

The SAM: definition, construction, and adaptation for MAMS

Marco V. Sánchez Rob Vos
UN-DESA

Tegucigalpa, December 20, 2010

What is a SAM?

- A consistent and complete data system that captures the interdependence that exists within a socio-economic system.
- It includes both the I-O and national accounts and product accounts in a consistent framework.
- Originated from the pioneering work on national accounts by Meade and Stone (1940).
- First SAM developed by Nobel Laureate Richard Stone for the UK in 1962; work on developing countries took off in the 1970s.

Features of a SAM

- A comprehensive, economywide data framework.
- Social → often focus on incomes and spending of households of different types
- SAMs apply to all kinds of “economies”: globe, nation, region, village, household.
- Disaggregation and classification of accounts vary widely across different SAMs.
- Uses
 - Description: snapshot of economic structure
 - Data assembly : draws together data from disparate sources
 - Data organization: helps to check data consistency
- Key data source for economy-wide models (SAM multiplier models and CGE models)

Features of a SAM (cont.)

- Square matrix → identical row and column accounts.
- Each cell shows payment from its column account to its row account
- Accounting consistency → Column totals = row totals.
- Rules for SAMs in SNA (1993).
- A SAM says nothing about the behavioral and technical relationships that generated its values (producer goals, household goals, rules for government tax collection,).
- We assume (accept) that all data used to construct the SAM are “correct”.

Main account types in a (macro) SAM

- **Activities**: each activity produces one or more commodities using factor services and intermediates.
- **Commodities**: supplied by activities and/or via imports; demanded for exports and domestic final and intermediate use.
- **Factors**: services produced by stocks. Main types: labour, capital, land, other natural resources
- **Institutions**: Entities that own factors, consume and invest, receive or pay taxes and transfers. Main types: households, enterprises, government, rest of world. Each institution typically has a current account.
- **Auxiliary institutional accounts**: taxes, interest (rarely), saving, capital, and investment.

Stylized SAM and Its Notation

Table. Stylized SAM

	ag	na	l	k	u	r	tot
ag					50	75	125
na					100	50	150
l	62	55					117
k	63	95					158
u			60	90			150
r			57	68			125
tot	125	150	117	158	150	125	

Table. Notation in SAM

Item	Explanation
ag	agricultural sector
na	non-agricultural sector
l	labor
k	capital
u	urban household
r	rural household

Stylized SAM

- Key simplifications compared to real-world economy:
 - No government or taxes (see below)
 - No rest of world (see below)
 - No intermediate inputs
 - No separation of saving and investment from other payments (see below)

SAM-based CGE Model Calibration

- A typical CGE model is calibrated using a SAM.
- SAM-based calibration → On the basis of a data set for a base period given by the SAM, the parameters of the model are estimated in a manner that enables the model solution to precisely replicate the SAM.

Steps in Model Calibration

1. Prices and wages (P and W) set at one \rightarrow the related quantities reflect what is traded at a price of one.
2. Given (1) and selected values of SAM cells, base-year levels are defined for all remaining variables (quantities: Q , QF , QH ; incomes: YF and YH) and the factor supply parameter (qfs)
3. Share parameters (α , β , shr), among other types of parameters, are defined as shares of cell payments in column totals (for sectors, factors, and households)
 - When solved, the resulting model will replicate base-year data; the model solution can be used to define a SAM (which will be identical to the original SAM)
 - Larger models will require other data (i.e. factor quantities, elasticities, and so on).

Example: computing parameter values from an stylized SAM

	ag	ng	l	k	u	r	tot
ag					50	75	125
na					100	50	150
l	62	55					117
k	63	95					158
u			60 $\text{shr}(u,l) \cdot YF(l)$	90			150
r			57 $\text{shr}(r,l) \cdot YF(l)$	68			125
tot	125	150	117 $YF(l)$	158	150	125	

$\text{shr}(u,l)$	Labour income share of household "u"	$\text{shr}(u,l) = 60 / 117 = 0.51$
$\text{shr}(r,l)$	Labour income share of household "r"	
$YF(l)$	Total labour income	

Stylized SAM in Algebraic Format

	ag	na	l	k
ag				
na				
l	$W(l)*QF(l,ag)$	$W(l)*QF(l,na)$		
k	$W(k)*QF(k,ag)$	$W(k)*QF(k,na)$		
u			$shr(u,l)*YF(l)$	$shr(u,k)*YF(k)$
r			$shr(r,l)*YF(l)$	$shr(u,k)*YF(k)$
tot	$P(ag)*Q(ag)$	$P(na)*Q(na)$	$YF(l)$	$YF(k)$

	u	r	tot
ag	$P(ag)*QH(ag,u)$	$P(ag)*QH(ag,r)$	$P(ag)*Q(ag)$
na	$P(na)*QH(na,u)$	$P(na)*QH(na,r)$	$P(na)*Q(na)$
l			$W(l)*qfs(l)$
k			$W(k)*qfs(k)$
u			$YH(u)$
r			$YH(r)$
tot	$YH(u)$	$YH(r)$	

Assessment of SAM-based Model Calibration

- Main disadvantage: High dependence on data for one year; results may be misleading, especially if the year is exceptional or there are data errors. → Make sure the SAM is good!
- Main advantage: It makes it possible to develop a model that can address relatively detailed policy-relevant issues without asking for non-existent data and/or carrying out complicated economic estimations.
- Implications: Careful judgment has to be applied; draw on model for insights, not for exact numbers.

Macro SAM 1

Account	Explanation
act	production activity
com	commodity
hhd	household
gov	government
row	rest of world
sav-inv	saving-investment

Cells in Macro SAM 1

Item	Explanation
prod	production (output)
cons	consumption
exp	exports
imp	imports
va	value added
inv	investment
sav	savings
dtax	direct taxes
itax	domestic indirect taxes
mtax	import taxes (tariffs)

Macro SAM 1 – verbal explanations

	act	com	hhd	gov	row	sav-inv	total
act		prod					
com			cons	cons	exp	inv	
hhd	va						
gov	itax	mtax	dtax				
row		imp					
sav-inv			sav	sav	sav		
total							

Macro SAM 1 – numerical

	act	com	hhd	gov	row	sav-inv	total
act		93					93
com			75	25	10	20	130
hhd	90						90
gov	3	7	5				15
row		30					30
sav-inv			10	-10	20		20
total	93	130	90	15	30	20	

Macro SAM 2

- Includes sufficient detail to be constructed for any real-world economy using data for the national accounts, the government budget, and the balance of payments.
- Separate accounts for factors and taxes.
- Consolidated saving-investment account.

Accounts in Macro SAM 2

Account	Explanation
act	production activities
com	commodities
<i>fac</i>	<i>factors</i>
hhd	households (domestic non-government)
gov	government
RoW	rest of world
<i>tax-dom</i>	<i>domestic taxes</i>
<i>tax-imp</i>	<i>import taxes</i>
sav-inv	saving-investment (consolidated)

Cells in Macro SAM 2

Item	Explanation
prod	production (output)
cons	consumption
exp	exports
imp	imports
va	value added (=GDP at factor cost)
<i>va-g</i>	<i>value added paid to government</i>
<i>va-h</i>	<i>value added paid to household</i>
inv	investment
sav	savings
dtax	direct taxes
itax	domestic indirect taxes
mtax	import taxes (tariffs)
<i>trns</i>	<i>transfers</i>
<i>incf</i>	<i>factor income</i>

Micro (more detailed) SAM – standard version

- Disaggregation of accounts for:
 - activities, commodities, factors, households
 - SAM shows how different household groups earn and spend their incomes.
- Consolidated saving-investment account is maintained.
- It can be more and more micro though.

Accounts in “standard” Micro SAM

Account	Explanation	Account	Explanation
a-agr	activity - agriculture	h-rur	household - rural
a-ind	activity - industry	h-urb	household - urban
a-ser	activity - services	gov	government
c-agr	commodity - agriculture	tax-d	taxes - domestic
c-ind	commodity - industry	tax-m	taxes - imports
c-ser	commodity - services	row	rest of world
f-lab	factor - labor	s-i	saving-investment
f-cap	factor - capital		

Micro SAM - numerical

	a-agr	a-ind	a-ser	c-agr	c-ind	c-ser	f-lab	f-cap	h-rur	h-urb	gov	tax-d	tax-m	row	s-i	total
a-agr				7.9												7.9
a-ind					25.3											25.3
a-ser						19.8										19.8
c-agr	0.3	2.7	0.1						1.3	0.6				3.0	0.0	7.9
c-ind	1.3	7.8	4.6						5.2	7.5	0.3			2.5	5.4	34.6
c-ser	2.0	4.2	2.1						2.5	3.0	4.5			1.6	0.3	20.3
f-lab	1.4	3.8	7.6													12.9
f-cap	2.0	6.0	4.8													12.8
h-rur							1.6	2.0		5.8	1.1			0.1		11.2
h-urb							11.2	10.8		3.3	1.6					26.9
gov											5.2	1.9		0.3		7.4
tax-d	0.2	0.7	0.5						0.7	3.0						5.2
tax-m				0.0	1.8	0.1										1.9
row				0.1	7.5	0.5	0.0			0.5	0.4					9.0
s-i									1.4	3.2	-0.5			1.6		5.7
total	7.9	25.3	19.8	7.9	34.6	20.3	12.9	12.8	11.2	26.9	7.4	5.2	1.9	9.0	5.7	

SAM for MAMS: *Macro Version*

- Minimum account disaggregation:
 - Activities/commodities: government, private
 - Factors: labour, private capital, government capital
 - Institutions: household, government, rest of world
 - **Important extension from the standard SAM!**
 - Accounts of each institution: current (= named after the institution) **but also capital.**
 - Other institution-related accounts: taxes **but also interest payments.**
 - **One investment account per capital stock**

Cells in SAM for MAMS: *Macro Version*

Item	Explanation
prod	production of gov/priv commodity
cons	gov/hhd consumption of gov/priv commodity
exp	exports of private commodity
imp	imports of private commodity
interm	intermediate use of priv commodity by gov/priv activity
va	value added to labor/priv-capital from priv/gov activity
va-h	value added to hhd from labor/capital
incf	factor income to capital/RoW from RoW/capital
sav	gov/hhd/RoW savings
borr	borrowing
inv	investment use of private commodity for gov/priv capital
inv-g	investment in gov capital financed by gov
inv-p	investment in priv capital (financed by hhd or RoW)
dstk	stock change for priv commodity
dstk-g /dstk-h	stock change financed by gov / stock change financed by hhd
dtax	direct taxes
itax	domestic indirect taxes
mtax	import taxes
trns	transfers to gov/hhd/RoW from gov/hhd/RoW
intd	domestic interest to hhd from gov
intr	RoW interest (total)
intr-g /intr-h	RoW interest from gov / RoW interest from hhd

Numerical SAM for MAMS: Macro Version

	a-prv	a-gov	c-prv	c-gov	f-lab	f-capprv	hhd	gov	row	tax-dom	tax-imp	int-dom	int-row	cap-hhd	cap-gov	cap-row	inv-prv	inv-gov	dstk	total
a-prv		145.5																		145.5
a-gov			22.7																	22.7
c-prv	60.8	9.5				71.6		12.2									16.0	4.7	0.0	174.9
c-gov	1.4					6.2	15.2	0.1									0.0	0.0		22.9
f-lab	41.0	10.7																		51.7
f-capprv	37.8	2.2																		40.0
hhd				50.6	39.1		1.2	1.7				1.0								93.6
gov								7.0	7.7	3.5										18.3
row			25.8	0.2	1.1	0.9						0.5								28.4
tax-dom	4.5	0.3				3.0														7.7
tax-imp			3.5																	3.5
int-dom							1.0													1.0
int-row							0.5													0.5
cap-hhd						12.8														12.8
cap-gov							0.5						-0.2		4.3					4.7
cap-row								7.4												7.4
inv-prv													13.0		3.0					16.0
inv-gov														4.7						4.7
dstk												0.0								0.0
total	145.5	22.7	174.9	22.9	51.7	40.0	93.6	18.3	28.4	7.7	3.5	1.0	0.5	12.8	4.7	7.4	16.0	4.7	0.0	

SAM for MAMS: *Macro Version*

Is there monetary sector?

- Given that the MAMS Macro SAM is economy-wide and consistent, the monetary sector must be “hidden” or “netted out” under other accounts.
- MAMS’ treatment of the monetary sector:
 - its current account: merged with service activities/commodities
 - its capital account: merged with the government capital account
- Note: Macro consistency matrices that treat the monetary sector as a “pure intermediary” often do not have any separate *current* account for the monetary sector.

SAM for MAMS: *Macro Version*

Is there monetary sector? (cont.)

- Cells in the government capital account that are influenced by the monetary sector:
 - sam(cap-gov,cap-hhd):
 - net direct borrowing to government from household (on which the government pays interest) *PLUS*
 - net increase in the claims of the household sector on the monetary sector (= [changes in broad money] – [monetary sector credit to the household]).
 - sam(cap-gov,cap-row):
 - net direct borrowing to the government from the rest of the world *MINUS*
 - increases in foreign exchange reserves.

SAM for MAMS: What other new dimensions?

- Additional focus of the **MDG version of MAMS**: human development (health, education, water-sanitation).
- Given this, its SAM also needs to disaggregate:
 - government and private sectors (activities – commodities – investments – capital stocks) in areas related to human development services;
 - labour by educational attainment to capture the effects of education on the productivity of the labour force
- Disaggregation of the government also makes it possible to single out government sectors providing productivity-raising infrastructure services.

SAM for MDG version of MAMS: typical additional disaggregations

- Government activity, commodity and investment disaggregated into education (primary, secondary, tertiary), health, water and sanitation, public infrastructure (roads, bridges, airports, and so on), and other government (public administration and other services).
 - MDG-related sectors → education, health, and W&S.
- Labour disaggregated by educational achievement into labour with less than completed secondary, with completed secondary but not tertiary, and with completed tertiary.
- Private activity and commodity into private agriculture, industry, and services, the latter split further to single out MDG-related services provided by the private sector (education, health, and maybe water & sanitation if this is a regulated sector).
- Private capital into private capital (defined more narrowly), agricultural land, and/or natural resources.
- Public capital? → unusual and may only reflect depreciation.
- Household and related capital account into rural/urban or by income characteristics if needed.

Steps in SAM construction

1. Create macro SAM from data for national accounts, government budget, and the balance of payments.
2. If needed, create a more disaggregated “micro” SAM:
 - Use data in macro SAM as control totals;
 - Selectively disaggregate accounts for activities, commodities, factors, institutions (esp. households); let the disaggregation be driven by your purpose (our purpose is to calibrate MAMS!);
 - Additional data sources for micro SAM: existing SAMs, input-output tables; disaggregated trade data; surveys (households, labour market), miscellaneous studies (inter alia on production sectors, human development and public finance).
3. Putting all together will likely result in an unbalanced SAM. What to do? Try to balance manually, using plausible assumptions regarding cells that are likely to serve as residuals (e.g. institutional savings). The problem cannot be solved, what to do next?
4. Estimate a balanced SAM using a method (e.g. with entropy method) → we should be able to assist you on this!

Key references

- Pyatt, Graham and Jeffery I. Round. 1985. Social Accounting Matrices: A Basis for Planning. A World Bank Symposium. World Bank, Washington, D.C.:
- Reinert, Kenneth A., and David W. Roland-Holst. 1997. "Social Accounting Matrices," pp. 94-121 in Joseph .F. Francois and Kenneth. A. Reinert (eds.), Applied Methods for Trade Policy Analysis, Cambridge: Cambridge University Press.
- Robinson, Sherman, Andrea Cattaneo and Moataz El-Said. 2001. Updating and Estimating a Social Accounting Matrix Using Cross Entropy Methods. Economic Systems Research, Vol. 13, No. 1, pp. 47-64.
- Round, Jeffery I. 2003. Constructing SAMs for Development Policy Analysis: Lessons Learned and Challenges Ahead. Economic Systems Research, Vol. 15, No. 2, June, pp. 161-183.
- Round, Jeffery I. 2003. Social Accounting Matrices and SAM-based Multiplier Analysis. Ch. 14 in eds. François Bourguignon and Luiz A. Pereira da Silva. The Impact of Economic Policies on Poverty and Income Distribution: Evaluation Techniques and Tools. World Bank and Oxford University Press, Washington, D.C. and New York, pp. 301-324.
- Stone, Richard. 1984. The Accounts of Society. Nobel Memorial Lecture.