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Construction of a Social Accounting Matrix for Kenya 2009

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Abstract

This paper sought to construct a social accounting matrix for Kenya 2009 given that the most recent SAM dates back to 2003. The objective of this exercise was to construct a micro SAM incorporating accounts of individual activities, primary factors, and economic institutions and to balance the SAM using cross entropy method. The SAM 2009 provides a new opportunity for modelers to use most recent Kenyan SAM to undertake economy wide analysis.

Résumé

L'objectif de ce papier est de construire une matrice de comptabilité sociale de 2009 du Kenya, la plus récente remontant à l'année 2003. La micro-sam construite se devait d'incorporer les comptes individuels des activités, des facteurs primaires et des institutions économiques, le rééquilibrage reposant sur la méthode de l'entropie croisée. La SAM de 2009 ainsi construite donne de nouvelles opportunités aux modélisateurs dans leur analyse de l'économie dans son ensemble.

1. Background

A Social Accounting Matrix (SAM) is a matrix representation of transactions in a socio-economic system. It is generally a comprehensive and disaggregated framework that shows the generation of incomes by activities of production. It provides information on the income generation process of a country, generating details on the sources and destinations of transactions by economic institutions. Within the SAM framework, one is able to establish the income and revenue links between agents and institutions at an empirical level. Able to generate information on interdependencies in the socio-economic systems and the interaction between various agents within the socio-economic system, a SAM is therefore an important tool for economic analysis.

Pioneer work on social accounting techniques were undertaken by Stone (1978) and Pyatt and Round (1979, 1985). A SAM can be used to undertake several analytical questions, such as economic drivers of growth, the impact of public policies on millennium development goals, food security, and poverty reduction. However, such questions can only be answered depending on the level of disaggregation of a SAM and its availability. In Kenya, for example, the country has set out its development goals and strategies in the economic blue print "Kenya Vision 2030: A Globally Competitive and Prosperous Kenya," but the most recent SAM that can be used to undertake economy-wide analysis for Kenya dates back to 2003. Moreover, the level of disaggregation of the 2003 SAM does not allow for undertaking in-depth development analysis.

1.1 The Problem

"Kenya Vision 2030" has been put in place as the vehicle that will accelerate the transformation of the country into a rapidly industrialized middle income nation by 2030. The main anchors of this vision are macroeconomic stability, continuity in government reforms, enhanced equity and wealth creation opportunities for the poor, and development in infrastructure, energy science, and technology, among others. Under the economic pillar, six sectors are projected to experience a 10 percent growth rate per annum: tourism, agriculture, manufacturing, wholesale and retail trade, business process outsourcing, and financial services. While these are important sectors for the economy, there is no evidence on how the choice of these sectors as the main drivers of growth was reached. An analysis of the forward and backward linkages within the economy would greatly advise policy makers of the main sectors to focus on. This kind of information can be obtained from a detailed SAM.

Secondly, under the social pillar, education and health have been identified as factors that would ensure equitable social development in a just and cohesive society. Within the social sector, the government is expected to increase quality and access to social services through increased funding. It would be important to differentiate private and government production in a SAM in order to establish the

economy-wide effects of government social policies. Such an analysis is important in monitoring and evaluation of the medium term implementation framework of the Vision 2030. The Kenya SAM 2003 is too dated and lacks disaggregation needed to effectively analyse the economy-wide effects of the government's social policies and the millennium development goals which form an important part of social policies.

Lastly, there are new issues arising in the global arena such as climate change, energy use, and environmental conservation. Such issues should also be incorporated appropriately in an integrated data framework so that economy wide effects can be established. This is possible through examination within a SAM framework.

1.2 Objectives of the Study

The main objectives of this study are as follows:

- 1. To construct a micro SAM incorporating accounts of individual activities, primary factors, and economic institutions.
- To balance the SAM using cross entropy procedure in GAMs (General Algebraic Modeling System).
- 3. To construct a macro SAM that consistently captures and represents the macroeconomic framework for the Kenyan economy in 2009.

1.3 Significance of the Study

As previously mentioned, there are new issues arising in the global development arena-- climate change, clean energy development, and environmental conservation, for example-- and these issues are cross cutting and tend to affect different sectors of the economy. It is important to update the SAM so it can facilitate such analysis within a general equilibrium framework to determine the economy-wide impact of these developments. This study intends to construct a 2009 SAM that can be used to analyse the 21st century's emerging issues.

An additional significance of this study will be its contribution to currently ongoing research. For example, the Institute of Economic Affairs, a public policy think-tank, is involved in examining the impact of the Doha negotiations on poverty in Kenya within its trade programme. Initial impacts of the Doha on poverty have been undertaken under the project using the SAM for Kenya for 2003, which is quite dated. A more updated SAM will be appropriate in undertaking analysis of the impact of the on-going Doha negotiations. The same goes for analysis of Kenya under the FAO Policy Support Programme multi-country project "Impact assessment of development paradigms and related policies." This project is aimed at providing conceptual insights on the impact of selected development paradigms and policy assistance to address specific long term sustainable development issues relevant

to poverty and food security by means of strategies and policies. The methodology adopted is CGE analysis using country specific social accounting matrices; but again it would be beneficial to undertake the analysis using a more recent SAM since the only available SAM is for 2003.

Looking to the future, the updated SAM will contribute significantly to answering the 21st century challenges related to millennium development goals, trade liberalization impacts, climate change and environmental impacts. The SAM is intended to include components that would facilitate such analysis.

2. Methodology and Data

2.1 Methodology

2.1.1 Construct a micro SAM incorporating accounts of individual activities, primary factors, and economic institutions.

The 2009 micro SAM was derived from the Kenya 2009 supply and use table (SUT). The SUT is a main table in the system of national accounts. It can be used for both analytical and statistical purposes. The SUT's supply table shows the value of all commodities produced in the economy at basic and at purchaser's prices. The use table shows the value of production of each commodity and its use in the economy. In order to derive the SAM from the Kenya SUT 2009, the following issues were considered:

- a) Seventeen activity-commodity mappings using the broad economic category (BEC) classification were used based on the official data availed to the public.
- b) Institutions were disaggregated as follows:
 - 20 households from both rural and urban areas were included, disaggregated by deciles.
 - While the original intention was to disaggregate ROW to East Africa Community, European Union, United States, China and the Rest of the World, disaggregated services data was not available even though goods data was available. Consequently, the ROW was not disaggregated.
 - Taxes were disaggregated to income taxes, value added tax, import duty, and other taxes.
 - Margins were not disaggregated to domestic, import, and export costs due to data unavailability.
- c) Factors were aggregated as capital and labour (skilled, unskilled and semi-skilled).

The SUT (Table 2.1) was converted to a SAM (Table 2.2) reflecting relationship between the SUT and the SAM. For example, intermediate consumption (U1) in the SUT became the input-output matrix in the SAM (2,1) because intermediate consumption shows the commodities each activity uses to produce output. Compensation of employees (U8), which is a component of gross value added in the SUT, became factors (3,1) in the SAM, which is the value factor of production that activities use to produce

output. Taxes, which constitute value added (U8) in the SUT, became taxes paid by activities to institutions (4,1) in the SAM. The total for Column 1 in the SAM is the total cost of production, which equals total from for row 1, Gross output. Household and government consumption (U3 and U4 respectively) makes up final consumption in the SAM (2,4); this is the amount of commodities demanded by institutions. Gross fixed capital formation (U5) and changes in inventory (U6) form investment demand for commodities in the SAM (2,5). Exports (U2) in the SUT is the amount of commodities demanded by the rest of the world in the SAM (2,6). The row total for the second row in the SAM is the final demand for composite commodities, while the corresponding column total supply of the composite commodity. The composite nature of the commodities. Kerwat et al. (2009) also used this methodology for deriving the SAM for Libya.

Factor revenues and domestic and international institutional transfers and savings are derived from the integrated economic accounts. However, as most developing countries rarely produce the integrated economic accounts and the supply and use table in tandem, alternative data sources such as economic surveys (in the case of Kenya) and the central bank reports were used to derive this data.

2.1.2 Balance the SAM using cross entropy procedure in GAMs (General Algebraic Modeling).

Given that different data sources were used in deriving the 2009 SAM for Kenya, the SAM derived was initially unbalanced (i.e. rows were not equal to columns). The cross entropy method by Robinson and El- Said (2000) was then used to balance the SAM. Kerwat et al. (2009) explain that this approach attempts to find a new SAM which is consistent with the original matrix but whose corresponding rows and columns have the same totals. This balancing method minimizes the entropy distance of the new SAM from the initial SAM subject to the constraint that row and column totals are equal and will penalize larger deviations between two corresponding cells more heavily than smaller deviations. Each cell in a matrix represents a payment from a column *j* to a row *i* represented by $t_{i,j}$. The row totals must equal the column total so that

$$y_i = \sum_j t_{i,j} = \sum_j t_{j,i} \tag{1}$$

 y_i represents the total receipts and expenditures of account *i*. A SAM coefficient matrix *a* is constructed from a matrix T by dividing cells of each column by the column total so as to obtain:

$$a_{i,j} = \frac{t_{i,j}}{y_j} \tag{2}$$

The cross entropy method by Robinson and El Said (2000) for updating or balancing a SAM explains the estimation of coefficients of the input-output table. The objective is to find a new set of a_{ij} coefficient that minimizes the distance between the prior a_{ij} and the new estimated coefficient matrix.

$$\min\left[\sum_{i}\sum_{j}a_{i,j}\ln\frac{a_{i,j}}{\overline{a}_{i,j}}\right]$$
(3)

Subject to

$$\sum_{j} a_{i,j} y_{j}^{*} = y_{i}^{*}$$
(4)

$$\sum_{j} a_{j,i} = 1 \text{ and } 0 \le a_{j,i} \le 1$$
(5)

Forming the langrangian r and solving the equation (3)-(5) provides the solution (6). λ_i are the langrage multipliers associated with the information from the data and the prior.

$$a_{\bar{y}} = \frac{a_{\bar{y}} \exp(\lambda_{\bar{z}} y_{\bar{j}}^*)}{\sum_{\bar{y}} a_{\bar{y}} \exp(\lambda_{\bar{z}} y_{\bar{j}}^*)}$$
(6)

Table 2-1: Model Supply and Use Table

				SUPPL	AY TABLE				
Category of goods & services	Output at basic prices (S7)	Taxes and subsidies (S6)	Margins (85)	Supply at purchasers prices (S4)	s D Tota	ACTIVITIES Domestic supply at domestic price(S1) Total Supply at purchasers price (S8)		Total supply at purchasen price (S2)	y Imports (S3)
				USE	TABLE				
Category of goods & services	Output at basic prices (U7)	A	CTIVITIES		Exports (U2)	Household consumption (U3)	Gov. consumption (U4)	GFCF (U5)	Changes in inventory (U6)
		Intermediate cons	umption (input-out	put table)					
		V 1 11 1/170)	(UI)	1					
		Value added $(U8)$:	compensation of en	mployees,					
		taxes and su	osidies, mixed inco	mes					
		Output at p	ourchasers price (U	9)					

 Table 2-2: Model Social Accounting Matrix

		ACT	COMM	MARGINS	FACTORS	INST	SAV/INV	ROW
		(1)	(2)	(2')	(3)	(4)	(5)	(6)
ACT	(1)		Domestic Purchase SUT (S1)					
СОММ	(2)	Intermediate Consumption SUT (U1)				Final Consumption SUT (U3&U4)	Investment Consumption SUT (U5&U6)	Exports SUT (U2)
MARGINS	(2')		Transport and Trade margins SUT (S5)					
FACTORS	(3)	Gross Value Added SUT (U8)						
INST	(4)	Act. Taxes and Subsidies SUT (U8)	Com. Taxes and Subsidies SUT (S6)		Factor Revenues	Transfers		Transfers
SAV/INV	(5)					Domestic Savings		Foreign Savings
ROW	(6)		Imports SUT(S3)					

Table 2-3: Unbalanced Macro SAM Kenya 2009	Table 2-3:	Unbalanced	Macro	SAM	Kenya	2009
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							Enterprise					
	Activities	Commodities	Capital	Labour	Households	Government	S	Taxes	Investment	Stock	ROW	TOTAL
	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)	(C9)	(C10)	(C11)	TOTAL
Activities												
(R1)		4,383,505			344,629							4,728,134
Commodities												
(R2)	2,154,263				1,958,930	453,607			500,072	(1,932)	464,886	5,529,827
Capital												
(R3)	1,716,687											1,716,687
Labour												
(R4)	892,809											892,809
Households												
(R5)				892,809		662,199	196				435,013	2,164,360
Government												
(R6)								378,898			24,540	573,051
Enterprises												
(R7)			1,716,687								153,313	1,870,000
Taxes												
(R8)	(496)	298,897			209,098		41,012					548,511
Savings												
(R9)					(376,367)	(542,756)	1,828,792				(369,760)	539,909
Stock												
(R10)									(1,932)			(1,932)
ROW												
(R11)		882,135										882,135
TOTAL	4,728,134	5,529,827	1,716,687	892,809	2,164,360	573,051	1,870,000	548,511	498,140	(1,932)	882,135	

2.1.3 Construct macro SAM that consistently captures and represents the macroeconomic framework for the Kenyan economy in 2009.

The Macro SAM was derived by aggregating the micro SAM so that it consistently captured the macroeconomic framework of the economy is 2009.

2.2 Data Sources

The sources of the data and the year are shown on the table below:

Data	Source	Year
Supply and Use Table 2009	Kenya National Bureau of Statistics	2009
Household Income	Kenya Integrated Household Budget Survey	2005/2006
Labour Data	Kenya Integrated Household Budget Survey	2005/2006
Remittance Data	Central Bank of Kenya	2009
Tax Data	Economic Survey (Kenya)	2009
	Statistical Abstract (Kenya)	2009

The supply table shows the total supply of goods and services supplied in the economy in 2009. The supply table has three sub-matrices: the production matrix, which shows all products produced in the economy; the import matrix, which shows the imports of goods and services in the economy; and the valuation matrix, which has trade and transport margins, taxes, subsidies. The valuation matrix is largely used for converting basic output prices to purchasers' prices. The Use table shows the final use of goods and services in the economy. It provides the input structure of the economy. The two tables when combined produce a supply and use table (SUT), which can be used to obtain the following sub accounts for the social accounting matrix: input-output table, value added sub matrix, exports and imports and consumption data.

The Kenya Integrated Household Budget Survey (KIHBS) 2005/2006 data was collected with the main objective of obtaining a wide spectrum of socio-economic indicators required to measure monitor and analyse the progress in improving living standards in a single integrated household survey. This data contains information on demographics, housing, education, health, agriculture and livestock, enterprises, expenditure and consumption, household social amenities and community perspectives. From the KIBHS data, one is able to use the data on consumption, labour, and transfers to disaggregate the SAM accounts to a required level of aggregation for household domestic consumption, institutional transfers, and taxation. Tax levied on institutions was obtained from the Kenya Economic Surveys, while savings were taken as residuals.

3. Results and Discussion

A social accounting matrix for Kenya (2009) was constructed from various data sources as explained in section 2.2. The summarised Kenya SAM (2009) is provided in table 3.1, while table 3.2 gives the disaggregation to 17 commodities.

3.1 The Kenyan Economy

The gross domestic product¹ (GDP) at market price is approximately KES 1.7 trillion; this comes from 81 activities within the economy derived from the SUT. These activities have been categorized to 17 sectors by broad economic categories as shown on Table 3.3. The service sector is the largest contributor to GDP (around 50 percent). The manufacturing sector contributes 21 percent to GDP, while food manufacture constitutes 44 percent of manufacturing in general. Mining and quarrying seems to be a less developed sector, as it reduces GDP by 2.2 percent.

3.2 Total Value Added

Total value added, i.e. earnings received from the factors of production (capital in the form of profits paid to capital and labour in the form wages) is also known as GDP at factor cost. GDP at factor cost is KES 1.8 trillion. Production in Kenya is capital intensive, given that it constitutes around 65 percent, while labour (in the form of wages) takes the remaining 35 percent of the value added (see table 3.3). Agriculture, forestry and fishing, and real estate are the most capital-intensive economic sectors (35.3 and 14.3 percent, respectively). Disaggregated to skilled, unskilled and semi-skilled labour, more skilled labour is found in the social sectors of education and health. The public sector has unskilled and semi-skilled labour.

3.3 Intermediate Demand and Transaction Costs

Intermediate demand shows the demand for commodities and services used in the production process. This is shown in the SAM (Table 3.1) by cell (R2, C1), which amounts to KES 1.487 trillion. Intermediate consumption constitutes 39 percent of the total demand. The disaggregated SAM (Table 3.4) provides information on production technologies, i.e. how much input is used per unit of output. Manufactured foods, for example, use approximately 49 percent of inputs from agricultural sector.

The transport margins as shown on Table 3.1 sum up to zero; however, when disaggregated in Table 3.2, manufactured goods and transport and storage spend approximately KES 249 billion on margins. The row/column total for margins equal zero because the same margins are included in the wholesale and retail sector.

¹ This is given by the identity GDP=C+G+I+X-M i.e. GDP= private consumption + government consumption + investment + exports - imports.

3.4 Factor Income Distribution

Households receive their incomes from labour and transfers from government, enterprises, andROW (Table 3.1). Income from labour forms the highest proportion of household income source (41 percent), followed by transfers from government (30 percent), and remittances from abroad (28 percent). With the disaggregated SAM (Table 3.4), one can establish the sectors from which poor households obtain most of their income, with rural households obtaining most of their incomes from the agricultural sector while the rich urban households derive their incomes from manufacturing and services.

3.5 Consumption and Savings

Around 87 percent of household income is spent on commodities; the rest of the income is shared between tax and savings. Households have two sources of consumption: own production (KES 345 billion) and marketed production (KES 1.3 trillion). Overall households have negative savings (table 3.1), however, the disaggregated SAM, table 3.4 shows rural and urban households in the fourth decile having positive savings. The government is a major consumer of services such as public administration, education and health; and, like households, the government dis-saves, meaning that the government has a budget deficit. The private sector (enterprises) is the main saver in the economy.

3.6 Government and Investment

The government receives KES 379 billion in income from taxes: value added tax (VAT), income tax, import duties, other taxes, and transfers from the rest of the world. Income tax and value added tax constitutes approximately 63 percent of government income. Income receipt from the ROW is largely in the form of budgetary or development support. Investment demand (C9) is largely made up of mining and quarrying, non-food manufactures and construction. Savings from the enterprises largely finances this investment demand.

3.7 Foreign Trade

Exports (R2, C11) constitute almost 10 percent of domestic production, which amounts to KES 322 billion. Clearly the structure of exports has been changing in Kenya: while previously the main exports came from agriculture, currently 60 percent of the exports are from manufacturing and agricultural exports constitute 17 percent of the total exports. Manufacturing, which includes both food and other manufactured goods, has an export intensity (EI²) of 49.8 percent. Mining, on the other hand, has an EI of 19 percent.

Imports (R11, C2- table 3.1) constitute 35 percent of GDP, KES 601 billion. Non-food manufactured goods constitute 69 percent of imports. The top two import non-food manufactured products for Kenya are petroleum products and transport equipment. Total imports almost double exports, implying a huge negative trade

² Export Intensity = Exports/Gross output

balance. It is possible to establish the import penetration ratio from the disaggregated SAM, where mining and quarrying has a high import penetration ratio of 65 percent followed by other manufactured goods at 37 percent. Other manufactured goods consist of metallic and chemical products.

	Activities	Commodities	Capital	Labour	Households	Government	Enterprises	Taxes	Investment	Stock	ROW	
	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)	(C9)	(C10)	(C11)	TOTAL
Activities												
(R1)		2,977,922			344,629							3,322,551
Commodities												
(R2)	1,486,889				1,323,197	312,670			343,430	-1,362	322,432	3,787,256
Capital												
(R 3)	1,208,877											1,208,877
Labour												
(R4)	627,137											627,137
Households												
(R5)				627,137		465,905	143				435,013	1,528,197
Government												
(R6)								378,898			17,566	396,464
Enterprises												
(R7)			1,208,877								105,405	1,314,282
Taxes												
(R8)	-352	207,919			142,294		29,037					378,898
Savings												
(R9)					-281,923	-382,111	1,285,103				-279,001	342,068
Stock												
(R10)									-1,362			-1,362
ROW												
(R11)		601,415										601,415
TOTAL	3,322,551	3,787,256	1,208,877	627,137	1,528,197	396,464	1,314,282	378,898	342,068	-1,362	601,415	

Table 3-1: Balanced Macro SAM Kenya 2009 (KES Million)

Activities by Broad Economic Category (BEC)	Number of activities	SAM GDP	% Share of GDP
Agriculture, forestry and fishing	5	273,011	13.0
Mining and quarrying	1	4,196	(2.2)
Manufactured food	13	402,329	21.1
Other manufactured	17	513,688	5.8
Electricity and water	3	23,279	1.4
Construction	1	177,764	10.5
Wholesale and retail trade; repairs	2	4,039	0.1
Transport and storage	12	178,976	10.0
Accommodation and catering services	1	61,317	3.5
Information and communication	3	86,257	4.2
Financial and insurance services	5	63,571	3.5
Real estate services	1	65,867	3.9
Professional and support services	4	18,747	0.3
Public administration	1	169,007	9.9
Education	3	174,748	10.2
Health and social work	2	64,375	3.8
Other services	4	19,198	1.1

Table 3-2: GDP shares by Broad Economic Categories

Table 3-3: Distribution of Factors of Production

	Unskilled	Semi-Skilled	Skilled	Capital
Agriculture, forestry and fishing	11.7	6.5	4.2	35.3
Mining and quarrying	1.0	0.2	0.0	0.6
Manufactured food	5.3	2.9	1.8	4.1
Other manufactured	5.6	6.6	1.5	10.1
Electricity and water	1.9	2.1	0.0	2.1
Construction	3.7	5.1	7.3	3.7
Wholesale and retail trade; repairs	14.6	8.5	3.3	5.8
Transport and storage	6.4	6.7	6.0	8.2
Accommodation and catering services	3.5	2.1	2.2	1.5
Information and communication	1.5	5.0	3.3	3.6
Financial and insurance services	0.1	11.1	6.9	4.7
Real estate services	2.7	2.9	0.0	14.3
Professional and support services	5.7	2.3	2.9	2.1
Public administration	15.4	14.8	0.0	1.0
Education	18.0	14.6	37.2	0.8
Health and social work	2.2	7.8	14.4	0.1
Other services	0.7	0.7	9.1	2.0
	13.1	18.7	2.3	65.8

4. Concluding Remarks

The 2009 SAM has captured the key characteristics of the Kenyan economy. Services have been found to contribute 50 percent of gross domestic product (GDP), followed by manufacturing sector, which contributes 21 percent. The agricultural sector contributes the rest and is considered a key sector in the economy because it contributes an average of 30 percent to rural household incomes. Agricultural production has also been found to be capital intensive, constituting about 65 percent of value added in the agricultural sector. This sector also forms a major intermediate input (over 40 percent). Private sector savings finances investment demand in the economy. With a huge trade balance, it follows that there is a huge balance of payment deficit.

This SAM for Kenya 2009 has been built using the most recent and available data, namely the supply and use table (SUT) 2009 and KIBHS data set 2005/2006. Normally, an Integrated Economic Account (IEA) is required to produce the institutional transfers used in the SAM. Given that the Kenyan government does not produce this data set, several data sources were used. It is hoped that revised editions of this paper can be produced in the future with the availability of more recent household survey data. Additionally, the use of different data sources and the consequent SAM balancing tends to alter the final value of GDP even though the structure of the economy remains the same as the original SAM. One major way to solve this challenge is the use of consistent data sources from SUT and the IEA in SAM construction.

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