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Modeling the Distributive Effects of an Agricultural Shock on Household Income in South Africa: A Sam Multiplier Decomposition and Structurel Path Analysis

By Julius MUKARATI [a†] & Godswill MAKOMBE [b]

Abstract. Natural resource redistribution and ownership transfer programs are introduced as a way of improving income distribution and alleviating poverty in rural areas of most developing countries. In the case of South Africa, these redistributive policies are implemented in line with the national development plan targeting extreme poverty alleviation and reduction of wide income disparities by 2030. This paper analyses the distributive effects of the land redistribution policy which is a shock in the agriculture sector on poor household income in South Africa by applying a multiplier decomposition and structural path analysis. The study contributes to the existing literature by providing a microscopic analysis of the global multiplier to show the transmission mechanism of household income from a shock into the agriculture sector and show how income moves across sectors, factors and households by dividing the multiplier effects into all its components. The results showed that poor households received higher direct effects and the rich households received high indirect effects from the shock in the agricultural sector. The structural path shows that a significant portion of the global influence of the shock in agriculture is transmitted through the path of factor income which in turn increases poor household income.
Keywords. Multiplier decomposition, Structural path analysis, Land redistribution.
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1. Introduction

The promotion of sustainable economic growth and reduction of poverty continues to be the main concern and focus of most developing countries. As a way of promoting inclusive growth, Sub Saharan countries embarked on the distribution of natural resources to improve ownership of productive resources for the benefit of mostly the rural and poor households. Most empirical findings analyzing the relationship between poverty, inequalities and land redistribution have applied a wide range of approaches and different results have led to huge debate on the nature and size of the relation. In South Africa, the economy continues to experience positive growth due to large infrastructure investment; however, the country continues to experience extreme poverty especially in rural areas and this have shown that the growth in the economy is not inclusive (Ncube *et al.,* 2012). To promote inclusive growth, the government through the national development plan 2030 targeted at improving access to productive agricultural land by redistributing 30 percent of productive land from large commercial farmers to smaller scale farmers. This is viewed as a way of promoting increased production

[a†] School of Economics and Management, University of Limpopo, 0727 Polokwane, South Africa.
☎. +263 (0)54 260 568 / 2482
✉. jmukarati@gmail.com
[b] Turfloop Graduate School of Leadership (TGSL), University of Limpopo, 0727 Polokwane, South Africa.
☎. +27 (0)15 2684245 / 4141
✉. godswill.makombe@ul.ac.za

by small scale farmers thereby reducing poverty and increasing access to income. Given the continued commitment by the government towards land redistribution and poverty reduction, it is pertinent to analyse the economy-wide impact of land redistribution taking into account growth in output, value added and income distribution between different income groups.

A number of studies analyzing the land inequality and redistribution have been done in developing countries (Thurlow, 2002; DFID, 2003; Lahiff, 2005; World Bank, 2006) and most of these studies have pointed to the fact that inclusive growth is an effective way of reducing poverty (DFID, 2003; World Bank, 2006). However, most analytical techniques employed in these studies made no attempt to investigate the effect of the proposed land redistribution on the welfare of interested stakeholders in the long run. The empirical techniques applied, generally did not provide a complete picture of the economy- wide effects attributable to agricultural land redistribution. For effective policy formulation and implementation, there is need to investigate the economy-wide effects and welfare consequences of the redistribution taking into account both the backwards and forward intersectoral linkages of the South African economy. Using a SAM multiplier decomposition framework, this study intends to analyse the economy-wide and redistributive effects of land redistribution on poor household income in South Africa. This SAM multiplier decomposition and structural path analysis model enables the tracking of the linkages among demand driven shocks and economic growth, income generation and distribution among different economic groups through linking household income to the productive sectors of the economy. The main contribution of this study is to provide a microscopic analysis of the global multiplier by adopting the SAM multiplier decomposition as proposed by Pyatt & Round (2006). The multiplier decomposition can help show the transmission mechanism of household income from a shock into the agriculture sector and to show how income moves across sectors, factors of production and households by dividing the multiplier effects into the relevant components.

2. Theoretical Framework

To analyse the intersectoral impact of land redistribution on South African economy, this study adopted the IFPRI 2009 SAM which was built using official supply-use details, national accounts, state budgets and balance of payments accounts, therefore the SAM provides a detailed representation of the South African economy. The social accounting matrix records the transactions between different economic accounts; therefore it is an ideal data base for conducting economy wide impact assessments such as SAM based multiplier analysis and computable general equilibrium models. The IFPRI 2009 SAM consists of 49 activities, 85 commodities, 14 household types, a government sector, enterprise and the rest of the world. The SAM has 5 factors of production, namely capital, labor with primary education, labour with middle school education, labour with completed secondary school education and labour with tertiary education.

Given the nature of multiplier decomposition and structural path analysis, activity and commodities accounts are aggregated into single production accounts. For the purpose of this study, the SAM was aggregated into 41 production activities (and in this case production activities is a combination of 49 activities and 85 commodities), 4 factors of production and private institutions which combine 5 household categories and the enterprise accounts. The private institutions, activities and factor accounts form the endogenous account while the exogenous account will combine the government account, saving and investment as well as the rest of the world (Pyatt & Round, 2006). This SAM framework can be quite effective in capturing the linkages between these different production accounts and institutions in the economy and as such have been widely employed to explore the impact of different exogenous shocks in the economy (Civardi *et al.,* 2006; Pansini, 2008).

A number of empirical studies have applied SAM multiplier framework to analyse growth and distributive impacts of different government policies (Nseera, 2014; Juana & Mabugu, 2005; Sadoulet & de Janvry, 1995). Though these input-output and social accounting matrix models have been extensively used in the early literature to analyze growth linkages between various economic sectors, especially to investigate the role of agriculture and industry as engines of economic growth (Olbrich & Hassan, 1999; Bautista *et al,* 2002; Delgado, *et al,* 1998), however, detailed and effective analysis of land redistribution requires SAM decomposition and structural path framework which captures intersectoral effects (Sadoulet & de Janvry, 1995). This study adopted this framework to analyse the impact of an exogenous shock in the agricultural sector on the income of poor households in South Africa.

An explanation of how the social accounting multiplier analysis can be applied to analyse the economy-wide impacts of land redistribution focusing mainly on the impacts on sectorial output, value added and household income distribution in South Africa as illustrated by the SAM structure in table 1.

Table 1. *The basic structure of the SAM*

	Act1	Act2	Com1	Com2	factors	h/holds	total
Act1			S_{11}	S_{11}			X_1
Act2			S_{21}	S_{22}			X_2
Com1	Z_{11}	Z_{11}				C_1	S_1
Com2	Z_{21}	Z_{22}				C_2	S_2
factors	v_1	v_2					J
h/holds					D		Y-E
Total	X_1	X_2	S_1	S_2	J	E	

In order to analyse the effects of an exogenous shock in the agricultural sector on the endogenous variables, a SAM system is transformed into an economic model which can useful for simulation and for the purpose of the multiplier model the SAM are designated as endogenous and exogenous accounts as shown in the Table 2.

Table 2. *SAM: Endogenous and Exogenous Accounts*

	Activities	Factors	Households	Exogenous	Total
Activities	T_{11}		T_{13}	X_1	Y_1
Factors	T_{21}			X_2	Y_2
Households		T_{32}	T_{33}	X_3	Y_3
Exogenous	l_1	l_2	l_3		$\sum l$
Total	Y_1	Y_2	Y_3	$\sum x$	

Source: Civardi & Targetti (2006) and Pansini (2008).

The SAM is partitioned into endogenous accounts which include factors, institutions and productions accounts and exogenous accounts which include savings and investment, government and rest of the world. These partitions are represented in terms of matrix as shown in table 2 and these matrices are T_{11} which represent intermediate input requirements, T_{32} which captures factorial income distribution and T_{33} captures inter-household income distribution. The interactions among the different accounts in the SAM which are the production activities, factors and institutions can be represented in term of a triangle in Figure 1.

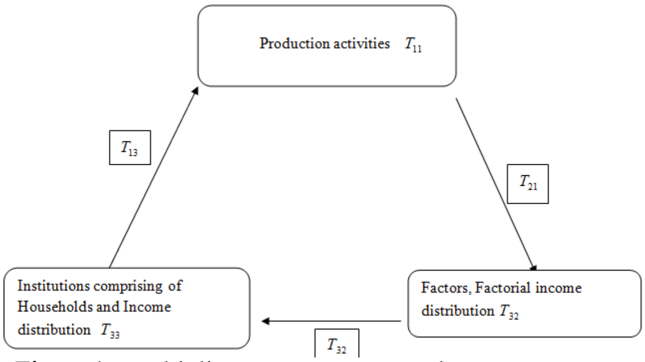

Figure 1. *Multiplier process among endogenous accounts*
Source: Civardi & Targetti, (2006).

Figure 1 represents the mechanisms through which the multiplier process operates as results of different exogenous injections into the economic system (Thorbecke, 2000). These mechanisms are represented as the relationship among the production activities, institutions and factors which are the endogenous accounts in the model. The production activities generates value added which is allocated as factor income distributed to households and enterprises. These institutions will then spend their income on different commodities generated by the production activities.

The economic model which is representation by the SAM in Table 1 can be translated into a system of linear equations as shown below:

$$S_{11}S_1+S_{12}S_2 = Z_1 \quad (1)$$
$$S_{21}S_1+S_{22}S_{22} = Z_2 \quad (2)$$
$$A_{11}Z_1+a_{12}Z_2+C_1E+JD_1 = S_1 \quad (3)$$
$$A_{12}Z_1+a_{22}Z_2 +C_2E+JD_2 = S_2 \quad (4)$$
$$v_1Z_1 +v_2Z_2 = J \quad (5)$$
$$hJ = Y \quad (6)$$

Following the methodology by Pyatt (2004), the system of equations (equation 1-6) can be converted into a matrix. The resultant matrix is as follows;

$$\begin{bmatrix} 0 & 0 & s_{11} & s12 & 0 & 0 \\ 0 & 0 & s_{21} & s_{22} & 0 & 0 \\ a_{11} & a_{12} & 0 & 0 & 0 & c_1 \\ a_{21} & a_{22} & 0 & 0 & 0 & c_2 \\ v_1 & v_2 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & h & 0 \end{bmatrix} \mathrm{x} \begin{bmatrix} Z_1 \\ Z_2 \\ S_1 \\ S_2 \\ J \\ Y \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ D_1 \\ D_2 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} Z_1 \\ Z_2 \\ S_1 \\ S_2 \\ J \\ Y \end{bmatrix}$$

The matrix shows that gross output from the economy can be represented by the product of technical coefficient matrix and output from different sectors of the economy. On the other hand the level of activity in the economy in real terms is determined by the vector of intermediate demand and the total final demand for inputs.

The SAM can be used as the basis for modeling by introducing the matrix of average propensities which will be defined within the framework of the social accounting matrix. If change in exogenous uses (J) can be accommodated by the change in total activity (Z^1), then total income of the endogenous account matrix will be represented the basic materials balance equation specified as:

$$Z^1 = AZ^1 + J \quad (7)$$

Where Z^1 is an $nx1$ column vector of total sectorial output, A is an $n\ x\ n$ matrix of direct technical coefficients for the endogenous factors and J is an $nx1$ column vector of final demand. The dimension of the 'A' matrix coincides with the number of productive sectors. Solving for Z^1 from material balance equation leads to equation 8 below

$$Z^1 = (I - A)^{-1} * J \tag{8}$$

Where 'I' is the identity matrix and $(I - A)^{-1}$ represents the Leontief inverse.

The input-output model is concerned with solving for the sectorial output levels (Z) that satisfy final demand for those outputs (J) given the inter-industry structure of production (A). The model is used to determine the production plan that is consistent with a desired final demand vector, given the inter-sectorial transactions matrix (A). The equation $(I\text{-}A)^{-1}*J=Z^1$ shows the impact of exogenous shocks to the different entries in the social accounting matrix. The above equation can be used to derive various types of multipliers, the most common of which are the production and income multipliers.

The above equation can be reduced to:

$$Z^1 = N^1 J \text{ , where } N^1 = (I - A)^{-1} \tag{9}$$

Equation 9 solves for the equilibrium levels of the endogenous accounts due to an exogenous shock in the elements of the exogenous accounts and the same equation can be used to calculate the endogenous incomes associated with any changes of the total exogenous accounts, given the multiplier matrix. It can also be used to analyze the effects on output arising from exogenous shocks, such as changes in investment or government expenditure or the rest of the world, that change final demand.

The change in output resulting from redistribution of land can be represented by the equation below:

$$(1 - A_1)^{-1} * J - (1 - A)^{-1} * J = [(1 - A_1) - (1 - A)] = \Delta Z^1 \tag{10}$$

Where ΔZ^1 represent the change in sectoral output resulting from redistribution and its impact of the technical coefficient matrix.

The SAM multiplier enables the quantification of the different ways in which the impact of the exogenous is distributed across the economy. This multiplier analysis also indicates the effects of an exogenous shock on the distribution of income and sectoral output (Round, 2003). However, to examine the nature of the linkages in the economic system, it is imperative to decompose the SAM multipliers. For a detailed analysis of the intersectoral linkages due to land redistribution in South Africa, the study adopted SAM multiplier decomposition as proposed by Pyatt & Round (2006).

This multiplier decomposition allows the assessment of the linkages between households and different components of the economic system affecting the distribution of income (Civardi, *et al,* 2008). The total multiplier can be decomposed into three components which are the transfer multiplier, the open-loop multiplier and the closed loop multiplier. The transfer multiplier captures the effects on the same set of account, the open-loop multiplier identifies the spill-over effects and the closed loop captures the full circular flow from the exogenous shock into the endogenous accounts. Thus using the multiplicative decomposition proposed by Pyatt & Round (2006), the total multiplier from equation 9 can be rewritten as:

$$(I - A)^{-1} = M_3 M_2 M_1 \tag{11}$$

Where $(I\text{-}A)^{-1}$ represents the total multiplier and M_1 is the transfer multiplier, M_2 is the spill-over effects and M_3 represents the full circular flow.

To derive the multiplier matrix, we first divide elements in each column of define the T matrix by its column total (y) to get average propensities (Round, 2003). The matrix of average propensities which is obtained by dividing each element in the transaction matrix of endogenous account by the corresponding column sum vectors can be represented as:

$$A_n = \begin{vmatrix} A_{11} & 0 & A_{13} \\ A_{21} & 0 & 0 \\ 0 & A_{32} & A_{33} \end{vmatrix}$$

And the diagonal matrices of the average propensities can be represented as:

$$A_0 = \begin{vmatrix} A_{11} & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & A_{33} \end{vmatrix}$$

The multiplier that will capture the transfer elements M_1 will be given by:

$$M_1 = \begin{vmatrix} {}_1M_{11} & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & {}_1M_{33} \end{vmatrix}$$

And the open loop multiplier will be given:

$$M_2 = I + (I - A_0)^{-1}(A_n - A_0) + \left[(I - A_0)^{-1}(A_n - A_0)\right]^2 + \left[(A_n - A_0)(I - A_0)^{-1}\right]^3$$

$$= \begin{vmatrix} I & {}_2M_{12} & {}_2M_{13} \\ {}_2M_{21} & I & {}_2M_{23} \\ {}_2M_{31} & {}_2M_{32} & I \end{vmatrix}$$

The closed loop multiplier which captures the full circular flow from exogenous shock to endogenous account will be represented by:

$$M_3 = \begin{vmatrix} {}_3M_{11} & 0 & 0 \\ 0 & {}_2M_{22} & 0 \\ 0 & 0 & {}_3M_{33} \end{vmatrix}$$

If we let $A^*=(I-A_0)^{-1}(A_n-A_0)$, then the multiplier will be given as $M=(I-A^{*3})^{-1}(I+A^*+A^{*2}+A^{*3})(I-A_0)^{-1}$. As in Pansini (2008), the focus of multiplier decomposition is on household income distribution. From the Table 2, the equation is given by:

$$Y_4 = (M_{33} M_{32} M_{31})x \tag{12}$$

$$Y_4 = M_{31}x_1 M_{32}x_2 M_{33}x_3 \tag{13}$$

Where $M_{31} = {}_3 M_{3_2} M_{311} M_{11}$

$M_{32} = {}_3M_{33\,2}M_{32}$

$M_{33} = {}_3M_{33\ \ 1}M_{33}$

To disentangle the three effects namely the transfer multiplier, open loop and closed loop, we consider the single element m_{ij} of matrix of the global multipliers. The single element m_{ij} can be expressed as:

$$m_{ij} = d_i^{'} M_3 M_2 M_1 d_j = i'(r' As')i \quad (14)$$

Where $d_i^{'}$ and d_j are vectors in the *ith* element and *jth* element which are equal to one and all others are equal to zero (Pyatt & Round, 2006; Pansini, 2008; Civardi & Targetti, 2008). The matrix A and vectors r' and s' are defined as:

$r' = d_i M_3 \qquad A = M_2 \qquad s' = M_1 d_j$

This implies that each m_{ij} must be equal to the sum of all elements of an $r'As'$ type transformation of the matrix M_2 when the vector r' is formed from the i[th] row of M_3 and the vector s is formed from the j[th] column of M_1 (Pyatt & Round, 2006). This approach of multiplier approach allows the decomposition of direct-direct effect, indirect-direct effect, direct-indirect effect effects and indirect-indirect effects (Pansini, 2008). In this study, i represent the poor rural household in South Africa and j is the agriculture sector, it follows that the element m_{ij} becomes a sub-matrix M_{HA} of M and the element m_{ij} is given by $m_{ij}=(d'{}_3M_{HH})_2M_{HA}({}_1M_{AA}d_j)$.

This approach enables the assessment and identification of microeconomic detail about the nature of the linkages in the economy. In order to capture and assess both the direct and indirect effects of land redistribution on different sectors of the economy which is the main focus of this study, the social accounting multiplier decomposition and structural path analysis were adopted as in Round (2008).

This decomposition shows clearly the way the consequences of an exogenous of in the j[th] activity on the i[th] household. Using the block matrices ${}_2M_{HA}, {}_2M_{HF}$ which represent the cross effects and explain how the original injection into the activities/factor accounts effects in the household account (Civardi *et al.* 2008). An injection or a shock in an activity account of the production sector will be directly translated by the A part of the $r'As'$ transformation into the income for the endogenous institutions. The main focus of this decomposition is the block matrix M_{HA}, where the column totals of this matrix indicate the effects of each sector of production on the household account of a shock on the agriculture sector where as the row totals indicate the total effect on each household group due to shock on the agricultural activity account. These column and row totals enable the identification of the four different effect in the single multiplier m_{ij} can be divided.

The four different effects can be defined mainly as:

i) Direct-direct effects which represent the direct effect of agricultural land redistribution on the poor household without considering the other indirect effect on other household categories and is equal to the j^{th} element of the column vector of the block matrix.
ii) Indirect –direct effects. This measures the effect from other production accounts apart from agriculture on the i^{th} household group and is calculated as the difference between row totals of the block matrix and the direct-direct effect.
iii) Direct- indirect effect is the effect from the shock in the agricultural sectors on other household groups. This effect is calculated as the difference between the column totals of the block matrix and the direct-direct effect.

iv) Indirect-indirect effect. This is the effect from other accounts of the production accounts which are different from the agricultural sector on other household groups which are also different from the i^{th} category. The indirect-indirect effect is the difference between the total effects on i^{th} household and the direct-direct effect.

Though the multiplier decomposition enables the distribution of the global effects on the endogenous accounts of the SAM into three microscopic effects, the analysis alone do not highlight the paths/channels through which these influence are transmitted and show which path is better than other in transmitting the influences. Based on multiplier decomposition results, the structural path analysis is adopted so as to identify the transmission mechanism of the interactions among different accounts in the SAM.

If we consider every endogenous account in the SAM as the pole and the link between poles as arch(i,j), then element a_{ij} in the average expenditure matrix A_n is considered as the intensity of the arch (i,j) which captures the magnitude of the influence transmitted from pole i to pole j and the sequence of the different arcs.

i) Direct influence-this measures the change in income or production of j induced by a unitary change in i of all the other poles remaining constant and the direct influence can be measured as: $I^{D}_{(i\rightarrow j)} = A_{ji}$ where a_{ij} is the $(j,i)^{th}$ element of the matrix of average expenditure propensities A_n. The direct influence along more than one elementary path $(i\ldots j)$ can be represented as a product of the intensities of the arcs constituting the arc, hence, $I^{D}_{(i\rightarrow j)} = a_{jn}\ldots a_{mi}$. The number of arc composition will then be identified as the length of path and the path which does not pass more one time through the same pole is called an elementary path while the one whose origin coincides with its pole of destination is the circuit.

ii) Total influence-given an elementary path $q=(i\ldots\ldots j)$ with origin i and destination j, the total influence will be the influence transmitted from i to j along the elementary path q plus all the indirect effects induced by the circuits adjacent to the same path. Algebraically, the total influence can be represented as: $I^{T}_{(i\rightarrow D_P)} = I^{D}_{(i\rightarrow j)_p} M_P$ Where, M_P is the path multiplier which measure the extent to which the direct influence along path q is amplified through the effects of adjacent feedback circuits. Thus, the total effects accumulate the direct effects from an elementary path and the indirect effects from an adjacent circuit.

iii) Global influence- this influence measures the total influence on income or output of pole j consequent to an exogenous shock on income or output in pole i and this global influence captures the reduced form of the SAM model equation $Z^{l}=(I-A)^{-1}*J$. The global influence captures the direct influence transmitted by all the elementary paths linking the two poles which will be under consideration thus the global influence cumulates all the induced and feedback effects resulting from the existence of circuits (Lantner, 1974; Gabon, 1976). The global influence linking any two poles will thus be the sum of the total influences of all elementary paths spanning poles i and j, thus the global influence can be represented as:

$$I^{G}_{(i\rightarrow j)} = m_{a_{ji}} = \sum_{q=1}^{n} I^{T}_{(i\rightarrow j)_p} = \sum_{q=n}^{n} I^{D}_{(i\rightarrow j)_p} M_P$$

3. Simulation Technique

The main purpose of this study is to investigate whether redistribution of agricultural land from large commercial farmers to small scale farmers will promote land use social equity. Social equity in this context refers to job creation and income generation and redistribution in favor of the low-income households. As the SAM entries are in millions on rands and the proposed land redistribution are in physical quantities, the land transfers are first converted into land income (revenue shares). This conversion is essential as transfer of land from commercial farmers to small scale farmers means transfer of land income. The land revenue share are then use to shock the social accounting matrix. This SAM multiplier approach enables the tracking of among demand –driven shocks, economic growth, income generation and distribution. Furthermore a multiplier decomposition analysis was applied to show the distributional mechanism across the economy with the focus on the household component of the global multiplier matrix which are M_{31}, M_{32} and M_{33}. The multiplier decomposition shows the capacity of an activity to stimulate household income. The study seeks to analyse and assess the direct and indirect effects of land redistribution (which represent a shock in the agriculture sector) on poor household income in South Africa and for this study we assumed a progressive 30 percent land transfer from the large scale to small scale farmers.

4. Results and Discussion

In this study, the global matrix multiplier which reflects the total effects was decomposed to show how income is distributed across various household groups. The focus of the results from the decomposition was on the household section of the total effect which are M_{31}, M_{32}, M_{33}. as shown in Table 3 below.

Table 3. *Summary of M_{31}, M_{32}, M_{33}*

Household type	M_{31}	M_{32}	M_{33}
hhd1	0.889	0.203	1.095
hhd2	1.839	0.414	1.201
hhd3	3.001	0.626	1.335
hhd4	5.551	1.05	1.63
hhd5	22.683	3.802	3.62
Total	33.963	6.095	8.883
Total average	0.828	1.52	1.7766

Source: Authors' computation from South African SAM, 2010.

From Table 3, the income effects on household income due to a shock into the production system as measured by matrix M_{31} indicates that household income increase by the size of the average multiplier. The results indicates that a shock in the agricultural sector of one unit, has a household income effect 0.828 and of this multiplier most occurs for the richer households (0.553). From these results it is important to note that the rural households benefitted more from most of the agricultural activities.

Matrix M_{32} measures the impact of an exogenous shock on the agricultural sector on household income which is directed to the factor account and on average an exogenous injection into the factors of production will increase the income especially of the poor household by a multiplier of 1.52 and by 2.3458 total income of the endogenous account. The redistribution of the factor income among different household group which is represented by the matrix M_{33}, the household income increase by a multiplier of 1.7766. From the redistributive matrix, it can be noted that because of the multiplicative effect due to the movement of income through the economic system, household income increase by a factor greater than one when there is a unit injection on the income of different groups of households as all the elements of the diagonal matrix are greater than one. This more than proportionate income can be explained by the diagonal elements of the M_{33} matrix which are all greater than one.

4.1. Multiplier Decomposition and Household Income

This section seeks to track the contribution of the direct and indirect effects of a shock in the agriculture sector on the income of rural households in South Africa. In addition the different directions in which the shocks into the agriculture sector operate will be traced and disentangled. The decomposition of the global multiplier matrix will be based on analyzing the elements of m_{ij} based on the *r'As'* type of transformation.

The corresponding element of the global multiplier for a shock in the agriculture sector on poor household income (represented by HHD1 in Table 4) is 0.002884 and this element is decomposed into four effects which are direct-direct effect, direct-indirect effect, indirect-direct effects and indirect- indirect effects as shown in Table 4 below. This decomposition enables the distinguishing of the link in an economic system that affects households in South Africa.

Table 4. *Decomposition of the global multiplier matrix*

Column j	Row i	Household group	Direct-direct effect	Indirect-direct effect	Total effect for A1	Direct-indirect effect	Indirect-indirect effect	Total effect	multiplier
agric	hhd1	hhd1	0.0087	-0.00587	0.002827	0.00089	-0.00083	0.00006	0.0028874
agric	hhd1	hhd2	0.0001	-0.00008	0.000022	0.00949	-0.00662	0.00287	0.0028874
agric	hhd1	hhd3	0.0001	-0.0006	0.000023	0.00950	-0.00664	0.00286	0.0028874
agric	hhd1	hhd4	-0.000	0.00007	0.000022	0.00964	-0.00677	0.00286	0.0028874
agric	hhd1	hhd5	-0.001	0.00110	-0.000001	0.0107	-0.00781	0.00289	0.0028874

Source: Authors' computation from South African SAM, 2010.

From the Table 4, it can be seen that the poor household benefits more compared to other household groups due to an exogenous shock as the direct effect from an exogenous injection or shock in the agriculture sector on the poor household income represents about 98% of the total effect on household. The direct effect of agriculture on the poor household are higher (0.0087) compared to other different categories of households indicating a strong link between agriculture and the rural poor. However, the indirect-direct effect which captures the effects from other sector on poor household welfare is the minimum for the poor household compared to other groups. The significant direct-direct effect on poor households reflects the poverty incidence of rural household who relies more on subsistence agriculture practices for survival.

For the rich households who are mostly urban household the direct effect from agriculture is minimum implying that these households benefit from agriculture through mainly the indirect channel (which is about 98% of the total effects). In the case of South Africa where agriculture contributes less than 4% of total GDP (Economic Research Division, SA, 2010), we expected a minimal direct effect on rich household income from an exogenous shock in the agriculture sector. The shock in the agriculture sector generates intermediates demand for agriculture products which in turn generates income for the rich households.

The decomposition has shown that an injection in agricultural sector in South Africa will have different results for different households groups. From the results poor households received higher direct effects from the agriculture compared to the richer households however the indirect effects are much higher for the richer households. This indicates a strong link between poor households and agriculture but the link is much weak with the richer households. The results might be that poor households depends more on agriculture for the livelihoods compared to the richer households. These results implies that stimulus of the agricultural sector will benefit the poor households compared to the richer which might be a good policy for rural poverty reduction signifying the important role of agriculture for rural household welfare.

4.2. Structural path analysis

The structural path analysis helps us to identify the most important channels and paths within the economic system that will affect household income. In addition the analysis enables the identification of the sectors and activities that benefits from an exogenous shock in the agriculture sector. In this study, the origin is the agriculture sector where the shock occurs and in this case the shock is the land redistribution which will affect the land income of households and the destination is the unskilled households which mostly work in the agriculture sector and are viewed as the intended beneficiaries of the land redistribution exercise. The study chose a few sectors and factors which are mostly and directly linked to the agricultural sector and rural household income. The results of the structural path analysis are shown in Table 5 below.

Table 5. *Structural Path Analysis*

Origin	Destination	Global Influenc	Path	Direct Influenc	Path Multiplie	Total Influenc	Proportion
AGRI	HHD1	0.02582	AGRI, FLABLS, HHD1	0.00688	1.21498	0.00836	32.39
			AGRI, FCAP, ENT, HHD1	0.0007	1.46785	0.00103	3.98
			AGRI, FLABSK, HHD1	0.00062	1.24171	0.00077	3
			AGRI, FOOD, FLABLS, HDD1	0.00034	1.45392	0.00049	1.9
			AGRI, FOOD, TRAD, FLABLS	0.00017	1.76084	0.00031	1.19
			AGRI, TRAD, FLABSK, HHD1	0.00012	1.53034	0.00018	0.70
			AGRI, TRAN, FLABSK, HHD1	0.00012	1.40082	0.00016	0.64
			AGRI, TRAN, TRAD, FLABLS	0.0001	1.65305	0.00016	0.62
			AGRI, FOOD, FLABSK, HHD1	0.00008	1.4916	0.00012	0.15
			AGRI, FOOD, OSRV, FLABL	0.00004	1.64888	0.00007	0.28
			AGRI, OMIN, FLABLS, HHD	0.00005	1.26301	0.00007	0.25
			AGRI, FSRV, OSRV, FLABLS	0.00003	2.18007	0.00006	0.24
			AGRI, FLABHI, HHD1	0.00004	1.28871	0.00005	0.20
			AGRI, FOOD, TRAD, FLABLS	0.00003	1.80214	0.00005	0.18
			AGRI, FOOD, TRAN, FLABL	0.00003	1.63094	0.00004	0.12
			AGRI, FOOD, FCAP, ENT, HHD1	0.00002	1.7505	0.00003	0.12
			AGRI, OMIN, FCAP, ENT, HHD1	0.00001	1.51334	0.00001	0.03
			AGRI, OSRV, FLABSK, HHD	0.00001	1.42511	0.00001	0.03

Source: Authors' computation from South African SAM, 2010.

Table 5 shows the various channels through which the stimulation of the agriculture sector will impact on the income of poor households represented by *HHD1*. The results show that the global influence of a shock in the agricultural sector on household income is 0.02582 (which is column three from Table 5). This global influence implies that an injection in the production activity in this case agriculture yields a 2, 58 % increases in poor household income. However, there are no direct linkages between the income of poor households and agriculture hence the shock is transmitted via intermediate poles for example trade. A significant part of the global influence is transmitted through indirect channels especially the path of returns to factors of production. Of importance is that the food sector and trade sector plays a significant part in transmitting the influence of the shock in the agriculture sector to the poor household income.

The direct influence captures the change in poor household income induced by changes in the agricultural sector when all the other poles are assumed constant and from the results proved that the direct influence is minimal with the maximum influence being less than 1%. This implies that the agricultural influence on the income is necessarily transmitted via other poles/paths and not along the elementary direct path. The other paths are capturing the indirect influence imputed in the elementary path (Lantner, 1974). The amplifying actions of circuits which vary with the length of the path are powerful as indicated by path multipliers which are all greater than 1.2.

As indicated in the results, rural households received about 46.56% of their income from unskilled labour with a total of 13 paths passing through that arc of food sector and skilled labour contributing 5.71% of the income for the rural households with only 6 paths passing through that arc. Of importance to this study is the proportion of income for the rural households coming from the agriculture sector and the results showed that the proportion of income from unskilled labour from agriculture is 32.39% with only a single arc. This implies that the unskilled labour receive their income directly from agriculture and not via other sectors. The global influence on rural households from a shock in agriculture is 0.2582 and with the path of agric-flabsl-hhd1 as the most important path of the rural household income multiplier. This implies that an exogenous shock into the agricultural sector will affect household income mainly through affecting the returns to factors of production. The returns to employment for the unskilled labour are the main factor affected by the shock in the agriculture sector as the majority of them are employed in the agricultural sector. Though the unskilled households get most of the income from agricultural sector, path analysis help establish the other sectorial sources of income and employment following the shock in the agricultural sector.

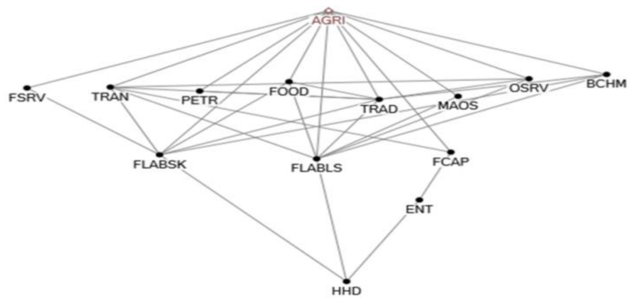

Figure 2. *Structural path to low income households*

Figure 2 shows the different and most important path that connects the agriculture sector and low income households which in this case are the intended beneficiaries of the land redistribution exercise in South Africa. As shown in Figure 2, the agriculture is connected to almost all the sectors even though the strength of the connections is almost the same. The existence of both forward and backward linkages among sectors in the economy may be the explanation of these connections. The existence of these connections implies that any exogenous movement in the agricultural sector will affect the whole economy through the different path that influences this arc.

As shown on Figure 2, skilled labor received their income from six of the sectors which include financial services, transport, trade sector, petroleum products, manufacturing services and food processing. This might be because the bulk of skilled personal are employed in this sectors. The least connected factor of production is capital which only receives its income directly from agriculture and the transport sector. Low income households receive the income mostly from low skilled workers and less from capital. The low income households are mostly connected with low skilled labour.

5. Conclusions

This study adopted a SAM multiplier decomposition and structural path analysis to analyse and track the channels through which an exogenous shock in agriculture will affect the income poor households. This approach enables the disentangling different effects (both direct and indirect effects) of an exogenous shock on the agricultural sector in South Africa. From the study different set of results emerged which have different policy implications for the government.

The results show that although the contribution of the agriculture sector to the overall economy which is only 4% of the GDP in South Africa, the sector influence household income through different paths and sectors. This can be explained by the existence of strong backwards and forwards linkages in the economy. Thus the proposed land redistribution will significantly alter the production structure of the agriculture sector which means that the income of the households will be altered.

The results also show that land income transfer increases the income of poor households and these results also identified the different path through which income is distributed from the origin (agriculture sector) to the destination(poor household income). These results can be very important in articulation of the impact of land redistribution policy of poverty and income distribution; however, more emphasis can be achieved through the relaxation of the assumption of linearity and fixed prices. This will allow for the analysis of long run and redistributive effects of land redistribution policy in South Africa. This analysis then requires the application of a dynamic computable general equilibrium micro simulation model.

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