Routledge
Taylor & Francis Group

Agrekon

Agricultural Economics Research, Policy and Practice in Southern Africa

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/ragr20

Analysis of the Kenyan economy: an input-output approach

Sofía Jiménez, Alfredo J. Mainar-Causapé & Emanuele Ferrari

To cite this article: Sofía Jiménez, Alfredo J. Mainar-Causapé & Emanuele Ferrari (2021): Analysis of the Kenyan economy: an input-output approach, Agrekon, DOI: 10.1080/03031853.2021.1984957

To link to this article: https://doi.org/10.1080/03031853.2021.1984957

Published online: 08 Nov 2021.

AGREKON
https://doi.org/10.1080/03031853.2021.1984957

Analysis of the Kenyan economy: an input-output approach

Sofía Jiménez [a], Alfredo J. Mainar-Causapé [b] and Emanuele Ferrari [c]

[a]School of Economics and Business, Economic Analysis Department, University of Zaragoza, Zaragoza, Spain; [b]Department of Applied Economics IIII, Faculty of Economics and Business, University of Seville, Seville, Spain; [c]European Commission, Joint Research Centre (JRC), Seville, Spain

ABSTRACT

Since the beginning of the 2008 economic crisis, economic growth and development have been in the forefront of economic research. In a global context, the highest levels of poverty as well as malnutrition problems are found in sub-Saharan African countries. Social Accounting Matrices (SAMs) are useful tools to describe the economic situation of these countries, the interactions among economic agents and to support policymakers in implementing their policies. The paper shows the macro- and micro-economic indicators of Kenya, which can be directly extracted from the described SAM 2017 for Kenya The analysis of the SAM multipliers shows that agri-food multipliers are in general above the average reflecting the strength of backward and forward linkages of Kenya's economy.

ARTICLE HISTORY
Received 15 May 2020
Accepted 19 September 2021

KEYWORDS
Social Accounting Matrix; Kenya; multipliers

1. Introduction

Since the beginning of the 2008 economic crisis, economic growth and development have been in the forefront of economic research (Francis et al., [2019]; McDowall et al., [2017]; Canova and Gambetti [2006]; Gallouj et al., [2015]). Within this area of research, many economic studies analyse the factors influencing the development of developing and emerging countries; factors such as foreign direct investment, fiscal policy or use of land among others (Berhanu and Poulton [2014]; Hanushek [2013]; Fedderke et al., [2006]; M'Amanja and Morrissey [2005]; Block [1999]).

Most sub-Saharan African countries are still characterised by high levels of poverty and of malnutrition and by the role played by agriculture. In many countries of the African continent, agriculture still represents more than 30% of the GDPs, it employs the majority of the labour forces and many of the agents involved in the sub-Saharan agriculture sectors are still subsistence farmers. This means that many farm-households consume what they produce, engaging in a double and contemporary role of producers and consumers.

Kenya's economic structure is similar to typical sub-Saharan economies. In Kenya, more than 70% of the Kenyan population lives in rural areas. The latest long-term strategy for Kenya's economic and social development (Kenya Vision 2030) identifies agriculture as one of the key sectors to drive economic growth. In this context, many policies have been formulated to increase agricultural productivity and income. To implement these policies successfully, it is required to understand the inter-sectoral links and the different transmission mechanisms of the shock generated

CONTACT Emanuele Ferrari emanuele.ferrari@ec.europa.eu European Commission, Joint Research Centre (JRC), Edificio Expo, Inca Garcilaso 3, Seville 41092, Spain

by these policies. Not considering the key characteristics of the Kenyan economy, any economic analysis based on a simulation model will provide biased interpretations of modelling results, especially those aimed at assessing ex-ante policy impacts (Tiberti [2011]; Taylor and Adelman [2003]).

Social Accounting Matrices (SAMs) show the economic transactions and transfers between different agents of a given economy, interacting through different markets, capturing all the economic flows of an economy. SAMs are useful tools to understand the interlinkages among economic sectors and are very useful if constantly updated to current economic situations and with most recent macroeconomic and microeconomic data.

The main objectives of this paper are the following. First, it presents a new SAM for 2017. To the best of our knowledge, this is the first SAM incorporating the most recent Household Budget Survey produced in Kenya in 2015/16. The paper describes the construction of this dataset that can serve as a tool to describe the Kenyan economy and to calibrate economic models such as Computable General Equilibrium (CGE) models. Secondly, the paper exploits 2017 Kenya SAM to show a series of macro- and micro-economic indicators extracted from the SAM, which provide a snapshot of the Kenyan economy in 2017. Thirdly, the SAM allows to calculate a set of linear multipliers and backward and forward linkages among the sectors represented in the SAM. The analysis of the SAM multipliers provides insights into the process of wealth generation and price formation of the different sectors of the economy. Multipliers show the effect on production, resulting from an exogenous shock in demand, and indicate which activities have the potential to generate impact on production and employment along the value chain. This analysis confirms the importance of agriculture sectors to produce wealth within the Kenyan economy.

The paper is structured as follows: Section 2 explains the structure of a SAM; Section 3 describes previous Kenya SAMs and briefly reports the process to estimate the SAM for 2017, which includes the part of consumption associated with home production and home consumption. The following section explains the main macroeconomic figures while Section 5 focuses on micro economic variables as consumption or household income. Section 6 shows the main results of the multipliers analysis and Section 7 concludes.

2. Structure of a SAM

A SAM is an economy-wide database including data on all transactions between all agents operating in a certain economy in a certain period. A SAM is usually employed for economic modelling e.g., to calibrate Computable General Equilibrium (CGE) models but also to show a complete and intuitive snapshot of an economy's structure. A SAM is founded on the idea of circular economy or circular flow of income and it reflects the complete process of production, income generation and redistribution between institutional sectors and trade. It is a square matrix in which each row and column represents different accounts (i.e., activity, commodity, factor or institutional sectors). Columns show the payments while rows show the transfers received by each account. In other words, the expenditures of an account are shown by the columns, while incomes by rows.

A typical SAM has six basic groups of accounts: activities or/and commodities, factors, institutions (households and/or corporations/enterprises), Government, capital accounts and accounts for the rest of the world (Table 1). The final dimension of the matrix depends on the disaggregation of these basic groups. The construction of SAMs can follow flexible concepts and assumptions; for this reason a SAM can assume many alternative structures. For instance, the 2017 Kenya SAM presented here considers both activities and commodities and includes commodities accounting for household production for household consumption. In that way, this SAM accounts for one of the characteristics of Kenyan agriculture (and other similar developing countries), which is the presence of an extensive subsistence agricultural sector. In these sectors, agents need to produce agricultural commodities for their own subsistence (Mainar-Causapé, McDonald, and

Table 1. Structure of a standard SAM.

	Commodities	Margins	Activities	Factors	Households	Enterprises / Corporations	Government	Savings-Investment	Rest of the World	*Total*
Commodities (C)		$T_{C,M}$ Transaction costs (trade / transport)	$T_{C,A}$ Intermediate (inputs) consumption		$T_{C,H}$ Household consumption		$T_{C,G}$ Government expenditure	$T_{C,S\text{-}I}$ Investment and stock changes	$T_{C,RoW}$ Exports	*Demand*
Margins (M)	$T_{M,C}$ Transaction costs (trade / transport)									*Margins*
Activities (A)	$T_{A,C}$ Domestic production									*Gross output / Production (activity income)*
Factors (F)			$T_{F,A}$ Remuneration of factors / Factor income						$T_{F,RoW}$ Factor income from RoW	*Factor income*
Households (H)				$T_{H,F}$ Factor income distribution to households	*($T_{H,H}$) (Inter Households transfers)*	$T_{H,E}$ Distribution of corporations income to households	$T_{H,G}$ Government transfers to households		$T_{H,RoW}$ Transfers to Households from RoW	*Household income*
Enterprises / Corporations (E)				$T_{E,F}$ Factor income distribution to enterprises			$T_{E,G}$ Government transfers to enterprises		$T_{E,RoW}$ Transfers to Enterprises from RoW	*Enterprise income*
Government (G)	$T_{G,C}$ Net taxes on products		$T_{G,A}$ Net taxes on production	$T_{G,F}$ Factor income to Government / Factor taxes	$T_{G,H}$ Direct Household taxes / Transfers to Government	$T_{G,E}$ Direct Enterprise taxes / Transfers to Government			$T_{G,RoW}$ Transfers to Government from RoW	*Government income*
Savings-Investment (S-I)				*($T_{S\text{-}I,F}$) (Depreciation)*	$T_{S\text{-}I,H}$ Household savings	$T_{S\text{-}I,E}$ Enterprise savings	$T_{S\text{-}I,G}$ Government savings	*($T_{S\text{-}I,S\text{-}I}$) (Capital accounts transfers)*	$T_{S\text{-}I,RoW}$ Capital transfers from RoW (Balance of Payments)	*Savings*
Rest of the World (RoW)	$T_{RoW,C}$ Imports			$T_{RoW,F}$ Factor income distribution to RoW	$T_{RoW,H}$ Household transfers to RoW	$T_{RoW,E}$ Corporations income to Row	$T_{RoW,G}$ Government transfers to RoW			*Payments to RoW*
Total	*Supply*	*Margins*	*Costs of production activities*	*Expenditure on factors*	*Household expenditure*	*Enterprise expenditure*	*Government expenditure*	*Investment*	*Incomes from RoW*	

Source: Kiringai, Thurlow, and Wanjala (2006), Mainar-Causapé, McDonald, and Ferrari (2018b), Round (2003).

Ferrari 2018b) and employ productive factors (land, labour and capital) for the subsistence production.

3. Kenya SAM 2017

3.1 Previous Kenya SAMs

The economic development literature produced a number of Social Accounting Matrices for Kenya. The first one, based on the year 1976 (Akinboade [1990]), is highly aggregated as it is constituted by three main activities (primary sector, industry and services) and four commodity accounts (domestic, imported, exported and composite).

A SAM produced for 2001 (Wobst and Schraven 2005) as part of the International Food Policy Research Institute (IFPRI) analytic support to USAID's Action Plan for Kenya includes 33 production sectors, 15 of which are agricultural.

The Kenya Institute for Public Policy Research and Analysis (KIPPRA) (Gakuru and Mathenge 2012) and the (IFPRI) in a joint project for the Food and Agriculture Organization of the United Nations (FAO) (Kiringai, Thurlow, and Wanjala 2006) produced two 2003 SAMs for Kenya. Then, Thurlow and Benin estimated for IFPRI a 2007 Kenya SAM with activities disaggregated by administrative region in 2008 (in an unpublished work for the Kenya's Comprehensive Africa Agricultural Development Programme (CAADP) Roundtable Discussion).

To the best of our knowledge, the last SAM for Kenya is a 2014 SAM (Mainar-Causapé et al. 2018a, 2020) on which this 2017 Kenya SAM is based. The main characteristic of the 2014 SAM is the high disaggregation of the agricultural sector as well as the regional disaggregation. The main value added of the 2017 Kenya SAM, compared with the 2014 Kenya SAM, is the use of more recent databases for its estimation. The SAM of 2014 (whose estimation was finalised in 2017), includes 2014 macroeconomic aggregates. The 2014 Kenya SAM employed the 2005/6 Kenya Integrated Household Budget Survey (KIHBS) to estimate households' income, economic activities and expenditures as the most recent 2015/16 KIHBS was not yet released by the Kenya Statistical Office. The Kenya 2017 SAM, estimated with data from the 2015/16 KIHBS, KNBS 2018a enhanced the internal coherence of the database due a greater proximity between the national accounts data and the household budget survey. This also allows for a more updated analysis of economic indicators based on households' income and consumption.

3.2 Estimation of Kenya SAM 2017

This section explains the process to estimate the 2017 Kenya SAM. This SAM has the same structure as a traditional SAM including commodities and activities and includes 195 accounts.

A list of databases was employed to populate the 2017 Kenya SAM. The main databases were the Kenya National Bureau of Statistics (KNBS) official statistics (Economic survey [KNBS 2018b] and Statistical Abstract [KNBS 2018c]), 2009 Kenya Supply and use tables, 2015/16 Budgetary Household survey (KIHBS 2015/16) KNBS 2018a and other micro data from KNBS official statistics (Leading Economic Indicator July 2018 or Quarterly Labour Force Reports). For the estimation of commodities and activities related with the primary sector, databases mainly related with agriculture (e.g., Government of Kenya 2015) were employed. When data was not available, the latest previous SAM (2014 Kenya's SAM, Mainar-Causapé et al. [2018a]) was updated to obtain values consistent with 2017 national statistics. These updates are mainly located in the relations between capital and activities, as well as in government account with all its counterparts (households, enterprises, savings and Rest of the World). In addition, the relations of labour with government, savings and Rest of the world have been updated from the 2014 SAM based on updated national accounts.

The use of different data sources and estimations resulted in an unbalanced SAM. To estimate a balanced one, a combination of RAS and Cross Entropy methods was employed (McDougall 1999;

Robinson, Cattaneo, and El-Said 2001). These methods ensure a suitable estimation of specific SAM cells in which there are a lack of information, subject to known macroeconomic targets.

One of the novelties of this set of SAMs is the inclusion of specific accounts representing Home Production for Home Consumption (HPHC) based on data included in the latest 2015/16 Household Budget Survey. HPHC is an essential element in the economies of developing countries. In economies characterised by the presence of a large subsistence agricultural sector as the Kenyan one, the role of households as producers and consumers is inseparable and the home-produced commodities represent a major component of consumption (see Mainar-Causapé et al. 2018a). In addition, the 2017 Kenya SAM considers a high regional disaggregation. Concretely, all Kenyan counties are aggregated into eight regions according to their main geographical characteristics: (i) Nairobi, (ii) Mombasa, (iii) High Rainfall zone, (iv) Semi-Arid North, (v) Semi-Arid South, (vi) Coast, (vii) Arid North and (viii) Arid South (Figure 1). These regions, which aggregate homogenous counties in terms of agronomic characteristics, are the basis of the split of households as productive units (for HPHC analysis) and the disaggregation of labour factor (combining in this case skill of workers). For households as institutional units, regions are also split between rural and urban areas (but by income quintiles in the case of Nairobi and Mombasa).

Out of the 195 account, 53 correspond to activities producing 55 marketed and 18 HPHC commodities. Eleven of these 53 activities accounts of households appear as producers.

Given the importance of the agri-food sector within the Kenyan economy, it is important to depict the sector with a detailed disaggregation of activities and commodities. This is another main value added of the 2017 Kenya SAM, which includes eight agricultural household activities (one per region) that produce 18 commodities that are not marketed (HPHC) and 17 marketed crops. The SAM also includes as activities enterprises producing food and cash crops, with commercial farmers producing only marketed food and agricultural commodities.

Regarding production factor accounts, the SAM includes 27 labour accounts, three types of capital and two types of land. The labour accounts are divided into three types of labour: skilled, semi-skilled and unskilled labour. Moreover, each type of labour is regionalised based on the eight regions. Capital is disaggregated into agricultural capital, non-agricultural capital and livestock. The SAM also includes two types of land: irrigated and non-irrigated.

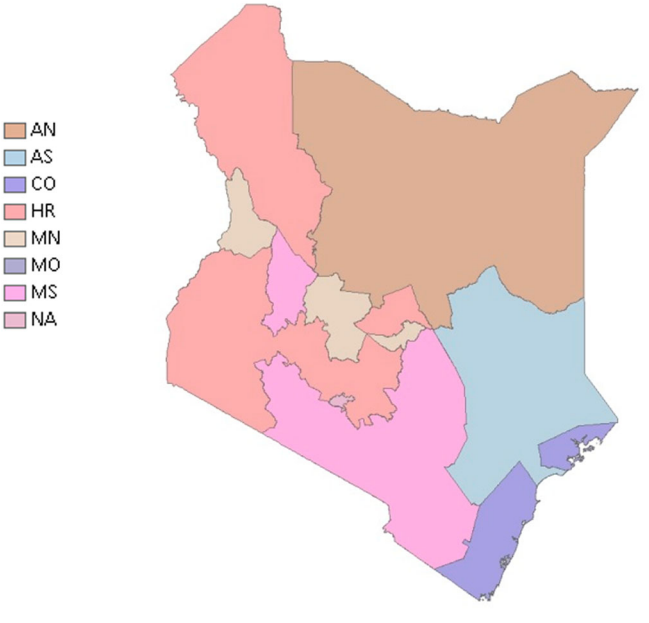

Figure 1. Kenyan regions included in the SAM. Source: own elaboration.

Table 2. Macro SAM Kenya 2017[a].

	ch	cm	m	ahf	ahc	a	flab	fland	flivst	fcp_ag	fcp_na	hh	enter	gov	dirtax	indtax	saltax	facttax	imptax	i-s	row	Total
HPHC commodities (ch)				191,488.9								242,161.1										433,649.9
Marketed commodities (cm)			431,365.3	360,117.6	57,525.0	4,182,843.1						6,446,443.9		1,110,535.0						1,493,542.0	978,625.5	15,060,997.4
Margins (m)		431,365.3																				431,365.3
Households as activities food (ahf)	433,649.9	1,879,238.0																				2,312,887.9
Households as activities cash-crops (ahc)		315,882.0																				315,882.0
Activities (a)		9,687,914.6																				9,687,914.6
Labour factor (flab)				154,904.4	26,244.3	2,355,117.5														40,774.0		2,577,040.2
Land factor (fland)				1,194,184.5	206,357.1	222,328.7																1,622,870.2
Livestock (flivst)				214,384.2		65,838.7																280,222.9
Capital agricultural (fcp_ag)				143,724.0	25,755.7	242,994.4																412,474.1
Capital non-agricultural (fcp_na)				54,084.3		2,417,279.5																2,471,363.8
Households (hh)							2,439,149.0	1,621,865.5	280,079.0	412,284.0	1,335,562.6		441,534.8	95,249.4						466,196.0		7,091,920.3
Enterprises (enter)								219.2			1,133,263.6			799,640.2								1,933,123.0

Government (gov)																672,148.6	201,512.8	378,594.2	15,507.8	293,361.8		19,046.0	1,580,171.2
Direct taxes (dirtax)												362,332.3	309,816.2										672,148.6
Indirect taxes (indtax)						201,512.8																	201,512.8
Sales taxes (saltax)		378,594.2																					378,594.2
Factor taxes (facttax)							11,850.8	785.4	143.9	190.1	2,537.6												15,507.8
Imports taxes (imptax)		293,361.8																					293,361.8
Save/Investment (i-s)												35,198.3	1,181,772.0	−425,253.3								701,825.0	1,493,542.0
Rest of the World (row)		2,074,641.5					126,040.4					5,784.6											2,206,466.5
Total	433,649.9	15,060,997.4	431,365.3	2,312,887.9	315,882.0	9,687,914.6	2,577,040.2	1,622,870.2	280,222.9	412,474.1	2,471,363.8	7,091,920.3	1,933,123.0	1,580,171.2	672,148.6	201,512.8	378,594.2	15,507.8	293,361.8	1,493,542.0	2,206,466.5		

[a]"ahf" represents household's own production own consumption, while "ahc" shows households consumption of marketed products.

The households as institutions are disaggregated into rural and urban, according to the area of residence. Moreover, households living in the two metropolises, Nairobi and Mombasa, are disaggregated by income quintiles. Thus, the 2017 Kenya SAM contains 22 representative household groups.

The saving – investment relationship is represented by five accounts in the 2017 Kenya SAM: a single account collects savings from Institutions (Households, Corporations, Government and Rest of the World) and allocates them into four accounts representing different types of investments. These four different accounts are investment in roads, irrigation, other infrastructures and other investments. Also, five types of taxes are included: direct, indirect, sales, factors and imports taxes. Table 2 shows the aggregate 2017 Kenya SAM.

4. Wide-economic analysis

This section analyses main macro-economic aspects of the Kenyan economy. These macroeconomic aggregates are extracted directly from the SAM accounts, both by sectors and for the "wide economy". The key macroeconomic indicators that the SAM provides are: the value added (sum of capital, labour and taxes less subsidies on activities) and GDP (incorporating taxes less subsidies on products); domestic absorption (household and government consumption plus gross investment), imports, exports and investment. The use of the new 2017 matrix improves the analysis of the Kenyan economy because of the greater precision in macroeconomic flows at the aggregate level used as the basis (as described in Section 3) compared to previous versions of the SAM.

According to the 2017 Kenya SAM, domestic absorption is 117.6% of GDP; exports and imports are 12.4% and 30%, respectively. Private consumption represents 72% of the domestic absorption while investment and government consumption achieve more moderate values, 16.1% and 12%, respectively.

Kenya is mainly importing manufactured goods (59.9%), petroleum and mining (26.3%), while almost 60% of its exports are agricultural goods. This highlights one of the characteristics of the Kenyan economy, importing high value added goods in exchange of exporting commodities, whose prices are more volatile and with a tendency to fall.

The activities generating more value added are: crops (78.2%), natural resources (75.2%), utilities (70.5%), livestock (69.1%) and services (62.6%) confirming that Kenya is still an agricultural economy with a strong role of services and a more moderate one for industry (34.8%).

Focusing on productive factors, labour and non-agricultural capital by groups of activities shows that non-agricultural capital is especially important in the case of Services, Utilities, Industrial and Food (percentages between 50% and 70%), while labour remains significant in the case of Construction, Natural resources and Livestock (Figure 2). In any case, labour is mainly concentrated in Construction as in most developing countries with a high rate of investments in infrastructures. Moreover, some of the sectors mentioned (natural resources, utilities, livestock, and services) are the main generators of value added, as previously indicated. All these results reveal the importance of these activities in the economy of Kenya.

5. Micro-economic analysis

The direct analysis of the 2017 Kenya SAM also provides information about the income and expenditure of the institutional agents represented in the SAM. In this case, as mentioned in the case of the general structure of the economy, the estimation of the 2017 SAM clearly improves the microeconomic analysis compared to previous versions. As the income, expenditure and HPHC structure of all households are estimated from the latest Household Budget Survey, this SAM allows to extract up-to-date micro-economic figures.

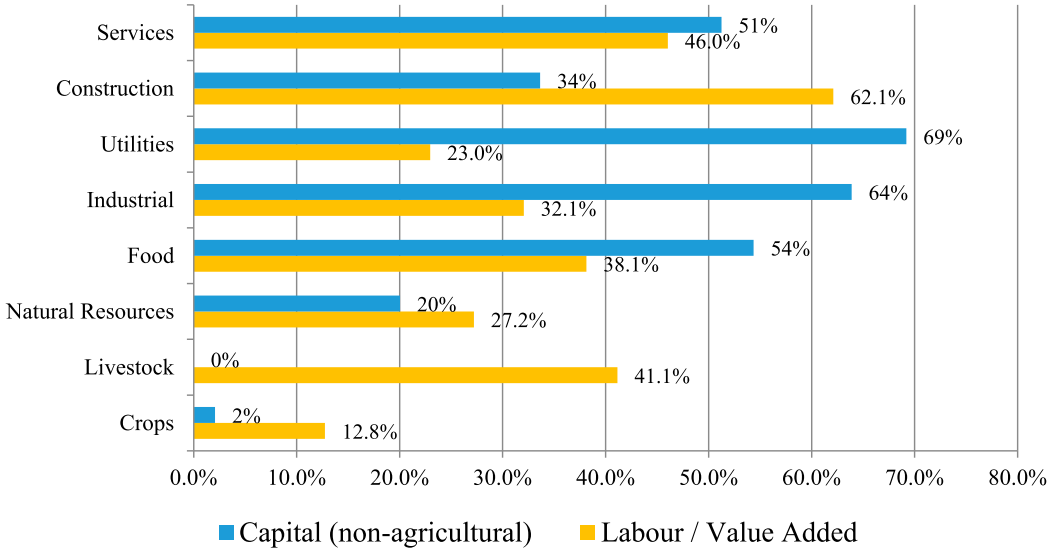

Figure 2. Labour and capital by groups of activities (% of VA). Source: Own elaboration.

Figure 3 shows household income divided by factor income and transfers from enterprises, government and the rest of world, by Rural and Urban and by region as recorded in the 2017 Kenya SAM. Transfers are small but they mainly come from either enterprises or from abroad showing the limited impact of the Kenyan public sector in the economy. In rural areas the main factor for income is land while in urban areas they are both labour and non-agricultural capital.

In Mombasa (62%), the importance of labour as main source of income is clear. In Nairobi (35%), labour is less significant. However, income from agricultural and non-agricultural capital becomes stronger, 13.1% and 24.1%, respectively.

Table 3 shows household income by quintiles for Nairobi and Mombasa and rural/urban for the rest of the regions. Figures highlighted in red represent the highest numbers of each column.

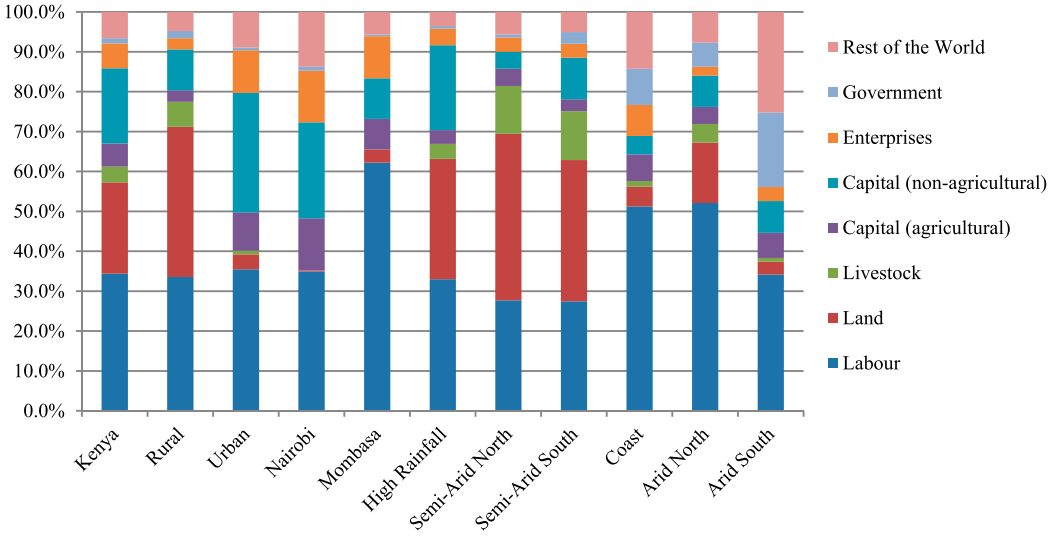

Figure 3. Household income (%). Source: Own elaboration.

Table 3. Household income by disaggregated regions (%).

Kshs million	Labour	Land	Livestock	Capital (agricultural)	Capital (non-agricultural)	Enterprises	Government	Rest of the world
Nairobi_Q1	24.01%	0.26%	0.00%	11.97%	33.09%	18.74%	0.56%	11.36%
Nairobi_Q2	46.41%	0.23%	0.00%	12.72%	15.46%	6.52%	2.44%	16.22%
Nairobi_Q3	48.03%	0.23%	0.00%	13.18%	13.03%	5.66%	0.08%	19.80%
Nairobi_Q4	46.18%	0.22%	0.00%	23.84%	11.09%	5.91%	1.42%	11.33%
Nairobi_Q5	62.87%	0.22%	0.00%	4.14%	6.13%	4.78%	1.23%	20.62%
Mombasa_Q1	50.76%	3.45%	0.00%	8.33%	14.90%	13.14%	0.58%	8.84%
Mombasa_Q2	69.17%	3.50%	0.00%	6.57%	5.23%	12.86%	0.40%	2.26%
Mombasa_Q3	77.34%	2.93%	0.00%	6.05%	6.53%	3.09%	0.19%	3.86%
Mombasa_Q4	68.25%	2.85%	0.00%	11.44%	8.65%	6.23%	0.21%	2.37%
Mombasa_Q5	80.49%	2.59%	0.00%	4.18%	4.46%	2.33%	0.00%	5.96%
High Rainfall Rural	34.92%	38.71%	4.54%	2.77%	11.52%	2.91%	0.80%	3.84%
High Rainfall Urban	27.68%	6.75%	1.71%	5.26%	48.04%	7.59%	0.28%	2.70%
Semi-Arid North Rural	22.17%	47.99%	13.83%	2.92%	4.07%	2.25%	0.84%	5.95%
Semi-Arid North Urban	60.28%	4.85%	1.31%	12.52%	5.43%	11.35%	0.46%	3.79%
Semi-Arid South Rural	24.87%	38.66%	13.54%	2.36%	10.74%	2.14%	3.01%	4.69%
Semi-Arid South Urban	44.64%	13.84%	3.30%	7.36%	8.35%	12.79%	2.28%	7.44%
Coast Rural	48.76%	5.49%	1.46%	6.02%	2.18%	5.09%	13.63%	17.36%
Coast Urban	55.96%	4.08%	1.23%	7.95%	9.39%	12.96%	0.26%	8.17%
Arid North Rural	67.19%	3.79%	0.94%	2.94%	4.58%	1.16%	9.17%	10.23%
Arid North Urban	27.56%	33.61%	10.75%	6.44%	13.15%	3.89%	1.02%	3.58%
Arid South Rural	32.11%	3.79%	1.15%	7.55%	9.69%	4.18%	27.37%	14.15%
Arid South Urban	38.30%	2.06%	0.58%	3.75%	4.43%	2.18%	0.82%	47.89%

Source: Own elaboration.

As related to transfers, those from enterprises are located in Nairobi and Mombasa together with urban areas of Coast, Semi-Arid South and Semi-Arid North, with percentages between 12% and 19%. This reflects the areas where industry is more important.

Figure 4 shows household consumption by region and group of commodities. At national level, food is the most consumed commodity group, as is usual in developing countries. This is a common tendency in all regions and different kinds of areas (in rural and urban areas). Nairobi, the richest region of the country, is the region with highest consumption share of transport and communications and services commodities and the lowest share dedicated to food, showing this relation between income and food consumption.

One of the main characteristics of developing countries and in particular of Kenya is the fact that many products produced by households are also own consumed, the so-called home production for home consumption (HPHC). It represents 7.5% of food consumption in the country and 10.5% vs. 1.9% in rural and urban areas, respectively. The highest percentages of HPHC are in the most rural and poorest regions: Semi-Arid North and Arid North.

At national level, food consumption is concentrated in pulses and oils seeds (14%), maize (13%), fruits (11%) and meat and dairy (8%). Clear differences between rural and urban areas emerge. While in rural areas pulses and oil seeds and maize are the main commodities consumed, while urban households mainly focus on fruits (18.6%), meat and dairy (11.4%), roots and tubers (11.2%). Nairobi and Mombasa have the same pattern as the one in urban areas, fruits being the main commodity consumed (21.1% and 17.5%, respectively). Arid North and Arid South are remarkable regions as other meat appears in first place, 17.5% and 12.6%, respectively. Also, dairy products increases their role in comparison with the other regions, whereas maize decrease in importance. This may be associated with the higher significance of livestock in these zones.

6. Multipliers analysis

A flourishing literature employs linear multiplier to describe and analyse Sub-Saharan African economies e.g., Block (1999) calculates multipliers for four main sectors to explain the economy of

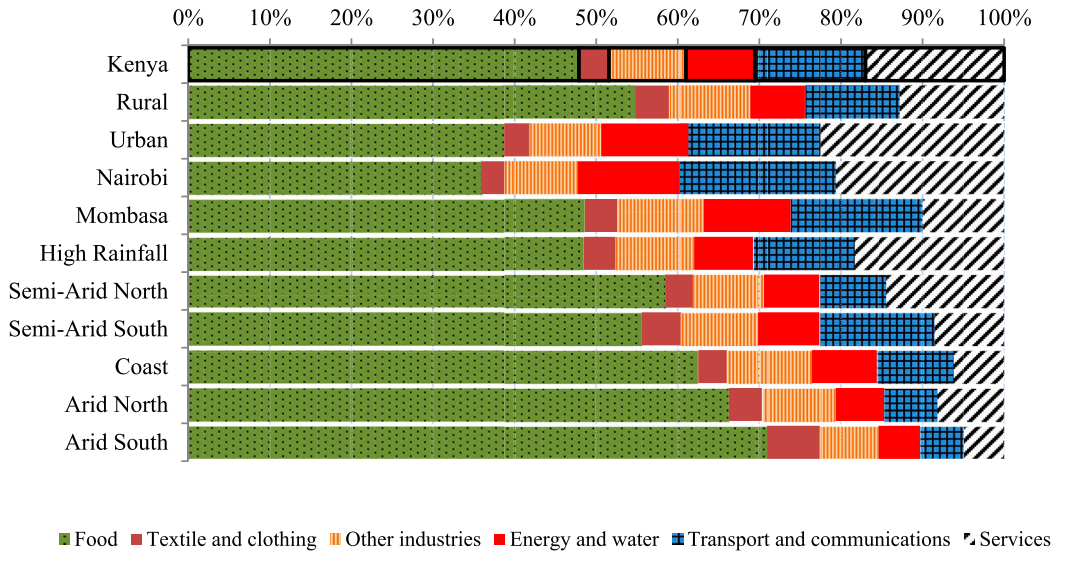

Figure 4. Private consumption by region and commodity. Source: Own elaboration.

Ethiopia, Powell and Round (2000) focus on the Ghana economy, Sassi (2011) studies the role of the government to mitigate the effects of food crisis in Kenya. As a difference from previous literature, the current paper focuses on the specific economic structure of Kenya's economy, particularly at the potentiality to expand the economy through the backward and forward linkages among the different sectors, both agricultural and non-agricultural.

This paper uses a conventional linear multipliers approach (Pyatt and Round 1979, among many others), assuming Leontief technologies (i.e., fixed prices and no substitution elasticities) and considering that all productive sectors are demand-driven with perfectly elastic supply. Equation (1) shows the main equation of this multiplier analyses;

$$\boldsymbol{x}_n = \boldsymbol{A}_n \boldsymbol{x}_n + \boldsymbol{y}_n = (\boldsymbol{I} - \boldsymbol{A}_n)^{-1} \boldsymbol{y}_n = \boldsymbol{M}\boldsymbol{y}_n \quad (1)$$

where $\boldsymbol{x}_n$ is the vector of gross output of endogenous accounts; $\boldsymbol{y}_n$ is the corresponding vector of final demand; $\boldsymbol{A}_n$is the matrix of average expenditure propensities[1] of endogenous accounts,[2] whose components a_{ij} represent the expenditure on account i for each unit of expenditure or employment in j; $\boldsymbol{y}_n$ is the column vector that counts the income flow received by endogenous accounts from exogenous accounts (usually total or partial final demand); and **M** is the SAM accounting multipliers matrix. The submatrix of **M** composed by activities in rows and commodities in columns contains the so-called output multipliers, reflecting its elements m_{ij} how much would activity i output increase following an exogenous increase of one unit of final demand of commodity j. In this sense, output multiplier analysis shows an overview of the potential of economic activities and commodities to generate output.

The global effect on production, resulting from an exogenous shock in the value of demand in commodity j is obtained by adding the values of the columns, reflecting both the "direct" effects, the "indirect" and the "induced".[3]

Figure 5 shows output multipliers for agricultural commodities. Products with the highest multipliers, i.e., with a greater impact of a unit demand shock on production, are vegetables and roots and tubers (3.51), fruits (3.48), tea (3.42), other cereals (3.38) and maize (3.37). Roots and tubers, fruits and maize are among the products that are much consumed by households.

The main characteristic of multipliers is their capacity to show the linkages among industries: the relationship between a given sector and all the sectors sitting earlier or later in a value chain.

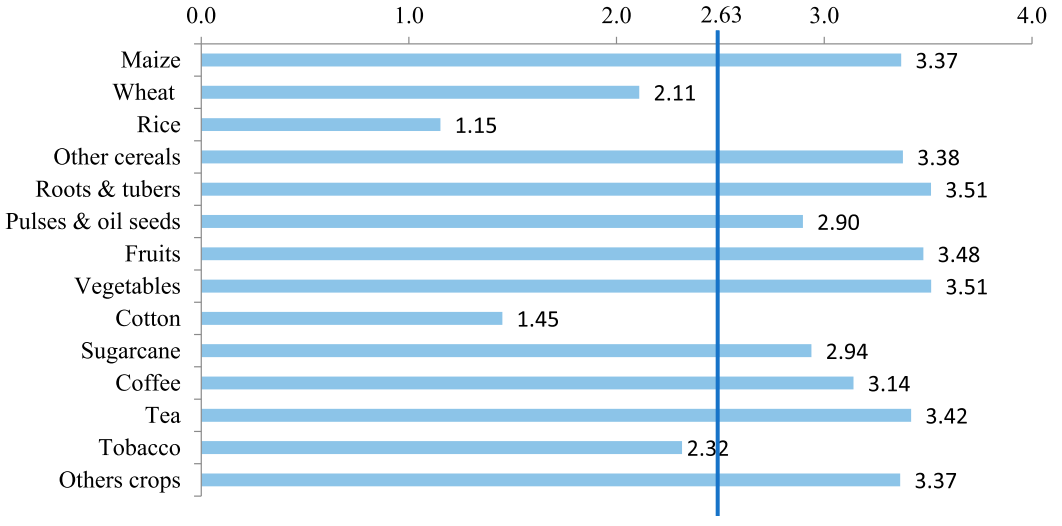

Figure 5. Output multipliers of agricultural commodities. Source: Own elaboration.

The majority of the multipliers of agricultural commodities are above the multipliers average of 2.63. Only wheat, rice, cotton and tobacco show values lower than the average. This is reflecting the importance of the agriculture sector to produce wealth within the Kenyan economy. On the other hand, this result is also due to the fact that these four commodities are the least produced in Kenya.

Although the major multiplier effect is found among agricultural commodities (the average value is 2.63), multipliers of food industries are also quite high. On average, the multiplier value is 2.54 (Figure 6).

Many industries are above the average: from the whole cattle industry to services such as health. The highest values are found in beef (3.50), diary (3.49), sheep, goat and lamb (3.40) and other livestock (3.41) but also in water (3.36), communication and education (3.27), which are some of the mainly consumed commodities in Kenya together with agriculture commodities. Livestock was especially significant in Arid North and Arid South where the private consumption of meat is the highest. All in all, this shows that increases in final demand not only led to increases in the analysed sectors, but an improvement of the economy as a whole, due to the strength of the linkages in the Kenyan economy. These results summarise in an intuitive way the different capacities of Kenya's economic sectors to generate new output, allowing to discriminate which products may be more receptive to policies or demand shocks. Clearly the importance and dependence upon agricultural sectors is remarkable.

In an economy like the Kenyan one, it is also very important to analyse the different impacts resulting from demand shocks on HPHC commodities or marketed commodities. The special structure of this SAM, which delves into the concept of HPHC and employs the latest available household budget survey, allows this type of analysis. In this sense, aggregate impact effect[4] of demand shocks of food commodities on output, distinguishing between self-produced commodities and traded commodities (Figure 7), provides this information. It is observed how HPHC commodities have a multiplying effect on the output of conventional activities (1.73), much higher than the impact that the demand for traded food commodities has on HPHC activities (1.35). This is due to the fact that the effect of the demand for traded commodities affects self-production activities in a much more indirect way, while the increase in self-consumption directly implies the use of traded inputs. This result also shows how subsistence agricultural has a strong link with the rest of the economy.

However, the effects of demand shocks in HPHC or traded commodities on the output of corresponding types of production (that is, of household activities and conventional activities, respectively) is almost the same, (multipliers with values 1.94 and 1.91).

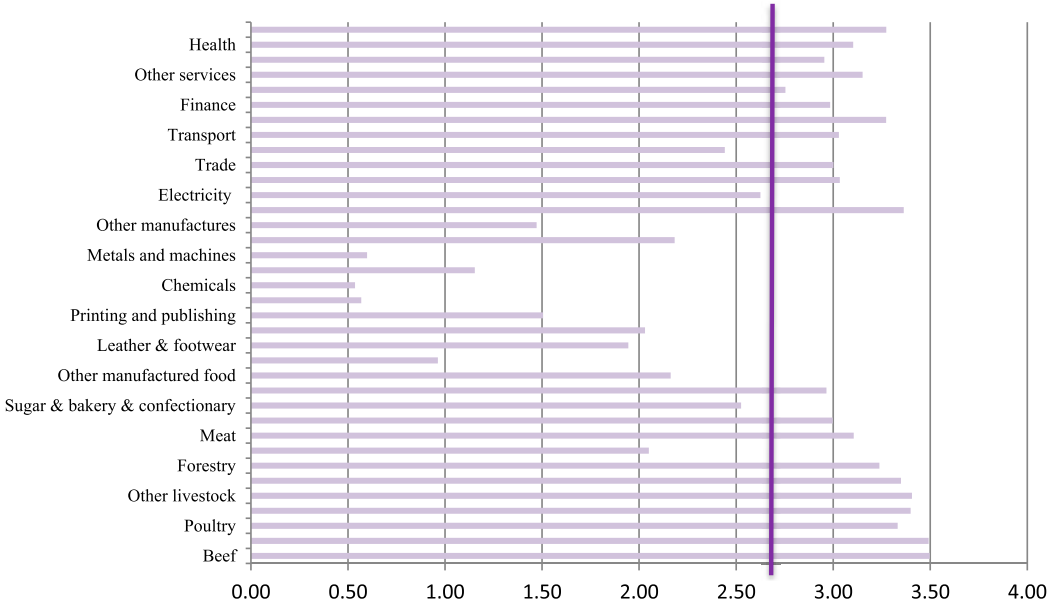

Figure 6. Output multipliers of other industries. Source: Own elaboration.

This SAM also allows to estimate the relevance of trade and transportation margins in conventional activities and self-consumption, using a supply-driven multipliers model[5] (Ghosh 1958). This model shows how value-added shocks of a sector (due, among other reasons, to factors price shocks) could impact on output value of activities. Since, in the Kenya SAM, margins are directly linked with commodities account for the way to estimate supply effects of margins in activities is shocking the trade activity, because trade is the main component of the margins in this SAM.

Applying the supply-driven model, the corresponding multipliers of trade activity value added-on output of different groups of activities (HPHC activities and conventional, total and food related-activities) distinguish the different relevance of margins in the sectoral output. Thus, Figure 8 shows the referred multipliers, indicating the increase in output due to an increase in trade value added. It is very significant that the high effect of margins on aggregated conventional activities (7.40), contrasts with the much lower values regarding food activities (1.60 for HPHC activities and

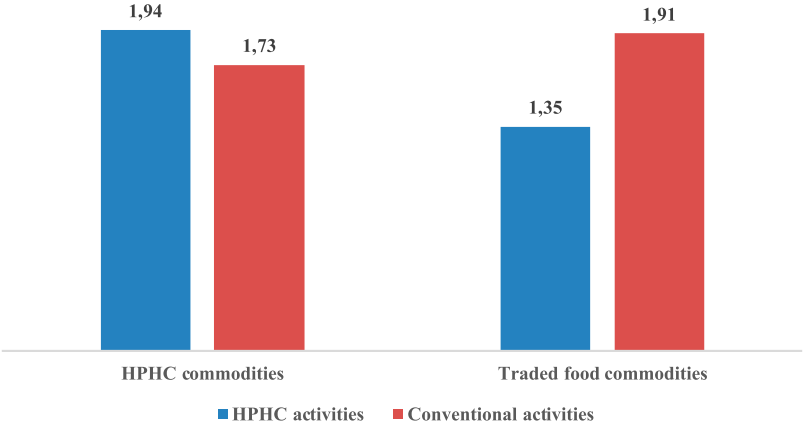

Figure 7. HPHC and traded commodities average output multipliers. Source: Own elaboration.

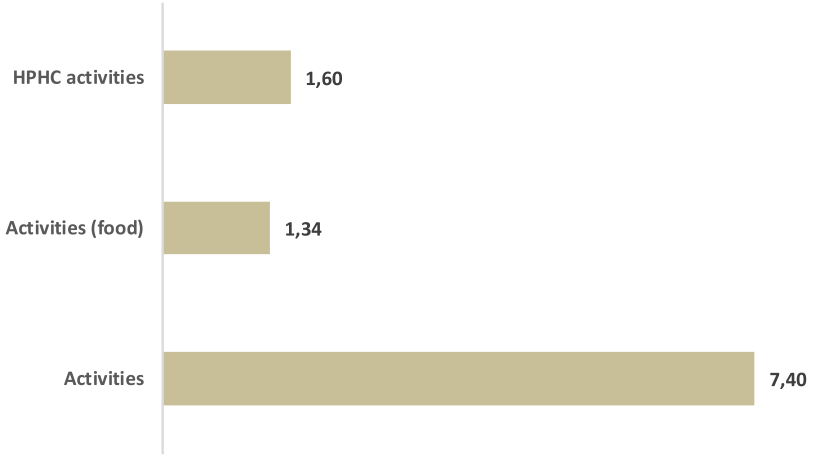

Figure 8. Supply-driven multipliers of trade activities (margins). Source: Own elaboration.

1.34 for conventional food activities). This is clearly explained by the fact that conventional activities products, especially manufactures and services, include margins while price formation of HPHC commodities do not account for any margin. The higher effect on HPHC activities versus trade activities, despite being marginal, could be explained by the use of intermediate inputs for household production, acquired as final product by households, instead as an input directly from factory (as is the case of conventional activities). This illustrates the importance of margins in a semi-subsistence economy such as Kenya, in which a significant part of food production (the subsistence way of living of many households) does not require direct trade costs, but is affected (even more than the food goods themselves traded) by these costs, through the use of the necessary inputs to obtain them.

7. Conclusions

This paper analyses in detailed the economy of Kenya using a newly constructed Kenya Social Accounting Matrix for 2017. The SAM, making use of the latest available data represents a valuable asset to describe the main Kenyan economic indicators, the economic relationships among its agents and as an input for modelling exercises. In addition, the current SAM includes specific accounts representing Home Production for Home Consumption (HPHC) based on data included in the latest 2015/16 Household Budget Survey.

The analysis of 2017 Kenya SAM shows the main macroeconomic (absorption, value added) and microeconomic aggregates (income, consumption) following the SAM detailed disaggregation in terms of activities, commodities and regionalised representative household groups.

Looking at the linear multipliers produced with the newly estimated SAM, roots and tubers and vegetables are the two agricultural commodities with the highest multipliers; an increase of one unit of final demand of these commodities generates the highest increase in their production and consumption. This can be associated with the fact that they are usually used as intermediate inputs in activities such as manufactured food. The cattle industry shows significant values as well, together with services as education or water. This reflects how powerful are backward and forward linkages in Kenya's economy.

Besides, self-produced commodities have a multiplying effect on the output of conventional activities much higher than the impact that the demand for traded food commodities has on HPHC activities. This is showing, once again, the importance of self-produced commodities in the Kenyan economy and the direct relations with the rest of the activities. Finally, commercial activities (trade margins) appears as quite important in Kenya, with a quite high multiplier for the whole economy.

This analysis helps to understand better the Kenyan economy and the behaviour of its agents. This thoughtful description of an economy is very useful to design evidence-based economic policies. This exercise shows that SAMs is a suitable tool for the analysis of developing countries and its policies implications without the necessity of carrying on with a complex model.

Notes

1. A is the so-called coefficient matrix; whose elements are the elements of the SAM divided by the total of their corresponding column.
2. Exogenous accounts in this exercise are Rest of the World, Government and Save-Investment (the most usual selection). Considering that a SAM is used instead an I-O framework, this selection of variables allows the consideration as endogenous the factors payment and distribution of incomes, as well as households' consumption and behaviour.
3. Direct effect is related to the output increase in the shocked activity i, and the indirect effect results through production relationships (intermediate consumption). Induced effect is driven by changes in household labour income which drives changes in household consumption for commodity j.
4. Using weighted average of multipliers, with commodities demand values as weights.
5. In the supply-driven so-called Ghosh model (Ghosh 1958), the main equation is $\mathbf{x}' = \mathbf{v}'\mathbf{B}+\mathbf{v}'$, where **v** is the value of expenses of endogenous on exogenous accounts (as "inputs") and **B** is the distribution coefficients matrix, whose elements are the elements of the SAM divided by the total of their corresponding row. The Ghosh- multipliers matrix is therefore derived as $\mathbf{G} = (\mathbf{I}-\mathbf{B})^{-1}$. In the present exercise, value added accounts are considered as exogenous.

Acknowledgements

We are grateful to two anonymous reviewers and the journal editors for their constructive comments on previous versions of this manuscript.

Disclaimer

The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission or any other institution.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This research benefited from the Administrative Agreement between DG for International Partnerships (DG INTPA) and the Joint Research Centre (JRC) on Technical and scientific support to agriculture and food and nutrition security sectors (TS4FNS).

ORCID

Sofía Jiménez http://orcid.org/0000-0001-8215-3227
Alfredo J. Mainar-Causape http://orcid.org/0000-0003-2032-9658
Emanuele Ferrari http://orcid.org/0000-0003-0031-7190

References

Akinboade, O.A. 1990. *Agriculture, income distribution and policy in Kenya: A SAM based general equilibrium analysis*. Unpublished PhD thesis, University of Oxford, Oxford, UK.

Berhanu, K., and C. Poulton. 2014. The political economy of agricultural extension policy in Ethiopia: Economic growth and political control. *Development Policy Review* 32, no. s2: s197–213. https://doi.org/10.1111/dpr.12082

Block, S.A. 1999. Agriculture and economic growth in Ethiopia: Growth multipliers from a four-sector simulation model. *Agricultural Economics* 20, no. 3: 241–52. https://doi.org/10.1016/S0169-5150(99)00007-9

Canova, F., and L. Gambetti. 2006. Structural changes in the us economy: Bad luck or bad policy? CEPR Discussion Paper No. 5457. https://ssrn.com/abstract=899362

Fedderke, J.W., P. Perkins, and J.M. Luiz. 2006. Infrastructural investment in long-run economic growth: South Africa 1875–2001. *World Development* 34, no. 6: 1037–59. https://doi.org/10.1016/j.worlddev.2005.11.004

Francis, N.R., L.E. Jackson, and M.T. Owyang. 2019. How has empirical monetary policy analysis in the US changed after the financial crisis? *Economic Modelling* 84: 309–321. https://doi.org/10.1016/j.econmod.2019.04.022

Gakuru, R., and N. Mathenge. 2012. Poverty, growth, and income distribution in Kenya: A SAM perspective. AGRODEP Working Paper 0001, June 2012. http://www.agrodep.org/sites/default/files/AGRODEPWP0001_3.pdf.

Gallouj, F., K.M. Weber, M. Stare, and L. Rubalcaba. 2015. The futures of the service economy in Europe: A foresight analysis. *Technological Forecasting and Social Change* 94: 80–96. https://doi.org/10.1016/j.techfore.2014.06.009

Ghosh, A. 1958. Input-Output approach in an allocation system. *Economica* 25: 58–64. https://doi.org/10.2307/2550694

Government of Kenya. 2015. *Economic-review-of-agriculture_2015-6*. Nairobi, Kenya: Ministry of Agriculture, Livestock and Fisheries of Kenya. http://kilimodata.developlocal.org/dataset/0db0b38f-a79e-44f9-b200-95e232baa207/resource/e01448e4-52fc-48d9-a5fc-e220d27d957d/download/economic-review-of-agriculture_2015.pdf

Hanushek, E.A. 2013. Economic growth in developing countries: The role of human capital. *Economics of Education Review* 37: 204–12. https://doi.org/10.1016/j.econedurev.2013.04.005

Kenya National Bureau of Statistics, KNBS. 2018a. *Kenya Integrated Household Budget Survey (KIHBS), 2015/16*. Nairobi, Kenya.

Kenya National Bureau of Statistics, KNBS. 2018b. *Economic survey 2018*. Nairobi: Kenya National Bureau of Statistics.

Kenya National Bureau of Statistics, KNBS. 2018c. *Statistical abstract 2018*. Nairobi, Kenya: KNBS.

Kiringai, J., J. Thurlow, and B. Wanjala. 2006. *A 2003 social accounting matrix for Kenya*. Nairobi; Washington, DC: Kenya Institute for Public Policy Research and Analysis (KIPPRA); International Food Policy Research Institute (IFPRI)(datasets). http://www.ifpri.org/dataset/kenya-social-accounting-matrix-sam-2003.

Mainar-Causapé, A., P. Boulanger, H. Dudu, E. Ferrari, S. Mcdonald, and A. Caivano. 2018a. Social Accounting Matrix of Kenya 2014, EUR 29056 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-79-77708-0. https://doi.org/10.2760/852198.

Mainar-Causapé, A., S. McDonald, and E. Ferrari. 2018b. How to elaborate a Social Accounting Matrix (SAM). Basics, applications and major steps in estimating a SAM, JRC Technical Reports, Publications Office of the European Union: Luxembourg. https://doi.org/10.2760/010600.

Mainar-Causapé, A.J., P. Boulanger, H. Dudu, and E. Ferrari. 2020. Policy impact assessment in developing countries using Social Accounting Matrices: The Kenya SAM 2014. *Review of Development Economics* 1–22. https://doi.org/10.1111/rode.12667.

M'Amanja, D., and O. Morrissey. 2005. Fiscal policy and economic growth in Kenya (No. 05/06). CREDIT Research Paper.

McDougall, R.A. 1999. Entropy theory and RAS are Friends, GTAP Working Paper, 300, Department of Agricultural Economics. Purdue University.

McDowall, W., Y. Geng, B. Huang, E. Barteková, R. Bleischwitz, S. Türkeli, and T. Doménech. 2017. Circular economy policies in China and Europe. *Journal of Industrial Ecology* 21, no. 3: 651–61. https://doi.org/10.1111/jiec.12597

Powell, M., and J.I. Round. 2000. Structure and linkage in the economy of Ghana: A SAM approach. In *Economic reforms in Ghana: miracle or mirage*, ed. E. Aryeetey, J. Harrigan, and M. Nissanke. Oxford: James Currey (Accra: Woeli Publishing; Trenton NJ: Africa World Press). 68–87.

Pyatt, G., and J.I. Round. 1979. Accounting and fixed price multipliers in a social accounting matrix framework. *The Economic Journal* 89, no. 356: 850–73. https://doi.org/10.2307/2231503

Robinson, S., A. Cattaneo, and M. El-Said. 2001. Updating and estimating a social accounting matrix using cross entropy methods. *Economic Systems Research* 13, no. 1: 47–64. https://doi.org/10.1080/09535310120026247

Round, J. 2003. Constructing SAMs for development policy analysis: Lessons learned and challenges ahead. *Economic Systems Research* 15, no. 2: 161–83. https://doi.org/10.1080/0953531032000091153

Sassi, M. 2011. Global crisis and agricultural public spending in Kenya: A SAM Multiplier approach in Research Topics in Agricultural and Applied Economics Volume: 2, A.N. Rezitis (Ed.), Bentham Science Publishers, 121–142.

Taylor, J.E., and I. Adelman. 2003. Agricultural household models: Genesis, evolution, and extensions. *Review of Economics of the Household* 1, no. 1-2: 33–58. https://doi.org/10.1023/A:1021847430758

Tiberti, M. 2011. *The impacts of agricultural policy reform in Tanzania: An agricultural household model-based assessment*. Part of a PhD diss., University of Florence.

Wobst, P., and B. Schraven. 2005. *A 2001 social accounting matrix for Kenya*. Washington, DC: Food Policy Research Institute. https://doi.org/10.7910/DVN/PH2CCG