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# Poverty, Growth, and Income Distribution in Kenya:

## A SAM Perspective

Rhoda Gakuru

Naomi Mathenge

## About the Authors

Rhoda Gakuru and Naomi Mathenge are policy analysts at the Kenya Institute for Public Policy Research and Analysis (KIPPRA).

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## Abstract

This study seeks to highlight the level of income inequality in Kenya and its implications on various poverty reduction policies. The 2003 Kenya SAM is used to develop a multiplier simulation model which tracks the linkages among demand-driven shocks and economic growth, income generation, and income distribution for different economic groups.

In the first section of our multiplier analysis, we determine the major sectors that can be used to promote generalized economic development in Kenya. The trade, hospitality (hotels and restaurants), manufacturing, and agricultural sectors play the highest role in the development of Kenya's domestic economy. We further decomposed the global multipliers to highlight in microscopic detail the linkages between each household group's income and productive sector accounts (agricultural and manufacturing) whose income has been exogenously injected.

The empirical results from our multiplier analyses show 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. Kenya will need to focus not only on economic growth but also on reducing inequality in order to effectively address the country's poverty. Based on the major sectors selected for this study, agriculture has higher direct effects on the incomes of rural households, while manufacturing has higher direct effects on the incomes of urban households.

**JEL Classification Numbers**: O10, C67, D57

**Keywords:** growth, poverty, inequality, SAM multipliers, Kenya

## Résumé

Cette étude vise à mettre en évidence le niveau d'inégalité de revenu au Kenya et ses implications sur différentes politiques de réduction de la pauvreté. Une matrice de comptabilité sociale de 2003 du Kenya est utilisée pour étudier, à l'aide un modèle de simulation basé sur les multiplicateurs, les liens entre les chocs de demande et la croissance économique, la génération et la distribution de revenu pour différents groupes économiques.

Dans la première section de notre analyse, nous déterminons les secteurs majeurs qui peuvent être utilisés pour promouvoir le développement économique étendu au Kenya. Le commerce, les hôtels et restaurants, l'industrie de transformation et les secteurs agricoles jouent les rôles les plus importants dans le développement de l'économie du Kenya. Nous avons décomposé les multiplicateurs globaux pour mettre en évidence dans le détail les liens entre le revenu de chaque groupe de ménage et les comptes des secteurs productifs (agricole et industrie) dont le revenu a été injecté de façon exogène.

Les résultats empiriques de nos analyses de multiplicateur montrent qu'en raison du niveau élevé d'inégalité au Kenya, la stimulation de la croissance dans les secteurs agricoles et industriels profite principalement aux déciles les plus riches des ménages urbains qui possèdent la plupart des facteurs de production. Le Kenya devra se concentrer non seulement sur la croissance économique, mais aussi sur la réduction des inégalités pour traiter efficacement la pauvreté du pays. Suivant les secteurs majeurs choisis pour cette étude, l'agriculture a des effets directs plus importants sur les revenus de ménages ruraux, tandis que l'industrie a des effets directs plus forts sur les revenus de ménages urbains.

**Codes JEL** : O10, C67, D57

**Mots-clés :** croissance, pauvreté, inégalités, multiplicateurs de matrice de comptabilité sociale, Kenya

# I. Introduction

In Kenya, inequality manifests itself in various dimensions including unequal access to basic social amenities and inequalities in income levels, as well as inequalities arising from gender bias. This study focuses on income inequality, as this is the most direct way to assess disparities in consumption levels in various economic groups.

This study seeks to highlight the level of income inequality in Kenya and its implications on various poverty reducing policies. Using the Kenya 2003 Social Accounting Matrix (SAM), we conduct multiplier analyses to identify and examine the effects of different policy options on various household incomes. SAM and multiplier decomposition models link household income to the country's productive structure. This type of model can be used in policies linked to poverty reduction and, more specifically, to household income redistribution. In Kenya, studies mainly focus on growth, poverty, or income distribution independently and are mainly qualitative as opposed to quantitative.

The aim of this study is to assess both direct and indirect effects of an exogenous injection to various sectors in the economic system on incomes of different household groups. The main contribution that this study makes to the debate on income inequality in Kenya is the microscopic analysis of the global multipliers from the 2003 Kenya SAM to show the transmission mechanism of household income from an injection into production sectors (agricultural and manufacturing).

The study is organized as follows: Section 1 gives an overview of the relationship between poverty, growth and inequality, Section 2 looks at the existing literature. Section 3 discusses the methodology and results are given in Section 4. Section 5 provides conclusions, policy recommendations, and suggested future research.

## *1.1 Poverty, Growth, and Inequality in Kenya*

Absolute poverty refers to the inability of individuals/households to attain a predetermined minimum level of consumption at which the basic needs of a society are assumed to be satisfied. Table 1 provides national and regional absolute poverty measures in Kenya. Substantial regional differences in the incidence of poverty exist in Kenya. About half of the rural population and between 29-50 percent of the urban population were poor in the 1990s and 2000s. Rural poverty is marked by its common connection to agriculture and land, whereas urban poverty is more heterogeneous in the ways in which incomes are generated. (Wambugu and Munga, 2009). Generally, about half the population in Kenya cannot meet the minimum level of basic needs and thus lives in poverty.

*Table 1: Summary of Poverty Estimates in Kenya*

| Year | Data Source | Poverty Incidence | | |
|---|---|---|---|---|
| | | National | Rural | Urban |
| 1992 | 1992 WMS I | -- | 46% | 29.30% |
| 1994 | 1994 WMS I | 40% | 46.80% | 29% |
| 1994 | 1994 WMS II | 38.80% | 39.70% | 28.90% |
| 1997 | 1997 WMS III | 52.30% | 52.90% | 49.20% |
| 2000 | Mwabu et al. (2002) using WMS III | 56.80% | 59.60% | 51.50% |
| 2005 | KIHBS | 45.90% | 49.10% | 33.70% |

Source: Wambugu and Munga, 2009

According to Thurlow et al (2007), accurate comparison of poverty over time is difficult in Kenya because the last three household surveys used different designs and implementation methods. For instance, the 1992 Welfare Monitoring Survey (WMSI) covered half of the country, the 1994 WMS (II) covered all districts, and the 1997 WMS (III) excluded the North Eastern province. With the above limitations in mind, the estimates in Table 1 suggest that there was a decline in poverty nationally as well as in both rural and urban areas.

Income inequality generally refers to the disparity in income level among individuals/households in an economy. Income inequality is thus a narrow way of looking at overall inequality in a given community, but it is the most direct way to assess disparities in consumption levels among various economic groups. The most common approach used to measure inequality is the Gini coefficient based on the Lorenz curve. The Gini coefficient is mainly used to assess inequality in income and consumption. The Gini coefficient ranges between zero and one, with the values closer to one indicating greater inequality.

Available estimates of the Gini coefficient for Kenya show that inequality has been increasing in the country. According to the available household surveys[1], the country's Gini based on general household income was estimated at 0.419 in 1997, compared to 0.459 in 2005-06.

Table 2 compares household data from the 1997 welfare monitoring survey and the 2005-06 KIHBS. The households are first grouped into rural and urban areas and then divided into 10 household groups; these groups are ranked from the poorest (1) to the richest (10). Inequality is higher in urban areas than in rural areas. Comparing the average expenditure of the poorest and richest deciles in 2005-06, 39 percent of average expenditure by urban households is by the

[1] Although widely used to measure inequality, Gini coefficients should be interpreted with caution because of the size and type of the data used for their calculation. The 1997 coefficient was based on WMS111, while the 1999 coefficient used LFS 98-99; the two surveys have different samples collected at different times of the day, which will affect the Gini coefficient calculated such that the two might not compare directly.

country's richest urban households, while only 2 percent of average expenditure by urban households is by the poorest urban households. According to the 2005-06 KIHBS, the richest rural decile spends 29 percent of average expenditure by rural households while the poorest rural decile spends only 2 percent.

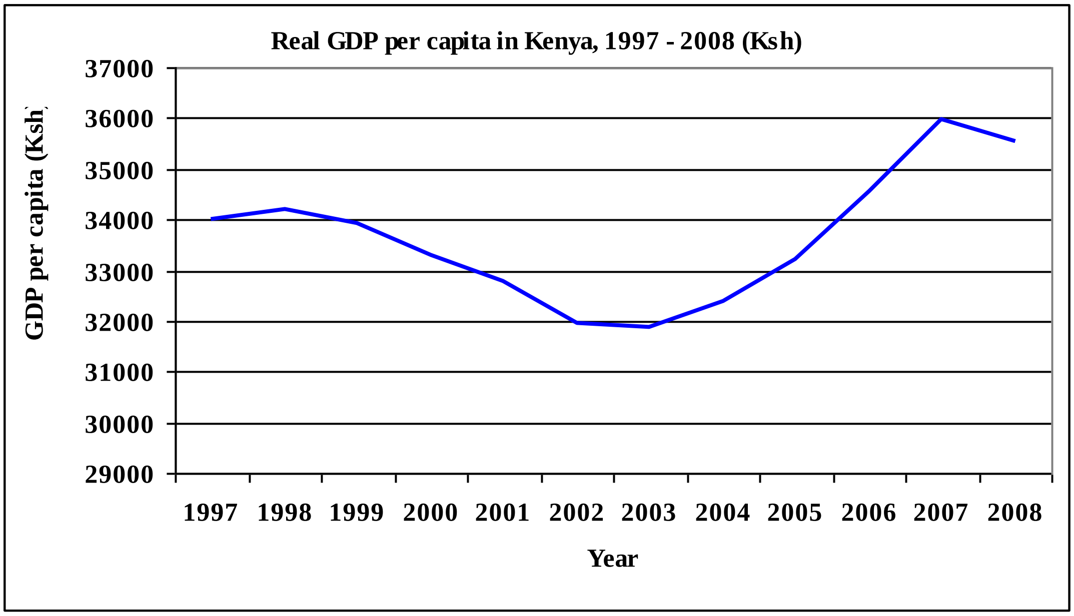
*Table 2: Average Rural and Urban Expenditure by Decile, 2005-06 and 1997*

| | **2005-06** | | | | **1997** | | | |
|---|---|---|---|---|---|---|---|---|
| **Decile** | **Rural** | **Share** | **Urban** | **Share** | **Rural** | **Share** | **Urban** | **Share** |
| 1 (Poorest) | 466 | 2% | 1110 | 2% | 444 | 3% | 1009 | 3% |
| 2 | 813 | 4% | 1888 | 3% | 609 | 4% | 1525 | 4% |
| 3 | 1038 | 5% | 2404 | 4% | 755 | 5% | 1809 | 5% |
| 4 | 1244 | 6% | 2955 | 5% | 914 | 6% | 2123 | 5% |
| 5 | 1458 | 7% | 3578 | 6% | 1088 | 7% | 2455 | 6% |
| 6 | 1719 | 9% | 4288 | 7% | 1283 | 8% | 2869 | 7% |
| 7 | 2039 | 10% | 5009 | 9% | 1531 | 10% | 3502 | 9% |
| 8 | 2473 | 12% | 6058 | 10% | 1862 | 12% | 4469 | 11% |
| 9 | 3147 | 16% | 8202 | 14% | 2402 | 16% | 6422 | 16% |
| 10 (Richest) | 5741 | 29% | 22823 | 39% | 4589 | 30% | 13756 | 34% |

Source: World Bank, 2008

Economic growth increased significantly from 0.27 in 1997 to 6.3 percent in 2006; per capita incomes in 2005-06 stayed at 1997 levels as shown in Figure 1, while poverty decreased from 52.3 percent in 1997 to 45.9 percent in 2005-06. Although the proportion of the population living in poverty has declined, the number of those living below the poverty line is estimated to have increased from 13.4 million in 1997 to about 16.6 million in 2006 (KIPPRA, 2009). The Gini coefficient increased slightly from 0.419 in 1997 to 0.459 in 2005-06, implying increased inequality.

*Figure 1: Real Per Capita GDP in Kenya*




Source: Government of Kenya Economic Survey, Various Issues

It has been argued that the increase in economic growth during 2003-2006 positively affected only a few groups, excluding those without ownership of factors of production such as land and capital, as well as those without relevant skills for employment. This led to increased inequality in income distribution such that even though there was an increase in per capita income growth, only a small portion of society benefited. Such scenarios have led to what is commonly referred to as "an unequal distribution of the national cake". High inequality in Kenya has been blamed for poor development in the country[2].

Rapid economic growth is viewed as the key to alleviating poverty in Kenya (Wambugu and Munga, 2009). All core public policy documents emphasize rapid and sustained economic growth as a way of alleviating poverty. Some of these policy documents include:

- National Poverty Eradication Plan (1999-2015).
- Economic Recovery Strategy for Wealth and Employment Creation (ERSWEC) 2002-2007.

[2] **Inequality in Distribution of Consumption Gains, 1997 – 2005-06:** Average welfare gains over the period between 1997—2005-6 as a whole were very much concentrated, in particular amongst the wealthiest quintiles, urban residents, and, in terms of provinces, Nairobi (especially), Nyanza, and Eastern. For many other groups, the aggregate improvement during this period was very limited and practically stagnant. Most striking are the findings that the poorest quintile lost out in absolute terms and that gains for the second poorest quintile were only about 1 percent annually. Even for the middle quintile, growth in consumption was below average (World Bank, 2008).

- Vision 2030 - The aim of the vision is to create a globally competitive and prosperous country with a high quality of life by 2030.

To a large extent, these development policies were on the right path, as there was an increase in GDP growth between 1997 and 2005-06. Despite the significant increase in economic growth, however, poverty decreased only slightly and inequality levels increased. Although a reduction in poverty depends on both economic growth and changes in income inequality, the responsiveness of poverty to these variables depends on the degree of initial inequality (Wambugu and Munga, 2009). According to Bourguignon (2004), the optimal economic growth-income distribution policy mix varies across countries; changing income distribution is more important for reducing poverty in highly unequal economies, while economic growth is relatively more important for poverty reduction in countries with low inequality. In this context, Kenya will need to focus not only on economic growth but also on inequality reduction in order to effectively tackle poverty in the country.

## 2. Literature Review

The relationship between poverty, economic growth, and inequality has been widely explored in recent years. The extent to which the poor gain from economic growth is a major topic in development policy analysis and discussions. Traditionally it was widely believed that gains from rapid economic growth would automatically trickle down to the poor; hence, the main goal of development policy was to increase economic growth. However, recent empirical studies show that while economic growth and poverty reduction work together, the response of poverty to economic growth varies across countries. Consequently, the question of how sensitive poverty is to economic growth has become the subject of extensive research.

The relationship between growth and poverty is complex and depends, to a large extent, on the relationship between growth and inequality (Datt and Ravallion, 1992). If there is a rise in inequality while the economy is growing, this may not only offset the poverty-reducing effects of growth, but may also retard subsequent growth through an increased emphasis on redistribution in favor of non-accumulable factors (Ghosh and Pal, 2004). Thus, understanding the sources or causes of inequality and its relationship to poverty is crucial in formulating appropriate policies to reduce poverty.

Some recent empirical evidence has tended to confirm the negative impact of inequality on growth. [3]Others have found that the level of initial income inequality is not a robust explanatory

[3] For a comprehensive review of literature on Poverty Growth and Inequality (PGI triangle), refer to the study by Bigsten and Levin (2001) which conducts a review of recent literature on this relationship.

factor of growth, although high inequality in the distribution of assets, such as land, has a significantly negative effect on growth (Bigsten and Levin, 2001). The implication of these findings is that economic growth is necessary to but not sufficient for poverty reduction (Wambugu and Munga, 2009). A recurring issue in development discussions is whether the main focus of development strategies should be placed on growth or poverty and/or on inequality. Poverty reduction requires economies to address inequality and economic structures in addition to sustaining high levels of economic growth. In summary, it is widely agreed that the rapid elimination of absolute poverty is a meaningful goal for development and that achieving this goal of rapidly reducing absolute poverty requires strong, country-specific combinations of growth and distribution policies.

Recent studies by Round (2003), Pyatt and Round (2004), Bottiroli and Targetti (2008), and Pansini (2008) have demonstrated the importance of the SAM and multiplier decomposition models in the analysis of income distribution by linking household income to the country's productive structure. This type of model can be used in policies linked poverty reduction and, more specifically, to household income redistribution. SAM decomposition models provide a structure for examining the potential effects of exogenous policies or external shocks on incomes, expenditure, and employment of different household groups in a fixed price setting (Round, 2003).

Studies by Bottiroli (1990), Bottiroli and Targetti (2002), Bottiroli and Targetti (2007), and Jami (2006) used a SAM-based analysis to develop a multiplier simulation model which enables tracking and quantifying the nature and extent of the linkages in the economic growth, income generation, and concomitant poverty and distribution implications of different socio-economic groups. Jami (2006) showed that in Bangladesh, sectoral growth patterns impart differential income impacts on various socio-economic groups. The impact of the growth stimuli that originated from agricultural sectors would be different for different households from growth stimuli originating from the manufacturing sector. Thus, different growth patterns would bear diverse poverty and inequality implications in Bangladesh.

Pansini (2008) looked at income distribution in different households in Vietnam. The paper showed how to assess both direct and indirect effects of an exogenous income injection on mean incomes of different household groups. Using the decomposition of SAM-based multipliers technique, the study highlighted in microscopic detail the linkages between each household endowment in terms of factors and the features of the productive system and shed light on the most powerful links among different components of the economic system affecting the distribution of income. Empirical results using Vietnamese SAM 2000 show that the highest effects are related to injections in agriculture and to the less skilled labor force. This type of multiplier decomposition allows the study to show which production sectors would increase the incomes of low income households, thus presenting a policy option for improving the distribution of income. A similar study by Civardi and Targeti (2008) also successfully applied this methodology to the Italian economy. Results showed that indirect effects were lower than direct effects, implying that the injections in the agricultural and public administration sectors did not generate increased intermediate demand and did not create significant extra income for all the household groups.

Using the Kenya 2003 SAM as our main source of data, we first derive the accounting fixed price multipliers matrix[4]. We then use the decomposition of SAM-based multipliers technique (Pyatt and Round, 2006) to decompose each element of the accounting price multiplier matrix to enlighten in "microscopic detail" the linkages between each household group's income and other accounts whose income has been exogenously injected.

## 3. Methodology

### *3.1 The Kenya 2003 SAM*

A Social Accounting Matrix (SAM) is a logical arrangement of statistical information concerning income flows in a country's economy within a particular time period, usually one year (Huseyin, S. 1996). It links production activities, factors of production, and institutions among other accounts and captures the circular interdependence characteristic of any economic system. Depending on the degree of disaggregation, the SAM can provide a conceptual basis to study the distribution of factor incomes and, consequently, income inequality in a country within a single framework.

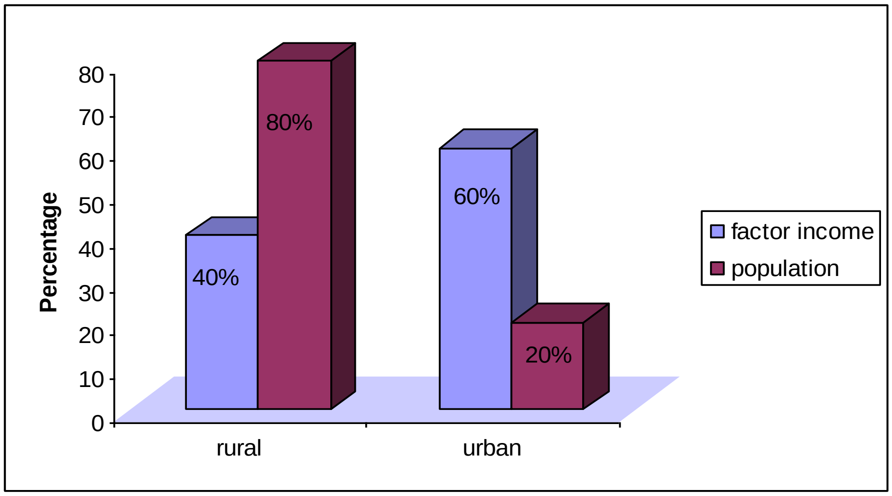
There have only been two major Social Accounting Matrices developed for Kenya since independence (1963). The first SAM was developed in 1976 by Vandermoortele (ILO) and the second was developed in 2003 by KIPPRA and IFPRI. Construction of the Kenya 2003 SAM was necessitated by the lack of an up-to-date tool for analyzing development policies in Kenya, especially at the sectoral level, as well as the need for a highly disaggregated SAM. (Kiringai et al. 2007). There has also been a regional SAM based on the 2003 National SAM, as well as a Vision 2030 SAM based on the 2003 National SAM.

The aggregated Kenya 2003 SAM in Table 3 shows total aggregate demand as 1,878,092 million and value added as 1,010,400 million. Total factor income was Ksh. 1,010,400 million, of which

[4] See equation 3 under methodology for definition of accounting fixed price multipliers matrix.

46% percent went to households. From the disaggregated SAM, the income share of rural households is 39.90 percent, while that of urban households is 60.10 percent.  This shows that rural households have relatively low incomes given that the rural population accounts for about 80 percent of total population in Kenya, while urban areas in Kenya account for only 20 percent of the population[5] as shown in Figure 2.

*Figure 2: Factor Incomes and Population Distribution in Kenya*




Source: United Nations Population Database, 2007; Kenya National SAM, 2003

[5] Source: United Nations population division, World Urbanization Prospects: The 2007 Revision Population Database

*Table 3: Kenya SAM 2003 (KSh. Millions)*

| | **Activities** | **Commodities** | **Factors** | **Enterprises** | **Households** | **Taxes** | **Govt** | **Capital** | **Rest of the World** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activities** | | 1,783,049 | | | 95,043 | | | | | 1,878,092 |
| **Commodities** | 867,692 | 117,117 | | | 772,972 | | 202,913 | 196,723 | 281,387 | 2,438,804 |
| **Factors** | 1,010,400 | | | | | | | | | 1,010,400 |
| **Enterprises** | | | 544,860 | | | | 41,297 | | 4,909 | 591,066 |
| **Households** | | | 461,261 | 335,194 | | | 17,898 | | 91,014 | 905,367 |
| **Taxes** | | 131,756 | | 37,053 | 33,603 | | | | | 202,412 |
| **Govt** | | | 4,279 | 7,332 | 6,298 | 202,412 | | | 5,677 | 225,998 |
| **Savings** | | | | 204,248 | -2,549 | | -36,286 | 17,498 | 31,310 | 214,221 |
| **Rest of the World** | | 406,882 | | 7,239 | | | 176 | | | 414,297 |
| **Total** | 1,878,092 | 2,438,804 | 1,010,400 | 591,066 | 905,367 | 202,412 | 225,998 | 214,221 | 414,297 | |

Source: KIPPRA/IFPRI Kenya SAM, 2003

Though the above SAM is set up in a standard basic framework, the choice of level of disaggregation depends on the objective of the study and on the availability of data. For a SAM to be useful in income distribution analysis, it should give a high level of detail about the circular flow of income, showing transactions between various institutions with production activities; as such, the institutions category (enterprises and households) data needs to be highly disaggregated. The Kenya 2003 micro-SAM is highly disaggregated; it is divided into six standard accounts: production account (activities and commodities), factors of production (labor, land, and capital), institutions (enterprises and households), government (a government account and taxes), capital account (savings/investment), and the rest of the world account.

Household income data is highly disaggregated in the Kenya 2003 micro-SAM. The household income data is first divided into two broad categories using location (rural and urban); from each location, the household income data is then arranged in an ascending order, where the total population (in each region) is divided into 10 equal groups or deciles. The top decile represents 10 percent of the population households with the highest income and the bottom decile represents the 10 percent of the population households with the lowest income. For more detailed explanation of the 2003 National SAM, refer to the study by Kiringai et al (2007).

### *3.2 The Model*

The SAM is a conceptual representation of statistical data; it does not constitute a model. Thus, the SAM must be transformed into an economic model which can be used to simulate the effects of shock/injections from the exogenous variables to the endogenous variables and analyze how the effects are transmitted through the interdependent SAM system. “The total direct and indirect effects of the injection on the endogenous accounts, i.e. the total outputs of the different production activities and the incomes of the various factors and socioeconomic groups are estimated through the multiplier process” (Thorbecke, 2000). To transform the SAM to an economic model, we make a few assumptions: that all the relations are linear, that prices are fixed, and that excess capacity and unemployed or underemployed labor resources exist. As long as excess capacity and a labor slack prevail, any exogenous change in demand can be satisfied through a corresponding increase in output without having any effects on prices (Pansini, 2008).

In developing a multiplier model using the SAM, each account should be designated as endogenous or exogenous. By design/convention, accounts beyond the control of domestic institutions are made exogenous; in this case, government (including taxes), savings/investment, and rest of the world accounts will be classified as exogenous. The endogenous accounts are therefore limited to production, factors, and institutions (households and enterprises). Defining the endogenous accounts in this way helps to focus on the interaction between two accounts - production and households - interacting through factors of production.

*Figure 3: Circular flow of income in the endogenous accounts*

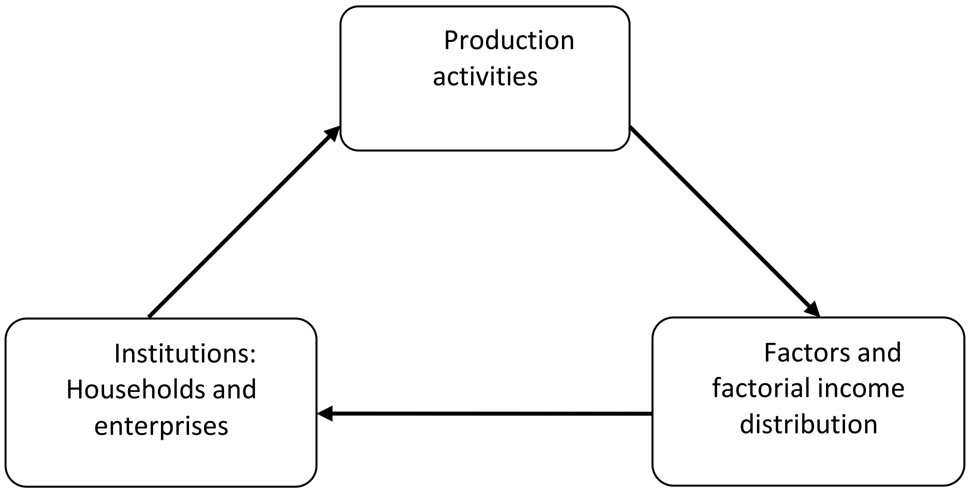



Figure 3 shows a simplified relationship among the endogenous accounts. Value-added generated by various production activities is allocated as income accruing to the factors of production. Factorial income is distributed to institutions including households and enterprises. Various institutions in turn spend their income on different commodities generated by the production activities.

Table 4 shows endogenous and exogenous accounts in the SAM as shown by Pansini (2008).

*Table 4: Schematic Representation of Endogenous and Exogenous Accounts in a SAM*

| | | | **Expenditures** | | | | **Total Receipts** |
|---|---|---|---|---|---|---|---|
| | | | **Endogenous accounts** | | | **Exogenous accounts** | |
| | | | **Activities** | **Factors** | **Private institutions** | **Sum of other accounts** | |
| **Receipts** | **Endogenous accounts** | **Activities** | T11 | | T13 | X1 | Y1 |
| | | **Factors** | T21 | | | X2 | Y2 |
| | | **Private institutions** | | T32 | T33 | X3 | Y3 |
| | **Exogenous accounts** | **Sum of other accounts** | L1 | L2 | L3 | LX | Y4 |
| | | **Total Expenditures** | Y1 | Y2 | Y3 | Y4 | |

Source: Pansini, 2008

For analytical purposes, the matrix of endogenous transactions is represented in summary form by the matrix T (see table above) and can be used to define a matrix $A_n$ of column shares by dividing elements in each column of T by its column total (y) (Round, 2003).

$$T = A_n \cdot y \tag{1}$$

where $\mathbf{A_n}$ (given by **T/y)** is defined as the matrix of average expenditure propensities, **x** is a column vector which represents the exogenous injections, and **y** is the total of each endogenous account which shows total demand for products. Using these notations, the general model is given as:

$$y = A_n \cdot y + x = (I - A_n)^{-1} \cdot x \tag{2}$$

$$y = Ma \cdot x \tag{3}$$

Ma is the "*global multiplier matrix*" or the "*accounting fixed price multipliers matrix*". The multiplier matrix **Ma** allows for relating exogenous injections of income to the endogenous accounts. From the above equation, **y** is derived by multiplying the vector of exogenous injections with the multiplier matrix, which gives the overall effect of a change in any of the exogenous components. The global multiplier matrix shows the overall effects resulting from direct transfer, indirect transfer, and closed loop processes generated by a change in the exogenous variables.

### *3.3 Multiplier Decomposition*

We use the Pyatt and Round (2006) multiplicative decomposition method which decomposes each element of the total multiplier matrix to show in microscopic detail the relative contribution of the forces operating behind the multiplier. This type of decomposition allows the SAM to be used for policy analysis at the household level.

According to Round (2003), the SAM multiplier analysis can give us some indication of the possible resultant effects of an exogenous shock on factoral and institutional distributions of income, as well as on the structure of output; however, to create more transparency, and in particular to examine the nature of linkages in the economy that leads to these outcomes, it is possible to decompose the SAM multipliers further.

The global multiplier matrix **Ma** can be decomposed into three multiplicative components (see box 1):

$$Ma = M_3 M_2 M_1 \quad (4)$$

$\mathbf{M_1}$ is referred to as the "transfer multiplier"; it represents the within-group effects, i.e. the multiplier effects an exogenous injection into one set of accounts will have on the same set of accounts. $\mathbf{M_2}$ is referred to as the open-loop multiplier; it captures the cross/spillover effects, where effects of an exogenous injection into one endogenous account are transmitted to other endogenous accounts. $\mathbf{M_3}$ is referred to as the closed loop multiplier; it shows the multiplier effects due to the full circular flow from exogenous accounts to endogenous accounts. "It represents the consequences of a change in **x** traveling around the entire system to reinforce the initial injection" (Pyatt and Round, 2006: as sited by Pansini, 2008).

From equation 3 and 4, we can write **y** as:

$$y = (M_3 M_2 M_1) \cdot x \quad (5)$$

where; $M_1$ $M_2$ and $M_3$ are all multiplier matrices.

**Box 1: Multiplicative Decomposition**

This decomposition technique is adopted from Pyatt and Round (1979). For more detailed description of this method, refer to Pyatt and Round (1979) as well as Pansini (2008). The global multiplier matrix **Ma** can be decomposed into three multiplicative components:

$$\mathbf{Ma = M_3\ M_2\ M_1}$$

To derive $\mathbf{M_3, M_2,}$ **and** $\mathbf{M_1,}$ we first define An and Ao and A* as shown below**:**

**An =** Average propensities

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

**Ao =** Diagonal matrices of An

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

$$\mathbf{M_1 = (I - Ao)^{-1}} = \begin{vmatrix} {}_1M_{11} & 0 & 0 \\ 0 & I & 0 \\ 0 & 0 & {}_1M_{33} \end{vmatrix}$$

$$\mathbf{A^* = (I - Ao)^{-1}\ (An - Ao)}$$

$$\mathbf{M_2 = I + A^* + A^{*2} + A^{*3}} = \begin{vmatrix} I & {}_2M_{12} & {}_2M_{13} \\ {}_2M_{21} & I & {}_2M_{23} \\ {}_2M_{31} & {}_2M_{32} & I \end{vmatrix}$$

$$\mathbf{M_3 = (I - A^{*3})^{-1}} = \begin{vmatrix} {}_3M_{11} & 0 & 0 \\ 0 & {}_3M_{22} & 0 \\ 0 & 0 & {}_3M_{33} \end{vmatrix}$$

Hence, Ma= $\mathbf{[1 - A^{*3}]^{-1}\ (I + A^* + A^{*2} + A^{*3})\ (I - A_0)^{-1}}$

As in Pansini (2008), when we focus on personal/household income distribution, the equation of interest is the equation on private institutions incomes (**y3**):

$$y_3 = (M_{33}\, M_{32}\, M_{31})\, x \quad (6)$$

$$y_3 = M_{31}x_1\, M_{32}x_2\, M_{33}x_3 \quad (7)$$

where:

$$M_{31} = {}_3M_{33}\ {}_2M_{31}\ {}_1M_{11} \quad (8)$$

$$M_{32} = {}_3M_{33}\ {}_2M_{32} \quad (9)$$

$$M_{33} = {}_3M_{33}\ {}_1M_{33} \quad (10)$$

Equation 6 indicates that the sub-matrices of interest are represented respectively by $\mathbf{M_{33}}$**,** $\mathbf{M_{32}}$**,** and $\mathbf{M_{31}}$, describing the multiplier affects on the household income. We then use the **"rAs"** technique by Pyatt and Round (2006) to further decompose each element of the multiplier matrix. This technique allows us to assess the linkages between the different SAM accounts; it sheds light on the most powerful linkages among different components of the economic system affecting the distribution of income.

If $m_{i,j}$ is the (i,j) element of the matrix Ma, we can write it as:

$$m_{i,j} = d'_i M a d_j$$

Substituting equation 4, we get:

$$d'_i M_3 M_2 M_1 d_j = i'(\hat{r} A \hat{s})i$$

where $\mathbf{d'}_i$ and $\mathbf{d}_j$ are vectors in, which respectively, the ith element and the jth element are equal to one and all others are equal to zero (Pyatt and Round ,2006; Pansini, 2008; Civardi and Targetti, 2008). In vector **i,** all elements are equal to one (Pyatt and Round, 2006; Pansini, 2008). Matrix A and vectors **r** and **s** are defined as follows:

$$r' = d_i M_3\,; \qquad A = M_2 \qquad \hat{s} = M_1 d_j$$

It follows that each $\mathbf{m_{i,j}}$ must therefore be equal to the sum of all elements of an **rˆ A ˆs** 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 and Round, 2006).

The matrix **ŝ** shows how the consequences of a particular injection into the account j "will be amplified as a result of transfer effects within the category of accounts in which the initial stimulus arises" and the matrix $A = M_2$ explains how these initial effects will spread to accounts belonging to other categories, that is, the so called open loop effect (Pyatt and Round, 2006). Finally, **r^** "quantifies the consequences for account i of the circulation around the entire system of the stimuli generated via the first two mechanisms"; all three mechanisms are important for diagnostic reasons since they allow us to account for $\mathbf{m_{ij}}$ in microscopic detail (Pyatt and Round, 2006).

This decomposition technique allows us to identify four different effects in which the single accounting multiplier $\mathbf{m_{ij}}$ can be divided: direct-direct effect, indirect-direct effect, direct-indirect effect, and indirect-indirect effect (Pansini, 2008).

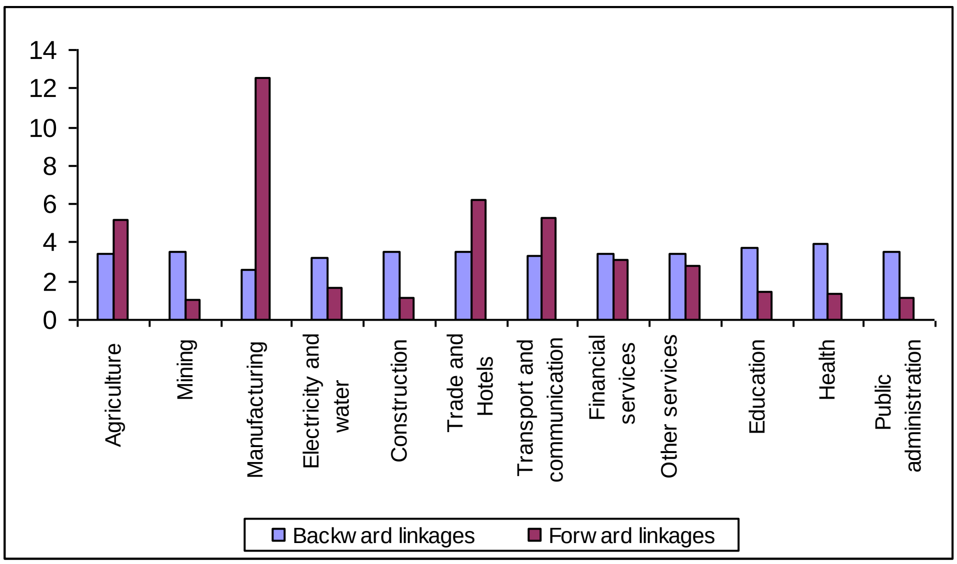
1. **Direct-direct effect** is the direct effect of an injection in the $j_{th}$ account of production activity on the $i_{th}$ household group without considering any other indirect effect on other activity sectors or household groups.
2. **Indirect-direct effect** is the effect from other production sectors, different from the one affected by the exogenous injection, on the $i_{th}$ household group. It captures the effect that an increase in the demand for $j_{th}$ sector has on other sectors and from those ones to the $i_{th}$ household group.
3. **Direct-indirect effect** is the effect from the $j_{th}$ account of production affected by the exogenous injection on other household groups different from the $i_{th}$. It captures the effect that an increase in the demand for $j_{th}$ sector has on the income of other household groups and from those ones to the $i_{th}$ household group.
4. **Indirect-indirect effect** is the effect from other accounts of production different from the one affected by the exogenous injection on the other household groups different from the $i_{th}$. It captures the effect that an increase in the demand of production of the $j_{th}$ sector has on other sectors and from those ones to other household groups.

## 4. Analysis of Results

### *4.1 Sectoral Linkages*

In this section, we use the Ma matrix derived in Section 3 to conduct a multiplier analysis and look at sectoral linkages in the Kenya 2003 SAM. The production activity sub-matrix shows that any injection into one production activity has different effects for the other activity incomes due to the activation of the demand of intermediate goods. The diagonal elements of the production matrix in the Ma matrix show how much a production sector is internally integrated. The diagonal elements of this matrix are all greater than one, indicating that a unit injection in the i$^{th}$ sector due to an exogenous injection has an effect on the income of the same sector higher than one due to the multiplicative process of the circulation of income through the economic system. These diagonal elements provide a relative measure of how much a production sector is internally integrated (Pansini, 2008). The column totals give the backward linkages while the row totals give the forward linkages. Identifying the key industry linkages emphasizes the role that each sector plays in the development of the domestic economy and, therefore, informs domestic policy for economic development (Wanjala and Kiringai, 2007). Figure 4 gives a summary of these linkages.

*Figure 4: Forward and backward linkages*




Source: Authors' computation from Kenya SAM, 2003

From Figure 4 we can conclude that the manufacturing sector does not rely heavily on output from other sectors (lowest rank in backward linkages) but other sectors rely heavily on its output (highest forward linkage). The opposite applies for mining and quarrying - i.e., these rely heavily on other sector outputs but other sectors do not rely heavily on their output (lowest forward linkage).

### *4.2 Simulations using the Kenya 2003 micro SAM*

Since the Ma matrix reflects the total effects, it does not show the income distributional mechanisms in the economy. Growth in different production sectors will ultimately lead to growth in household incomes; our objective is to show how these incomes are distributed to the various household groups. Looking at results from some simulation exercises performed using the multiplier model explained in the previous section, we focus on the household section of the global multiplier matrix, namely $M_{31}$, $M_{32,}$ and $M_{33}$ as shown in Table 5.

*Table 5: Summary of $M_{31}$, $M_{32,}$ and $M_{33}$*

| | $M_{31}$ | $M_{32}$ | $M_{33}$ |
|---|---|---|---|
| **$h_{10}$** | 0.1742 | 0.2533 | 1.2802 |
| **$h_{19}$** | 1.0795 | 2.3721 | 2.6326 |
| **$h_{21}$** | 0.0063 | 0.0163 | 1.0079 |
| **$h_{29}$** | 6.0556 | 8.7579 | 8.1934 |
| **Rural Average** | 0.5526 | 1.1234 | 1.8868 |
| **Urban Average** | 0.9698 | 1.4445 | 2.1731 |
| **Total Average** | 0.7497 | 1.2754 | 2.0224 |

Source: Authors' computation from Kenya SAM, 2003

$H_{10}$ represents the poorest rural household decile, $h_{19}$ represents the richest rural household decile, $H_{21}$ represents the poorest urban household decile[6], and $h_{29}$ represents the richest urban household decile.

**Household Incomes ($M_{31}$) -** This matrix shows the income effects on household incomes as a result of a unit injection into the production system in the SAM. The incomes of rural households increase by a multiplier of 0.5526 on average, while those of urban households increase by a multiplier of 0.9698. Agriculture produces higher effects across all households compared to manufacturing, which produces the least multipliers for households.

**Factor Incomes ($M_{32}$) -** This matrix measures the impact on household incomes from an exogenous injection directed to the factor account. With a unit injection into the factors of production, rural households' incomes increase by a multiplier of 1.1234 on average, while those of urban households increase by a multiplier of 1.4445.

**Redistribution of factor incomes among households ($M_{33}$) -** This matrix shows the effects on household income from an exogenous injection into the income of household groups. Diagonal elements are all greater than one, indicating that a unit injection in the income of a household group results in an increase greater than one of the income of the same household group due to the multiplicative effect of the circulation of the income through the system. On average, rural households' incomes increase by a multiplier of 1.8869 and those of urban households by a multiplier of 2.1731.

[6] Data for $h_{20}$ is not given in the Kenya 2003 micro-SAM and it is assumed to be insignificant for the purposes of this study.

### *4.3 Multiplier Decomposition and Household Income*

In this section, we show the results from the multiplier decomposition of the global accounting multipliers. The results show the structural components of the global multipliers, which shows the capacity of an activity to stimulate household incomes either directly and/or indirectly. The choice of agriculture is due to its income-generating capacity for households, while manufacturing was chosen due to the fact that other sectors rely very heavily on its output (highest forward linkages).

Disentangling the effects of injections into the productive system on different households allows for complete accounting of a global multiplier and shows that stimulating an activity stimulates other activities whose effects will be transmitted to other households with varying degrees of effects. Such decomposition will show the direct effect of an injection in the respective account of the productive sector on the household without considering any other effects activated in the other sectors or households. Table 6 shows the results of the decomposition (based on the $\hat{r}A\hat{s}$ type of transformation).

*Table 6: Multiplier Decomposition: Agriculture on the Poorest Rural Household ($H_{10}$)*

| **Column J (injection)** | **Row I (effect of injection)** | **Household groups** | **Direct-Direct Effects** | **Indirect-Direct Effects** | **Total Effects from Injection in J** | **Direct-Indirect Effects** | **Indirect-Indirect Effects** | **Total Effects on Households** | **Total Multiplier** |
|---|---|---|---|---|---|---|---|---|---|
| **agric** | h10 | h10 | 0.011006 | 0.00106785 | 0.012073 | 0.001068 | 0.007099312 | 0.008167 | 0.0202405 |
| **agric** | h10 | h11 | 0.000291 | 2.27144E-05 | 0.000314 | 0.011782 | 0.008144448 | 0.019927 | 0.0202405 |
| **agric** | h10 | h12 | 0.000358 | 2.74126E-05 | 0.000385 | 0.011715 | 0.00813975 | 0.019855 | 0.0202405 |
| **agric** | h10 | h13 | 0.000478 | 3.6541E-05 | 0.000514 | 0.011596 | 0.008130616 | 0.019726 | 0.0202405 |
| **agric** | h10 | h14 | 0.000531 | 4.20109E-05 | .000573 | 0.011543 | 0.008125151 | 0.019668 | 0.0202405 |
| **agric** | h10 | h15 | 0.000629 | 4.33892E-05 | 0.000672 | 0.011444 | 0.008123773 | 0.019568 | 0.0202405 |
| **agric** | h10 | h16 | 0.000722 | 5.01909E-05 | 0.000772 | 0.011352 | 0.008116871 | 0.019469 | 0.0202405 |
| **agric** | h10 | h17 | 0.000714 | 4.97363E-05 | 0.000764 | 0.011359 | 0.008117426 | 0.019477 | 0.0202405 |
| **agric** | h10 | h18 | 0.000724 | 5.06503E-05 | 0.000775 | 0.011349 | 0.008116512 | 0.019466 | 0.0202405 |
| **agric** | h10 | h19 | 0.000876 | 7.04062E-05 | 0.000947 | 0.011197 | 0.008096756 | 0.019294 | 0.0202405 |
| **agric** | h10 | h21 | 1.29E-06 | 5.92382E-07 | 1.88E-06 | 0.012072 | 0.00816657 | 0.020239 | 0.0202405 |
| **agric** | h10 | h22 | 4.79E-06 | 1.35071E-06 | 6.14E-06 | 0.012069 | 0.008165812 | 0.020234 | 0.0202405 |
| **agric** | h10 | h23 | 1.05E-05 | 2.79464E-06 | 1.33E-05 | 0.012063 | 0.008164368 | 0.020227 | 0.0202405 |
| **agric** | h10 | h24 | 1.55E-05 | 5.6266E-06 | 2.12E-05 | 0.012058 | 0.008161536 | 0.020219 | 0.0202405 |
| **agric** | h10 | h25 | 2.27E-05 | 9.89063E-06 | 3.25E-05 | 0.012051 | 0.008157272 | 0.020208 | 0.0202405 |
| **agric** | h10 | h26 | 4.29E-05 | 1.83719E-05 | 6.13E-05 | 0.01203 | 0.00814879 | 0.020179 | 0.0202405 |
| **agric** | h10 | h27 | 0.000248 | 7.35702E-05 | 0.000322 | 0.011825 | 0.008093592 | 0.019919 | 0.0202405 |
| **agric** | h10 | h28 | 0.000255 | 0.000105892 | 0.00036 | 0.011819 | 0.008061271 | 0.01988 | 0.0202405 |
| **agric** | h10 | h29 | 0,001183 | 0.000449948 | 0.001633 | 0.010891 | 0.007717214 | 0.018608 | 0.0202405 |

Source: Authors' Computation from Kenya SAM, 2003

The corresponding element of total multiplier ($m_{ij}$) for a unit injection in agriculture on $h_{10}$ is 0.0202405, which is further decomposed in Table 6. The results show the four different effects as explained in the methodology (direct-direct, indirect-direct, direct-indirect, and indirect-indirect).

By decomposing each element of the multiplier matrix, we show the relative contribution of the forces operating behind the multiplier. This allows us to distinguish the most powerful link in an economic system that affects households' income. The summary of these decomposition results are given in Table 7. This table shows the effect of an injection in agriculture and manufacturing on selected household deciles. For example, we calculate the total direct effect of an exogenous injection in agriculture from the total multiplier on the poorest rural household as: (0.012073/0.0202405)*100= 59.6 percent. The other tables on agriculture are given in the appendix and tables on manufacturing can be provided upon request.

*Table 7: Direct Effects from the Decomposition of Global Multipliers (percentage)*

| | Agriculture | | | | Manufacturing | | | |
|---|---|---|---|---|---|---|---|---|
| | $h_{10}$ | $h_{19}$ | $h_{21}$ | $h_{29}$ | $h_{10}$ | $h_{19}$ | $h_{21}$ | $h_{29}$ |
| **$h_{10}$** | 59.6 | 0.9 | 1.1 | 1.1 | 53 | 0.9 | 0.6 | 0.6 |
| **$h_{11}$** | 1.6 | 1.6 | 1.9 | 1.9 | 1.2 | 1.3 | 0.9 | 0.9 |
| **$h_{12}$** | 1.9 | 1.9 | 2.3 | 2.3 | 1.4 | 1.6 | 1 | 1.1 |
| **$h_{13}$** | 2.5 | 2.5 | 3.1 | 3.2 | 1.9 | 2.1 | 1.4 | 1.5 |
| **$h_{14}$** | 2.8 | 2.9 | 3.4 | 3.5 | 2.2 | 2.4 | 1.5 | 1.6 |
| **$h_{15}$** | 3.3 | 3.3 | 4.3 | 4.3 | 2.3 | 2.5 | 1.8 | 1.8 |
| **$h_{16}$** | 3.8 | 3.8 | 4.8 | 4.8 | 2.7 | 2.9 | 2 | 2.1 |
| **$h_{17}$** | 3.8 | 3.8 | 4.8 | 4.8 | 2.7 | 2.9 | 2 | 2.1 |
| **$h_{18}$** | 3.8 | 3.8 | 5.1 | 5.1 | 2.7 | 2.9 | 2.1 | 2.2 |
| **$h_{19}$** | 4.7 | 63.7 | 6.8 | 7.4 | 3.6 | 52.7 | 3 | 3.5 |
| **$h_{21}$** | 0 | 0 | 40.7 | 0 | 0 | 0 | 56.2 | 0 |
| **$h_{22}$** | 0 | 0 | 0 | 0 | 0.1 | 0.1 | 0 | 0 |
| **$h_{23}$** | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| **$h_{24}$** | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| **$h_{25}$** | 0.2 | 0.2 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 |
| **$h_{26}$** | 0.3 | 0.3 | 0.5 | 0.5 | 0.7 | 0.7 | 0.7 | 0.7 |
| **$h_{27}$** | 1.6 | 1.5 | 2.8 | 2.7 | 3 | 3.1 | 3.1 | 3 |
| **$h_{28}$** | 1.8 | 1.7 | 3.1 | 3 | 4.1 | 4.3 | 4.3 | 4.3 |
| **$h_{29}$** | 8.1 | 7.9 | 14.6 | 54.9 | 17.7 | 18.9 | 18.7 | 73.8 |

Source: Authors' Computation from Kenya SAM, 2003

The direct effect from an exogenous injection in agriculture on $h_{10}$ represents 59.6 percent of the total effect on households, compared to manufacturing with a direct effect of 53 percent on the same households. For $h_{19}$, the direct effects from agriculture and manufacturing are 63.7 percent and 52.7 percent, respectively. For urban households, the direct effects from agriculture on $h_{21}$ and $h_{29}$ are 40.7 percent and 54.9 percent, respectively, while the direct effect from manufacturing on urban household deciles is 56.2 percent and 73.8 percent, respectively.

We note that the direct effects from agriculture on rural households are higher than direct effects on urban households. However, $h_{29}$ receive higher direct effects from agriculture than $h_{21}$. The opposite is true for direct effects from manufacturing, where urban households receive higher direct effects from the sector than rural households. The $h_{29}$ household expenditure decile (the richest urban household decile) has very high direct effects compared to the other household deciles. These results point to the inequality in the ownership of factors of production and are later translated to inequalities in the distribution of household income.

Higher indirect effects of agriculture on the urban poor are an indication that the link between agriculture and the urban poor is not strong. Stimulating the agricultural sector generates intermediate demand for agricultural outputs, which generates extra income for the other household deciles and in turn generate income for the urban poor. The study by Pyatt and Round (2006) also finds similar results in which the indirect effects from food processing to small-scale farm households in Indonesia were higher than the direct effects. The direct–indirect effects (calculated in Table 7) of agriculture are highest for the urban poor (50.8 percent) compared to the rural poor (5.3 percent), rural rich (31.4 percent), and urban rich (40.6 percent). This leads us to conclude that for the urban poor, incomes are activated through the activation of incomes from other households and not directly from agriculture.

In other studies, direct effects on households from selected productive sectors have been found to be higher than indirect effects (Civardi and Targetti, 2008; Pansini, 2008). This study also finds similar results in which direct effects are higher save for the effects from agriculture on $h_{21}$.

We can therefore conclude that agriculture has the most powerful link to the incomes of low rural household deciles compared to the manufacturing sector, which has stronger linkages on the incomes of high income deciles by a much higher margin than agriculture. Earlier studies have shown that most of Kenya's rural households engage in agricultural activities, while the urban poor are mainly engaged in informal sector activities (Wambugu and Munga, 2009). This points to why the current study finds no powerful linkages between the agricultural sector and the urban poor. The manufacturing sector in Kenya is capital intensive and mainly relies on imported inputs; as such, the sector does not have strong domestic linkages (Wanjala and Kiringai, 2007). This contributes to the sector having low backward linkages and the least impact on household incomes. Consequently, growth strategies in this sector are bound to have minimal effect on poor household incomes.

The foregoing analysis gives insight into the existence of inequality in income distribution from a SAM perspective. The empirical results from our multiplier analyses show that due to high inequality in Kenya, stimulation of growth in the productive sector mainly benefits the richest urban household decile who own most of the factors of production.

## 5. Conclusion

From our sector analysis, we saw that the manufacturing sector does not rely heavily on other sectors but other sectors rely heavily on its output. From our analysis, the manufacturing sector generates the least income for households implying that agriculture is a more important sector for household income generation.

The decomposition methodology has shown different results for different households. Direct effects of an exogenous injection in agriculture on rural households were higher than for urban households. Among rural households, the rural rich received higher direct effects than the rural poor. Likewise, the urban rich received higher direct effects than the urban poor. On the other hand, direct effects from manufacturing on urban deciles were higher than on rural deciles. This means that the link between agriculture and rural households is higher than the link between agriculture and urban households; this link is weakest between agriculture and the urban poor. From a policy perspective, activating the agricultural sector is not the most important factor for the urban poor; this group derives more benefits from the activation of other sectors. These other sectors are activated from increased demand following an exogenous injection in agriculture.

On the other hand, the direct effects from manufacturing were highest for the urban rich (73.8 percent), an indication that these households own the majority of the factors of production (labor and capital) in the manufacturing sector. This is much higher than the direct effects of manufacturing on the other households, at 53 percent for the rural poor, 52.7 percent for the rural rich, and 56.2 percent for the urban poor. The differences in the direct effects point to the level of income inequalities among households that stem from the ownership of the factors of production.

Benefits from injections vary according to households. The highest urban expenditure decile benefits more than any other household group. When we target the agricultural sector, the highest income accrues to the highest urban expenditure decile. If the government wants to reduce poverty among the urban poor by targeting the poorest urban household decile using the manufacturing sector, only 56.2 percent of the initial injection would accrue to this household group. About 18.9 percent of this injection would accrue to the richest urban household decile, while the other urban household deciles receive a total of only 8.8 percent of the initial injection, hence widening the income inequality gap. For effective development, the government should ensure that policy measures to stimulate economic growth and reduce poverty are developed together with policies to reduce inequality.

The current strategies under the Kenyan government's Vision 2030 program are intended to ensure a society that guarantees equality in access to public services and income-generating activities. These strategies include increasing the volume of specific "devolved funds" allocated to local communities, increasing school enrolment for girls and children from nomadic communities and poor rural and slum communities, widening coverage of "essential health care", ensuring equitable distribution of water, sewerage, and sanitation services, improving in public transport, and attaining gender parity and fairness in the delivery of justice.

In this study, we assumed that all the relations are linear, prices are fixed, and excess capacity and unemployed or underemployed labor resources exist. This allows for the analysis of income effects on households, but not price effects. It is assumed that poor urban households benefit mostly from price effects, which contribute to increases in purchasing power. We propose to carry out an extension of this study using a Computable General Equilibrium (CGE) model. In the CGE approach, prices will be made endogenous, which will allow for the analysis of price effects.

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## Appendix

(NB: other tables can be obtained upon request from the authors)

*Multiplier Decomposition: Agriculture and Highest Rural Income Decile Household ($h_{19}$)*

| column j (injection) | row I (effect of injection to | Household groups | direct-direct effects | indirect-direct effects | **total effects from injection in j** | direct-indirect effects | indirect-indirect effects | **total effect on households** | **total multiplier** |
|---|---|---|---|---|---|---|---|---|---|
| agric | h19 | h10 | 0.000973 | 9.44524E-05 | **0.001068** | 0.105754 | 0.011289942 | **0.117044** | **0.1181123** |
| agric | h19 | h11 | 0.001702 | 0.000132697 | **0.001834** | 0.105026 | 0.011251697 | **0.116278** | **0.1181123** |
| agric | h19 | h12 | 0.002085 | 0.000159657 | **0.002245** | 0.104643 | 0.011224737 | **0.115867** | **0.1181123** |
| agric | h19 | h13 | 0.002782 | 0.000212812 | **0.002994** | 0.103946 | 0.011171583 | **0.115118** | **0.1181123** |
| agric | h19 | h14 | 0.003133 | 0.000248102 | **0.003381** | 0.103595 | 0.011136293 | **0.114731** | **0.1181123** |
| agric | h19 | h15 | 0.003684 | 0.00025409 | **0.003938** | 0.103044 | 0.011130304 | **0.114174** | **0.1181123** |
| agric | h19 | h16 | 0.004199 | 0.000292123 | **0.004491** | 0.102529 | 0.011092272 | **0.113621** | **0.1181123** |
| agric | h19 | h17 | 0.004158 | 0.000289614 | **0.004447** | 0.10257 | 0.01109478 | **0.113665** | **0.1181123** |
| agric | h19 | h18 | 0.004205 | 0.000294111 | **0.0045** | 0.102522 | 0.011090283 | **0.113613** | **0.1181123** |
| agric | h19 | h19 | 0.069628 | 0.00559401 | **0.075222** | 0.0371 | 0.005790385 | **0.042891** | **0.1181123** |
| agric | h19 | h21 | 7.19E-06 | 3.31204E-06 | **1.05E-05** | 0.106721 | 0.011381082 | **0.118102** | **0.1181123** |
| agric | h19 | h22 | 2.71E-05 | 7.62611E-06 | **3.47E-05** | 0.106701 | 0.011376768 | **0.118078** | **0.1181123** |
| agric | h19 | h23 | 5.96E-05 | 1.58324E-05 | **7.54E-05** | 0.106668 | 0.011368562 | **0.118037** | **0.1181123** |
| agric | h19 | h24 | 8.99E-05 | 3.25252E-05 | **0.000122** | 0.106638 | 0.011351869 | **0.11799** | **0.1181123** |
| agric | h19 | h25 | 0.000125 | 5.4519E-05 | **0.000179** | 0.106603 | 0.011329875 | **0.117933** | **0.1181123** |
| agric | h19 | h26 | 0.000239 | 0.000102199 | **0.000341** | 0.106489 | 0.011282196 | **0.117771** | **0.1181123** |
| agric | h19 | h27 | 0.001404 | 0.000415917 | **0.00182** | 0.105324 | 0.010968477 | **0.116293** | **0.1181123** |
| agric | h19 | h28 | 0.001431 | 0.000595199 | **0.002026** | 0.105297 | 0.010789196 | **0.116086** | **0.1181123** |
| agric | h19 | h29 | 0.006797 | 0.002585598 | **0.009383** | 0.099931 | 0.008798796 | **0.108729** | **0.1181123** |

*Multiplier Decomposition: Agriculture and Lowest Urban Income Decile Household ($h_{21}$)*

| column j (injection) | row I (effect of injection to | Household groups | direct-direct effects | indirect-direct effects | **total effects from injection in j** | direct-indirect effects | indirect-indirect effects | **total effect on households** | **total multiplier** |
|---|---|---|---|---|---|---|---|---|---|
| agric | h21 | h10 | 0.000004 | 0.000000 | **0.000004** | 0.000322 | 0.000088 | **0.000410** | **0.000414** |
| agric | h21 | h11 | 0.000007 | 0.000001 | **0.000008** | 0.000318 | 0.000088 | **0.000406** | **0.000414** |
| agric | h21 | h12 | 0.000009 | 0.000001 | **0.000010** | 0.000317 | 0.000088 | **0.000404** | **0.000414** |
| agric | h21 | h13 | 0.000012 | 0.000001 | **0.000013** | 0.000314 | 0.000087 | **0.000401** | **0.000414** |
| agric | h21 | h14 | 0.000013 | 0.000001 | **0.000014** | 0.000313 | 0.000087 | **0.000400** | **0.000414** |
| agric | h21 | h15 | 0.000017 | 0.000001 | **0.000018** | 0.000309 | 0.000087 | **0.000396** | **0.000414** |
| agric | h21 | h16 | 0.000019 | 0.000001 | **0.000020** | 0.000307 | 0.000087 | **0.000394** | **0.000414** |
| agric | h21 | h17 | 0.000019 | 0.000001 | **0.000020** | 0.000307 | 0.000087 | **0.000394** | **0.000414** |
| agric | h21 | h18 | 0.000020 | 0.000001 | **0.000021** | 0.000306 | 0.000087 | **0.000393** | **0.000414** |
| agric | h21 | h19 | 0.000026 | 0.000002 | **0.000028** | 0.000300 | 0.000086 | **0.000386** | **0.000414** |
| agric | h21 | h21 | 0.000115 | 0.000053 | **0.000168** | 0.000210 | 0.000035 | **0.000246** | **0.000414** |
| agric | h21 | h22 | 0.000000 | 0.000000 | **0.000000** | 0.000326 | 0.000088 | **0.000414** | **0.000414** |
| agric | h21 | h23 | 0.000000 | 0.000000 | **0.000000** | 0.000325 | 0.000088 | **0.000414** | **0.000414** |
| agric | h21 | h24 | 0.000001 | 0.000000 | **0.000001** | 0.000325 | 0.000088 | **0.000413** | **0.000414** |
| agric | h21 | h25 | 0.000001 | 0.000000 | **0.000001** | 0.000325 | 0.000088 | **0.000413** | **0.000414** |
| agric | h21 | h26 | 0.000002 | 0.000001 | **0.000002** | 0.000324 | 0.000088 | **0.000412** | **0.000414** |
| agric | h21 | h27 | 0.000009 | 0.000003 | **0.000012** | 0.000317 | 0.000086 | **0.000402** | **0.000414** |
| agric | h21 | h28 | 0.000009 | 0.000004 | **0.000013** | 0.000317 | 0.000085 | **0.000401** | **0.000414** |
| agric | h21 | h29 | 0.000044 | 0.000017 | **0.000060** | 0.000282 | 0.000072 | **0.000354** | **0.000414** |

*Multiplier Decomposition: Agriculture and Highest Urban Income Decile Household ($h_{29}$)*

| column j (injection) | row I (effect of injection to | Household groups | direct-direct effects | indirect-direct effects | **total effects from injection in j** | direct-indirect effects | indirect-indirect effects | **total effect on households** | **total multiplier** |
|---|---|---|---|---|---|---|---|---|---|
| agric | h29 | h10 | 0.003632 | 0.000352393 | **0.003984** | 0.297729 | 0.073127891 | **0.370857** | **0.3748414** |
| agric | h29 | h11 | 0.006629 | 0.000516955 | **0.007146** | 0.294732 | 0.072963328 | **0.367696** | **0.3748414** |
| agric | h29 | h12 | 0.008092 | 0.000619601 | **0.008712** | 0.293269 | 0.072860683 | **0.36613** | **0.3748414** |
| agric | h29 | h13 | 0.011034 | 0.000844186 | **0.011878** | 0.290327 | 0.072636098 | **0.362963** | **0.3748414** |
| agric | h29 | h14 | 0.012038 | 0.00095328 | **0.012991** | 0.289323 | 0.072527004 | **0.36185** | **0.3748414** |
| agric | h29 | h15 | 0.014914 | 0.001028581 | **0.015942** | 0.286447 | 0.072451703 | **0.358899** | **0.3748414** |
| agric | h29 | h16 | 0.01669 | 0.001161028 | **0.017851** | 0.284671 | 0.072319255 | **0.35699** | **0.3748414** |
| agric | h29 | h17 | 0.016821 | 0.001171751 | **0.017993** | 0.28454 | 0.072308533 | **0.356848** | **0.3748414** |
| agric | h29 | h18 | 0.017974 | 0.001257022 | **0.019231** | 0.283387 | 0.072223261 | **0.355611** | **0.3748414** |
| agric | h29 | h19 | 0.025774 | 0.002070751 | **0.027845** | 0.275587 | 0.071409533 | **0.346996** | **0.3748414** |
| agric | h29 | h21 | 3.38E-05 | 1.55549E-05 | **4.93E-05** | 0.301327 | 0.073464729 | **0.374792** | **0.3748414** |
| agric | h29 | h22 | 0.000129 | 3.63784E-05 | **0.000165** | 0.301232 | 0.073443905 | **0.374676** | **0.3748414** |
| agric | h29 | h23 | 0.000287 | 7.64203E-05 | **0.000364** | 0.301074 | 0.073403863 | **0.374477** | **0.3748414** |
| agric | h29 | h24 | 0.00045 | 0.000162709 | **0.000612** | 0.300911 | 0.073317574 | **0.374229** | **0.3748414** |
| agric | h29 | h25 | 0.000707 | 0.00030873 | **0.001016** | 0.300654 | 0.073171553 | **0.373826** | **0.3748414** |
| agric | h29 | h26 | 0.001309 | 0.000560166 | **0.001869** | 0.300052 | 0.072920117 | **0.372972** | **0.3748414** |
| agric | h29 | h27 | 0.007672 | 0.002272921 | **0.009945** | 0.293689 | 0.071207363 | **0.364897** | **0.3748414** |
| agric | h29 | h28 | 0.007979 | 0.003319559 | **0.011299** | 0.293382 | 0.070160725 | **0.363543** | **0.3748414** |
| agric | h29 | h29 | 0.149197 | 0.056752298 | **0.20595** | 0.152164 | 0.016727986 | **0.168892** | **0.3748414** |

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