0053	0.0050	0.0054	0.0069	0.0069	0.0063	0.0071	0.0055	0.0057	0.0047	0.0022	0.0025
Tanks, reservoirs	0.0067	0.0061	0.0071	0.0102	0.0102	0.0094	0.0108	0.0072	0.0066	0.0060	0.0015	0.0021
Other fabricated metal	0.0332	0.0309	0.0352	0.0481	0.0480	0.0444	0.0503	0.0354	0.0330	0.0304	0.0092	0.0120
Engines, turbines	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000
Pumps, compressors	0.0011	0.0011	0.0011	0.0012	0.0012	0.0012	0.0012	0.0011	0.0011	0.0011	0.0006	0.0007
Bearings, gears	0.0011	0.0011	0.0012	0.0013	0.0013	0.0013	0.0014	0.0012	0.0012	0.0010	0.0006	0.0007
Lifting equipment	0.0069	0.0063	0.0073	0.0105	0.0105	0.0095	0.0111	0.0074	0.0068	0.0062	0.0015	0.0021
General machinery	0.0033	0.0031	0.0035	0.0048	0.0048	0.0045	0.0050	0.0035	0.0033	0.0030	0.0010	0.0013
Special machinery	0.0276	0.0252	0.0293	0.0416	0.0415	0.0382	0.0437	0.0296	0.0273	0.0252	0.0064	0.0089
Domestic appliances	0.0048	0.0051	0.0052	0.0048	0.0047	0.0054	0.0048	0.0046	0.0046	0.0044	0.0033	0.0034
Office machinery	0.0022	0.0023	0.0023	0.0024	0.0024	0.0025	0.0024	0.0022	0.0022	0.0021	0.0014	0.0015
Electrical machinery	0.0079	0.0078	0.0083	0.0090	0.0089	0.0091	0.0091	0.0083	0.0085	0.0069	0.0044	0.0052
Radio, television	0.0138	0.0144	0.0145	0.0142	0.0141	0.0151	0.0144	0.0137	0.0138	0.0129	0.0093	0.0098
Medical appliances	0.0024	0.0026	0.0026	0.0024	0.0024	0.0026	0.0024	0.0024	0.0024	0.0024	0.0019	0.0019
Motor vehicles, parts	0.0628	0.0621	0.0656	0.0764	0.0761	0.0744	0.0788	0.0650	0.0627	0.0589	0.0324	0.0361
Ships and boats	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001
Railway and trams	0.0004	0.0004	0.0004	0.0006	0.0006	0.0005	0.0006	0.0004	0.0004	0.0004	0.0001	0.0002
Aircrafts	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000
Other transport equipment	0.0015	0.0015	0.0015	0.0018	0.0018	0.0017	0.0019	0.0016	0.0015	0.0013	0.0007	0.0008
Construction	0.0009	0.0008	0.0008	0.0010	0.0010	0.0009	0.0010	0.0009	0.0009	0.0008	0.0004	0.0005

Sectors	Leafy vegetables	Fruit bearing vegetables	Root, bulb & tuberous vegetables	Oranges	Other citrus fruits	Grapes	Apples	Potatoes	Other tubers and edible roots	Sugar crops	Poultry	Eggs
Construction services	0.0009	0.0009	0.0009	0.0008	0.0008	0.0009	0.0008	0.0009	0.0009	0.0008	0.0006	0.0006
Trade services	0.0025	0.0026	0.0025	0.0026	0.0026	0.0024	0.0026	0.0026	0.0026	0.0022	0.0018	0.0019
Accommodation	0.0062	0.0065	0.0062	0.0059	0.0058	0.0058	0.0059	0.0062	0.0062	0.0055	0.0043	0.0046
Catering services	0.0107	0.0114	0.0114	0.0103	0.0102	0.0116	0.0104	0.0104	0.0104	0.0101	0.0077	0.0081
Passenger transport	0.0311	0.0329	0.0322	0.0296	0.0294	0.0317	0.0299	0.0302	0.0301	0.0270	0.0211	0.0222
Freight transport	0.0831	0.0843	0.0551	0.0663	0.0661	0.0132	0.0656	0.0949	0.0874	0.0386	0.0342	0.0448
Supporting transport services	0.0088	0.0087	0.0091	0.0094	0.0094	0.0097	0.0095	0.0093	0.0089	0.0087	0.0059	0.0066
Postal, courier services	0.0015	0.0015	0.0015	0.0014	0.0014	0.0015	0.0015	0.0015	0.0015	0.0014	0.0011	0.0011
Electricity distribution	0.0247	0.0258	0.0261	0.0242	0.0241	0.0268	0.0244	0.0245	0.0244	0.0229	0.0180	0.0191
Water distribution	0.0089	0.0091	0.0096	0.0100	0.0100	0.0097	0.0098	0.0090	0.0089	0.0085	0.0056	0.0059
Financial services	0.0594	0.0611	0.0611	0.0594	0.0590	0.0624	0.0598	0.0602	0.0587	0.0579	0.0354	0.0371
Insurance, pension	0.0316	0.0325	0.0333	0.0340	0.0338	0.0355	0.0347	0.0318	0.0313	0.0302	0.0207	0.0221
Other financial services	0.0293	0.0297	0.0297	0.0291	0.0290	0.0300	0.0294	0.0296	0.0325	0.0276	0.0180	0.0193
Real estate services	0.0644	0.0681	0.0680	0.0626	0.0622	0.0692	0.0632	0.0633	0.0637	0.0618	0.0479	0.0498
Leasing, Rental services	0.0159	0.0164	0.0152	0.0152	0.0152	0.0136	0.0153	0.0164	0.0166	0.0133	0.0115	0.0121
Research, development	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Legal, accounting	0.0059	0.0061	0.0060	0.0059	0.0059	0.0061	0.0059	0.0059	0.0062	0.0056	0.0042	0.0044
Other business services	0.0258	0.0266	0.0263	0.0258	0.0257	0.0258	0.0258	0.0261	0.0264	0.0242	0.0193	0.0201
Telecommunications	0.0242	0.0253	0.0251	0.0238	0.0237	0.0252	0.0240	0.0240	0.0243	0.0225	0.0171	0.0180
Support services	0.0245	0.0255	0.0248	0.0237	0.0235	0.0239	0.0237	0.0248	0.0247	0.0226	0.0190	0.0199
Manufactured services n.e.c.	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0006	0.0004	0.0005
Public administration	0.0063	0.0066	0.0066	0.0063	0.0063	0.0068	0.0064	0.0062	0.0062	0.0060	0.0045	0.0047
Education services	0.0114	0.0120	0.0119	0.0111	0.0110	0.0120	0.0111	0.0113	0.0114	0.0109	0.0083	0.0087

Sectors	*Leafy vegetables*	*Fruit bearing vegetables*	*Root, bulb & tuberous vegetables*	*Oranges*	*Other citrus fruits*	*Grapes*	*Apples*	*Potatoes*	*Other tubers and edible roots*	*Sugar crops*	*Poultry*	*Eggs*
Health, social services	0.0371	0.0381	0.0394	0.0408	0.0405	0.0429	0.0417	0.0372	0.0366	0.0353	0.0232	0.0247
Other services n.e.c.	0.0391	0.0407	0.0410	0.0398	0.0396	0.0421	0.0402	0.0390	0.0386	0.0372	0.0312	0.0319
total output multipliers	**2.6341**	**2.6378**	**2.6146**	**2.6440**	**2.6381**	**2.6024**	**2.6477**	**2.7002**	**2.6444**	**2.6074**	**2.7861**	**2.7997**

Source: Own calculations-2014 SA SAM multiplier model outcomes

Appendix 2: Disaggregated GVA multipliers across labour, land and capital

Sectors	Labour		Land		Capital	
	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank
Wheat	0.1126	124	0.06109	8	0.1460	109
Maize	0.2498	66	0.15488	5	0.3219	57
Sorghum	0.2199	81	0.19978	2	0.3066	64
Other cereals	0.1569	110	0.19380	3	0.2278	84
Leafy vegetables	0.3847	22	0.00893	37	0.3394	49
Melons	0.3755	24	0.02936	12	0.3568	44
Fruit bearing vegetables	0.4145	16	0.01471	26	0.3430	48
Green leguminous vegetables	0.3267	44	0.01894	20	0.3066	65
Root, bulb and tuberous vegetables, n.e.c.	0.4201	15	0.01536	24	0.3333	51
Other vegetables	0.2931	56	0.04312	10	0.2681	78
Tropical and subtropical fruits	0.3300	42	0.01612	23	0.2999	67
Oranges	0.3651	28	0.01073	32	0.3292	54
Other citrus fruits	0.3641	29	0.00870	38	0.3283	55
Grapes	0.4373	14	0.01972	19	0.3214	58
Apples	0.3728	27	0.00812	40	0.3302	52
Other fruits	0.3503	35	0.00978	36	0.3164	61
Nuts	0.3385	38	0.01617	22	0.3084	62
Oilseeds and oleaginous fruits	0.2225	78	0.17018	4	0.2819	75
Potatoes	0.3511	34	0.01994	18	0.3501	47
Other tubers and edible roots	0.3419	37	0.02827	13	0.3534	46
Stimulant, spice and aromatic crops	0.0570	131	0.06343	7	0.0675	129
Pulses	0.1441	112	0.05429	9	0.1730	100
Sugar crops	0.3033	54	0.07590	6	0.3195	59
Other plants	0.2023	83	0.40390	1	0.3174	60
Cattle	0.1987	90	0.02006	17	0.6060	11
Goats and sheep	0.1987	91	0.00428	50	0.5986	13
Poultry	0.2269	75	0.01120	31	0.3636	43
Pig	0.1584	109	0.00531	47	0.5623	15
Raw milk	0.1825	98	0.00788	42	0.6047	12
Eggs	0.2387	72	0.01204	29	0.3691	42
Other animals	0.1374	118	0.02165	15	0.6094	9
Forestry	0.3374	39	0.00190	88	0.4417	28
Fishing	0.3299	43	0.00184	92	0.5586	16

Sectors	Labour		Land		Capital	
	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank
Coal and lignite	0.3606	31	0.00189	90	0.6081	10
Metal ores	0.5034	8	0.00237	67	0.5441	20
Other minerals	0.2204	79	0.00105	119	0.2860	72
Electricity and gas	0.4041	19	0.00191	84	0.6745	5
Natural water	0.3941	21	0.00201	82	0.7788	1
Meat	0.2260	76	0.00628	44	0.4070	33
Fish	0.3068	52	0.00417	51	0.3922	35
Vegetables	0.2450	70	0.00275	58	0.2912	70
Fruit and nuts	0.3175	45	0.00557	46	0.3697	41
Oils and fats	0.0527	132	0.00353	53	0.1024	124
Dairy products	0.2202	80	0.00262	60	0.2825	74
Grain mill products	0.2484	67	0.02668	14	0.2581	81
Starches products	0.3368	40	0.03446	11	0.3812	37
Animal feeding	0.1793	100	0.01063	33	0.2714	76
Bakery products	0.3034	53	0.01499	25	0.3035	66
Sugar	0.2900	57	0.01746	21	0.2684	77
Confectionary products	0.1983	92	0.00326	54	0.2233	85
Pasta products	0.1743	102	0.01053	34	0.2853	73
Food n.e.c.	0.2016	84	0.00804	41	0.2077	87
Alcohol, beverages	0.1619	105	0.00477	48	0.1637	101
Soft drinks	0.2932	55	0.00859	39	0.2965	69
Tobacco products	0.1260	121	0.00371	52	0.1273	116
Textile fabrics	0.2482	68	0.02074	16	0.2532	83
Made-up textile, articles	0.1376	117	0.00765	43	0.1455	110
Carpets	0.2442	71	0.01396	27	0.3083	63
Textile n.e.c.	0.1617	106	0.01316	28	0.1623	102
Knitting fabrics	0.1611	107	0.00561	45	0.1129	120
Wearing apparel	0.1608	108	0.00325	55	0.1534	106
Leather products	0.1817	99	0.00457	49	0.3555	45
Footwear	0.1149	123	0.00285	57	0.1032	123
Wood products	0.3562	32	0.00203	81	0.3723	40
Paper products	0.2510	65	0.00194	83	0.2582	80
Printing	0.3156	47	0.00185	91	0.1958	93
Petroleum products	0.1070	125	0.00070	126	0.2038	91
Basic chemicals	0.1884	94	0.00131	109	0.2211	86
Fertilizers, pesticides	0.1860	96	0.00133	107	0.1577	104
Paint, related products	0.2576	61	0.00216	74	0.1822	98
Pharmaceutical products	0.2011	85	0.00155	101	0.1389	111

Sectors	Labour		Land		Capital	
	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank
Soap, cleaning, perfume	0.2644	59	0.00207	79	0.1815	99
Chemical products, n.e.c.	0.0849	127	0.00067	127	0.1073	122
Rubber tyres	0.1652	104	0.01025	35	0.1829	97
Other rubber products	0.1881	95	0.01134	30	0.2055	90
Plastic products	0.2561	63	0.00131	108	0.1532	107
Glass products	0.3337	41	0.00160	99	0.1928	94
Non-structural ceramic	0.1752	101	0.00113	114	0.2565	82
Structure non-refractory clay	0.1988	89	0.00129	110	0.2905	71
Plaster, cement	0.1418	114	0.00092	123	0.2067	88
Articles of concrete	0.2252	77	0.00146	104	0.3296	53
Non-metallic products n.e.c.	0.1336	119	0.00111	116	0.2063	89
Furniture	0.2567	62	0.00191	86	0.1962	92
Jewellery	0.1551	111	0.00176	97	0.2967	68
Manufactured products n.e.c.	0.1308	120	0.00110	117	0.1568	105
Wastes, scraps	0.2060	82	0.00260	61	0.3961	34
Iron, steel products	0.2321	74	0.00121	112	0.2602	79
Non-ferrous metals	0.1995	88	0.00111	115	0.1585	103
Structural metal products	0.3151	48	0.00155	100	0.1853	95
Tanks, reservoirs	0.3145	49	0.00147	103	0.1840	96
Other fabricated metal	0.2560	64	0.00123	111	0.1513	108
Engines, turbines	0.0394	133	0.00028	133	0.0229	133
Pumps, compressors	0.1910	93	0.00102	120	0.1281	115
Bearings, gears	0.1392	116	0.00073	125	0.0912	126
Lifting equipment	0.1432	113	0.00077	124	0.0963	125
General machinery	0.2001	87	0.00108	118	0.1348	113
Special machinery	0.1846	97	0.00097	121	0.1210	117
Domestic appliances	0.0958	126	0.00052	130	0.0647	130
Office machinery	0.0724	129	0.00039	132	0.0487	131
Electrical machinery	0.1675	103	0.00118	113	0.1193	118
Radio, television	0.1160	122	0.00057	128	0.1097	121
Medical appliances	0.0678	130	0.00054	129	0.0809	128
Motor vehicles, parts	0.1412	115	0.00095	122	0.0900	127
Ships and boats	0.2353	73	0.00179	96	0.1284	114
Railway and trams	0.2455	69	0.00183	93	0.1377	112
Aircrafts	0.2005	86	0.00145	105	0.1138	119
Other transport equipment	0.0752	128	0.00052	131	0.0427	132
Construction	0.3819	23	0.00251	63	0.4279	29
Construction services	0.4096	17	0.00237	68	0.5201	22

Sectors	Labour		Land		Capital	
	Multiplier	Rank	Multiplier	Rank	Multiplier	Rank
Trade services	0.5070	7	0.00241	66	0.5851	14
Accommodation	0.2641	60	0.00235	69	0.3277	56
Catering services	0.2819	58	0.00249	64	0.3737	39
Passenger transport	0.3161	46	0.00189	89	0.5575	17
Freight transport	0.3540	33	0.00213	77	0.6174	7
Supporting transport services	0.4673	11	0.00219	72	0.5437	21
Postal, courier services	0.3436	36	0.00154	102	0.4579	26
Electricity distribution	0.3743	25	0.00180	95	0.7120	2
Water distribution	0.3732	26	0.00191	87	0.7096	3
Financial services	0.6041	3	0.00244	65	0.6393	6
Insurance, pension	0.5347	4	0.00205	80	0.6099	8
Other financial services	0.8293	2	0.00271	59	0.5451	19
Real estate services	0.3144	50	0.00182	94	0.6867	4
Leasing, Rental services	0.4087	18	0.00214	76	0.4526	27
Research, development	0.5080	6	0.00257	62	0.4932	23
Legal, accounting	0.3968	20	0.00169	98	0.3346	50
Other business services	0.4855	9	0.00215	75	0.4152	31
Telecommunications	0.3092	51	0.00139	106	0.4103	32
Support services	0.5153	5	0.00227	71	0.4856	24
Manufactured services n.e.c.	0.4473	12	0.00191	85	0.3771	38
Public administration	0.8448	1	0.00287	56	0.3880	36
Education services	0.4692	10	0.00217	73	0.5494	18
Health, social services	0.4396	13	0.00207	78	0.4265	30
Other services n.e.c.	0.3622	30	0.00234	70	0.4780	25

Source: Own calculations-2014 SA SAM multiplier model outcomes

Appendix 3: The disaggregated output value increase across sectors (after 20% simulation of export demand increase)

Sectors	Maize	Oranges	Other citrus	grapes	Apples	Other animals	Meat	Fish	Processed fruit and nuts	Bakery	Other food	Alcohol & beverages
Wheat	1.352	1.629	1.305	1.591	0.985	1.042	2.170	5.607	5.957	26.625	23.819	5.973
Maize	766.220	2.484	1.990	2.417	1.500	2.816	9.321	17.820	20.484	21.279	20.031	4.761
Sorghum	0.038	0.046	0.037	0.045	0.028	0.050	0.107	0.362	0.415	0.438	0.409	0.090
Other cereals	0.144	0.172	0.138	0.166	0.104	0.127	0.262	0.692	0.804	0.759	0.738	3.524
Leafy vegetables	0.220	0.268	0.215	0.264	0.162	0.121	0.267	0.332	1.236	0.452	0.550	0.420
Melons	0.031	0.038	0.031	0.038	0.023	0.017	0.038	0.047	0.177	0.065	0.079	0.060
Fruit bearing vegetables	0.487	0.590	0.472	0.577	0.356	0.269	0.586	0.735	2.702	0.985	1.205	4.216
Green leguminous vegetables	0.023	0.029	0.023	0.028	0.017	0.013	0.028	0.035	0.125	0.046	0.056	0.044
Root, bulb and tuberous vegetables, n.e.c.	0.473	0.578	0.463	0.568	0.350	0.260	0.567	0.713	2.579	0.950	1.155	0.900
Other vegetables	0.264	0.323	0.259	0.317	0.195	0.145	0.293	0.392	1.203	0.459	0.588	0.492
Tropical and subtropical fruits	0.423	0.511	0.409	0.500	0.309	0.234	0.526	0.642	2.679	0.908	1.139	4.034
Oranges	0.416	786.517	0.401	0.488	0.303	0.231	0.676	0.677	4.395	1.389	1.685	4.093
Other citrus fruits	0.244	0.291	632.749	0.283	0.176	0.136	0.437	0.409	3.029	0.938	1.138	3.750
Grapes	0.897	0.982	0.786	649.715	0.591	0.513	1.247	1.414	6.939	2.276	2.924	79.385
Apples	0.422	0.509	0.408	0.497	467.576	0.234	0.609	0.665	3.610	1.169	1.423	4.072
Other fruits	0.281	0.336	0.269	0.327	0.203	0.156	0.443	0.453	2.834	0.897	1.091	3.804
Nuts	0.094	0.107	0.086	0.102	0.065	0.054	0.179	0.207	1.079	2.040	1.925	3.429
Oilseeds and oleaginous fruits	1.323	1.575	1.261	1.532	0.951	0.737	1.499	2.674	3.259	23.587	25.480	5.764
Potatoes	0.743	0.902	0.722	0.882	0.545	0.408	1.020	1.311	4.712	7.565	7.212	1.525

Sectors	Maize	Oranges	Other citrus	grapes	Apples	Other animals	Meat	Fish	Processed fruit and nuts	Bakery	Other food	Alcohol & beverages
Other tubers and edible roots	0.026	0.032	0.025	0.031	0.019	0.014	0.031	0.039	0.141	0.053	0.065	0.051
Stimulant, spice and aromatic crops	0.189	0.228	0.183	0.224	0.138	0.105	1.631	0.416	0.740	0.252	0.347	0.349
Pulses	0.243	0.297	0.238	0.292	0.180	0.133	0.206	0.353	0.364	0.355	0.432	0.423
Sugar crops	1.166	1.286	1.031	1.209	0.767	2.696	4.885	1.965	7.192	2.518	4.227	8.030
Other plants	1.213	1.663	1.334	1.348	1.008	28.269	5.857	1.295	2.537	0.848	1.581	20.769
Cattle	2.923	3.389	2.714	3.117	2.048	1.640	133.731	6.031	25.433	5.074	6.295	6.485
Goats and sheep	1.157	1.418	1.136	1.267	0.860	0.612	35.143	2.066	1.915	1.313	1.540	2.232
Poultry	4.544	4.747	3.798	4.459	2.855	2.697	122.712	7.862	7.439	4.992	5.963	7.702
Pig	0.593	0.700	0.560	0.631	0.424	0.323	14.489	0.998	0.944	0.624	0.742	1.109
Raw milk	1.750	1.863	1.491	1.751	1.121	1.025	8.858	2.588	80.386	5.704	8.466	8.784
Eggs	1.532	1.535	1.227	1.448	0.922	0.924	8.641	2.077	2.135	1.272	1.590	2.516
Other animals	0.581	0.539	0.432	0.465	0.315	686.267	5.563	0.632	4.141	0.758	1.629	0.916
Forestry	2.183	2.838	2.275	2.551	1.714	0.980	2.082	3.795	7.509	2.753	3.809	9.164
Fishing	0.794	0.866	0.694	0.807	0.522	1.607	3.119	196.824	3.125	4.202	5.982	1.525
Coal and lignite	6.151	7.065	5.666	6.831	4.177	2.741	4.383	7.259	9.375	4.816	6.455	10.056
Metal ores	3.057	5.697	4.572	4.427	3.516	0.917	1.794	2.938	3.340	1.808	2.006	3.615
Other minerals	49.802	65.264	52.407	51.390	39.876	12.381	29.670	38.312	40.123	21.541	26.599	43.748
Electricity and gas	12.189	15.000	12.046	20.649	8.201	6.269	7.143	6.860	9.249	4.583	7.914	10.472
Natural water	4.043	7.469	5.995	3.967	3.994	0.760	1.432	2.109	6.633	1.435	1.787	24.200
Meat	9.239	10.300	8.244	9.853	6.208	5.384	794.723	14.732	15.256	10.966	14.935	16.074
Fish	2.393	2.683	2.147	2.572	1.618	8.534	15.429	1218.605	13.704	8.446	21.486	4.771
Vegetables	1.442	1.673	1.339	1.627	1.010	0.813	3.614	2.050	3.160	2.354	2.712	2.521
Fruit and nuts	3.064	3.315	2.653	3.143	1.996	1.785	14.801	5.089	1278.834	14.853	16.049	54.044
Oils and fats	5.526	5.546	4.444	5.103	3.265	2.556	5.389	9.692	11.763	18.939	58.728	7.868

Sectors	Maize	Oranges	Other citrus	grapes	Apples	Other animals	Meat	Fish	Processed fruit and nuts	Bakery	Other food	Alcohol & beverages
Dairy products	6.751	7.074	5.659	6.722	4.252	4.000	8.073	9.489	67.817	22.475	30.331	14.042
Grain mill products	4.767	6.131	4.912	6.084	3.715	2.872	5.230	8.444	8.760	42.803	40.485	8.977
Starches products	2.167	2.677	2.145	2.623	1.612	1.076	1.780	2.928	4.003	2.980	4.306	4.899
Animal feeding	3.107	3.298	2.639	3.077	1.985	47.600	68.514	8.055	23.608	4.462	5.780	6.672
Bakery products	10.591	12.380	9.912	11.966	7.475	6.003	9.121	31.592	16.144	667.363	22.059	18.709
Sugar	3.334	3.773	3.023	3.598	2.255	1.719	6.433	5.364	24.259	8.504	12.480	31.342
Confectionary products	1.815	1.859	1.487	1.741	1.117	1.086	1.727	2.733	15.028	9.626	11.332	3.771
Pasta products	0.236	0.247	0.197	0.234	0.148	0.140	2.015	0.337	1.765	0.304	0.557	0.463
Food n.e.c.	4.731	5.396	4.320	5.187	3.254	2.861	14.041	14.891	32.035	27.569	1307.021	18.426
Alcohol, beverages	13.605	14.400	11.519	13.667	8.664	7.980	10.814	18.092	23.032	10.381	13.708	2989.324
Soft drinks	5.042	5.595	4.482	4.960	3.363	2.794	4.512	7.796	7.913	4.331	5.125	9.092
Tobacco products	7.601	8.162	6.533	7.467	4.906	4.348	6.400	10.912	11.233	6.106	7.488	13.202
Textile fabrics	3.505	4.774	3.827	4.090	2.910	1.648	2.969	5.102	5.011	2.716	3.114	12.293
Made-up textile, articles	4.725	9.244	7.417	7.361	5.732	1.507	2.051	3.783	3.612	2.053	2.541	4.760
Carpets	0.329	0.399	0.320	0.350	0.242	0.170	0.243	0.402	0.427	0.232	0.289	0.521
Textile n.e.c.	1.266	1.296	1.039	1.092	0.765	0.537	1.053	1.778	1.905	1.011	1.507	2.020
Knitting fabrics	0.361	0.410	0.328	0.371	0.248	0.199	0.354	0.616	0.580	0.320	0.352	0.638
Wearing apparel	10.925	11.928	9.544	11.413	7.185	6.302	8.544	14.428	15.153	8.191	10.478	18.287
Leather products	1.622	1.991	1.594	1.756	1.208	0.849	1.197	2.000	2.135	1.157	1.447	2.566
Footwear	3.493	3.882	3.107	3.686	2.340	1.973	2.761	4.671	4.910	2.651	3.358	5.883
Wood products	7.613	9.959	7.989	7.998	6.005	2.882	7.601	14.431	46.326	12.526	17.940	54.515
Paper products	9.937	10.563	8.463	8.948	6.278	4.708	11.970	22.345	39.280	16.626	24.427	54.939
Printing	5.925	6.217	4.976	5.478	3.728	3.231	4.902	8.374	9.956	5.879	7.362	11.346
Petroleum products	104.721	110.397	88.660	92.652	68.096	31.779	39.250	50.158	57.711	33.960	42.816	68.616
Basic chemicals	49.908	41.465	33.300	30.654	23.346	8.964	18.558	37.221	66.457	19.564	41.299	77.622

Sectors	Maize	Oranges	Other citrus	grapes	Apples	Other animals	Meat	Fish	Processed fruit and nuts	Bakery	Other food	Alcohol & beverages
Fertilizers, pesticides	173.315	85.588	68.864	53.709	41.498	6.165	6.995	13.346	14.572	15.558	17.980	19.436
Paint, related products	3.566	4.985	3.999	3.921	3.023	1.416	2.687	4.642	5.623	2.978	3.824	6.308
Pharmaceutical products	17.381	15.507	12.417	13.185	9.069	18.018	17.567	10.718	13.702	6.575	12.759	14.364
Soap, cleaning, perfume	8.453	9.034	7.230	8.497	5.414	4.589	6.273	10.517	11.212	6.047	8.400	13.524
Chemical products, n.e.c.	4.174	4.702	3.774	3.747	2.776	1.307	2.425	8.697	6.064	4.102	5.930	9.041
Rubber tyres	3.986	6.001	4.811	4.534	3.662	1.677	2.414	3.963	4.376	2.472	3.059	5.192
Other rubber products	7.826	19.943	16.012	14.967	12.469	1.049	2.379	3.293	3.451	2.156	1.851	4.176
Plastic products	18.483	36.112	28.987	27.601	22.299	4.352	13.352	19.247	74.479	24.915	33.595	67.537
Glass products	3.010	2.998	2.401	2.620	1.775	1.447	2.409	3.698	8.716	2.688	4.185	50.873
Non-structural ceramic	0.966	1.521	1.219	1.224	0.936	0.402	0.555	0.907	1.010	0.564	0.698	1.227
Structure non-refractory clay	0.755	0.886	0.710	0.701	0.531	0.364	0.667	1.111	1.839	0.937	1.150	1.648
Plaster, cement	2.112	4.384	3.520	3.287	2.716	0.527	1.000	1.682	2.026	1.124	1.287	2.224
Articles of concrete	0.931	1.074	0.863	0.811	0.642	0.438	1.184	2.077	2.651	1.391	1.474	2.176
Non-metallic products n.e.c.	1.025	1.832	1.471	1.384	1.128	0.313	0.989	1.705	1.667	0.924	0.853	1.325
Furniture	3.357	3.548	2.839	3.336	2.134	1.953	2.645	4.466	4.764	2.596	3.315	5.727
Jewellery	1.080	1.081	0.865	0.990	0.649	0.661	2.625	4.644	3.260	1.870	1.119	1.876
Manufactured products n.e.c.	2.101	2.200	1.760	2.025	1.322	1.206	1.654	2.792	3.044	1.695	2.153	3.627
Wastes, scraps	1.627	2.591	2.078	2.122	1.589	0.738	10.969	19.779	11.955	7.056	1.874	2.841
Iron, steel products	12.018	23.071	18.516	17.795	14.253	3.393	5.834	9.313	11.966	6.416	7.676	13.845
Non-ferrous metals	5.742	10.484	8.412	8.173	6.466	1.765	3.378	5.508	6.216	3.358	3.801	6.829
Structural metal products	2.860	5.388	4.328	4.060	3.324	0.846	2.059	3.536	4.285	2.328	2.448	4.022
Tanks, reservoirs	3.126	8.026	6.445	6.057	5.018	0.422	0.585	0.748	1.012	0.667	0.749	1.637
Other fabricated metal	16.982	37.708	30.269	28.737	23.444	3.343	5.139	7.784	10.004	5.601	6.723	13.877
Engines, turbines	0.033	0.053	0.043	0.046	0.032	0.013	0.019	0.029	0.035	0.020	0.025	0.041
Pumps, compressors	0.748	0.959	0.769	0.800	0.575	0.302	0.514	0.794	0.997	0.553	0.699	1.257

Sectors	Maize	Oranges	Other citrus	grapes	Apples	Other animals	Meat	Fish	Processed fruit and nuts	Bakery	Other food	Alcohol & beverages
Bearings, gears	0.710	1.032	0.827	0.826	0.630	0.297	0.472	0.783	0.888	0.501	0.615	1.067
Lifting equipment	3.223	8.247	6.622	6.156	5.155	0.429	0.592	0.849	1.063	0.707	0.812	1.776
General machinery	1.685	3.766	3.023	2.900	2.343	0.371	0.539	0.837	1.025	0.623	0.755	1.388
Special machinery	13.240	32.644	26.207	24.696	20.382	1.925	2.792	3.711	4.792	3.059	3.556	7.391
Domestic appliances	3.291	3.725	2.981	3.490	2.249	1.853	2.512	4.235	4.491	2.438	3.115	5.450
Office machinery	1.569	1.880	1.505	1.628	1.141	0.828	1.095	1.815	1.989	1.098	1.408	2.425
Electrical machinery	4.732	7.033	5.644	5.895	4.262	1.959	3.695	6.074	6.837	3.844	4.357	7.069
Radio, television	9.675	11.108	8.893	9.744	6.703	5.119	7.560	12.973	14.248	7.869	9.922	16.893
Medical appliances	1.918	1.871	1.496	1.700	1.120	1.132	1.505	2.504	2.805	1.567	2.015	3.354
Motor vehicles, parts	40.252	59.901	48.002	48.178	36.735	17.804	23.764	38.104	43.378	24.258	30.645	53.796
Ships and boats	0.122	0.143	0.115	0.128	0.087	0.067	0.087	0.143	0.153	0.083	0.106	0.187
Railway and trams	0.212	0.460	0.370	0.351	0.286	0.047	0.079	0.124	0.165	0.089	0.106	0.206
Aircrafts	0.036	0.063	0.051	0.050	0.039	0.013	0.018	0.029	0.034	0.019	0.023	0.042
Other transport equipment	0.832	1.443	1.158	1.101	0.888	0.306	0.432	0.703	0.778	0.443	0.547	0.956
Construction	0.496	0.790	0.634	0.580	0.483	0.168	0.292	0.550	0.856	0.442	0.539	0.963
Construction services	0.627	0.659	0.528	0.560	0.395	0.335	0.473	0.828	1.057	0.546	0.691	1.219
Trade services	1.676	2.035	1.631	1.577	1.222	0.783	1.422	2.611	3.423	1.917	2.483	4.777
Accommodation	4.369	4.607	3.686	3.765	2.755	2.450	3.422	5.623	6.771	3.830	4.741	7.903
Catering services	7.790	8.064	6.450	7.525	4.843	4.530	6.096	10.215	11.151	5.964	7.713	13.520
Passenger transport	19.832	23.178	18.564	20.541	13.924	10.432	16.432	28.644	34.712	18.306	23.574	41.547
Freight transport	29.259	51.967	41.726	8.558	30.584	8.584	13.779	26.257	32.714	23.209	26.847	26.880
Supporting transport services	6.025	7.377	5.919	6.270	4.422	2.180	5.476	7.152	11.236	6.233	8.089	13.978
Postal, courier services	1.050	1.135	0.910	0.959	0.677	0.508	1.046	1.801	2.535	1.868	2.241	3.155
Electricity distribution	17.422	18.998	15.209	17.314	11.377	9.322	15.021	24.610	31.260	18.918	22.955	33.209
Water distribution	6.400	7.870	6.304	6.309	4.587	3.047	4.631	7.580	10.047	5.082	6.308	16.211

Sectors	Maize	Oranges	Other citrus	grapes	Apples	Other animals	Meat	Fish	Processed fruit and nuts	Bakery	Other food	Alcohol & beverages
Financial services	49.839	46.545	37.255	40.363	27.874	18.579	28.465	60.121	53.708	31.445	43.708	64.148
Insurance, pension	22.645	26.657	21.336	22.991	16.158	12.166	16.001	27.457	28.992	16.055	20.580	35.375
Other financial services	22.387	22.840	18.319	19.412	13.703	8.881	18.328	35.163	30.294	17.474	20.200	31.795
Real estate services	48.718	49.098	39.265	44.776	29.450	28.351	39.079	65.275	72.857	44.422	54.779	89.040
Leasing, Rental services	10.343	11.947	9.576	8.775	7.126	4.970	10.128	16.380	32.576	14.808	17.496	24.202
Research, development	0.005	0.006	0.005	0.005	0.003	0.002	0.004	0.008	0.008	0.004	0.005	0.009
Legal, accounting	4.400	4.632	3.711	3.918	2.766	2.110	3.940	6.973	7.428	5.684	6.755	8.433
Other business services	18.997	20.255	16.233	16.707	12.045	8.674	17.469	30.488	48.885	31.936	42.354	49.421
Telecommunications	17.508	18.681	14.953	16.320	11.208	9.412	14.338	25.100	27.948	15.039	19.234	32.383
Support services	17.829	18.548	14.846	15.460	11.058	9.648	15.692	27.425	35.346	18.981	23.714	43.012
Manufactured services n.e.c.	0.493	0.523	0.419	0.439	0.313	0.201	0.413	0.762	0.827	0.520	0.613	0.832
Public administration	4.680	4.939	3.950	4.425	2.974	2.712	3.467	5.776	6.136	3.343	4.311	7.449
Education services	8.654	8.672	6.937	7.786	5.193	4.871	6.764	12.127	12.477	7.198	9.006	15.466
Health, social services	25.812	31.952	25.582	27.737	19.435	13.487	17.676	30.017	31.694	17.527	22.403	38.860
Other services n.e.c.	28.544	31.219	24.992	27.271	18.748	15.174	24.449	45.076	55.599	27.944	38.039	90.734
Total output increase	**1911**	**2073**	**1664**	**1684**	**1234**	**1195**	**1911**	**2578**	**2975**	**1617**	**2527**	**4862**

Source: Own calculations-2014 SA SAM quantity model simulation results