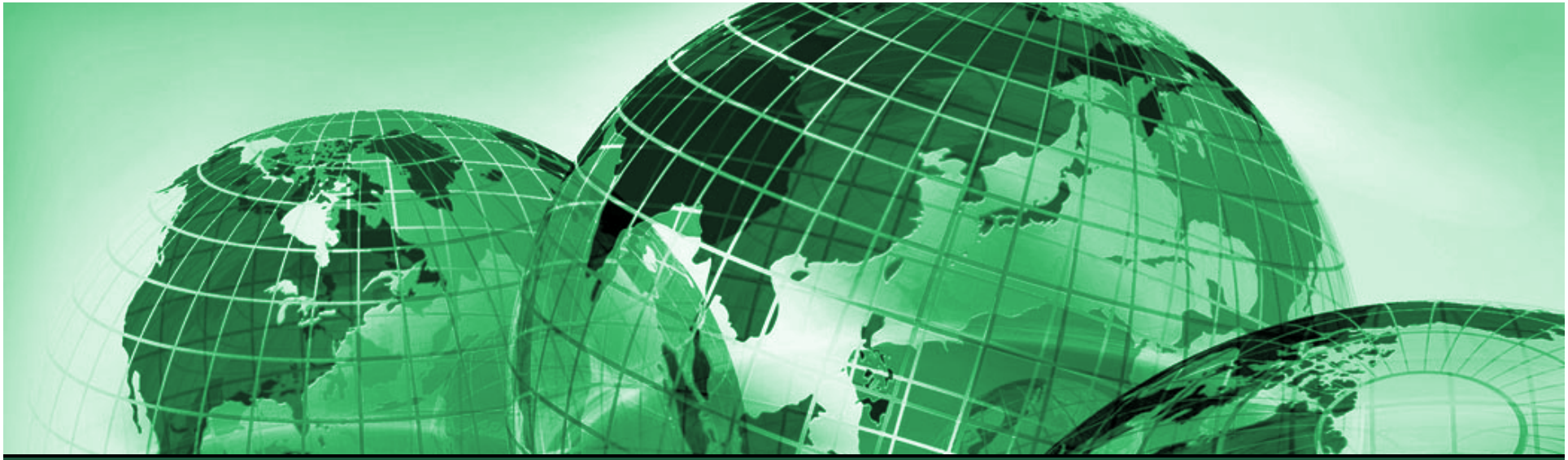

Scope and Applications of SAM and CGE Analysis

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A Short History of SAMs and CGE

There are two broad classes of economy-wide models:

- 1) The first class of models are fundamentally econometric. Most of you have probably seen/used these types of models in your econometrics courses. Macro-econometric models are useful for short-term forecasting, not for modeling adjustment processes.
- 2) The second class of models are "bottom-up" general equilibrium (GE) models that are based on a consistent set of macro and micro accounts. GE models are useful for modeling structural change.

SAM Introduction

- Detailed and rigorous accounting practices always have been at the foundation of sound and sustainable economic policy.
- A consistent set of real data on the economy is likewise a prerequisite to serious empirical work with economic simulation model.
- For this reason, a complete general equilibrium modeling facility stands on two legs: a consistent economywide database and modeling methodology.

Multi-Sectoral Development Analysis

- Macro policy is important, but so are economic structure and economic interactions.
- Indeed, linkages and indirect effects are often more important than the direct targets of policy.
- To improve visibility for policy makers and make appropriate recommendations, we need to understand these interactions.

What is needed?

To successfully develop a detailed, consistent, and up-to-date SAM, four ingredients are needed:

1. Official commitment
2. Component data resources
3. Methodology
4. Expertise and, where this is lacking, talent
5. Computer hardware and software

Fortunately, we are in a strong position in all these areas.

What is a SAM?

- An economy-wide accounting device to capture detailed interdependencies between institutions and sectors/regions. An extension of input-output analysis.
- A SAM is a form of double entry book keeping that itemizes detailed income and expenditure linkages across the economy.
- It is a closed form accounting system, reflecting the general equilibrium structure of the underlying economic relationships.

SAM Concepts

- A SAM is a square matrix that builds on the input-output table - but it goes further.
- A SAM considers not only production linkages, but tracks income-expenditure feedbacks (institutions are introduced).
- Each transactor (such as factors of production, households, enterprises, the government and the ROW) has a row (income sources) and a column (expenditures) – double entry national income accounting.
- A SAM is consistent data system that provides a snapshot of the economy – note that the SAM reconciles data from different sources.
- Detail is on the the biggest virtues of the SAM approach, but we actually build SAMs from the top down.

I/O to SAM

- At a basic level, the SAM extends the I/O by adding income and transfer accounts, thereby closing the flow of income, i.e.,

I/O

	L	**F**
	V	

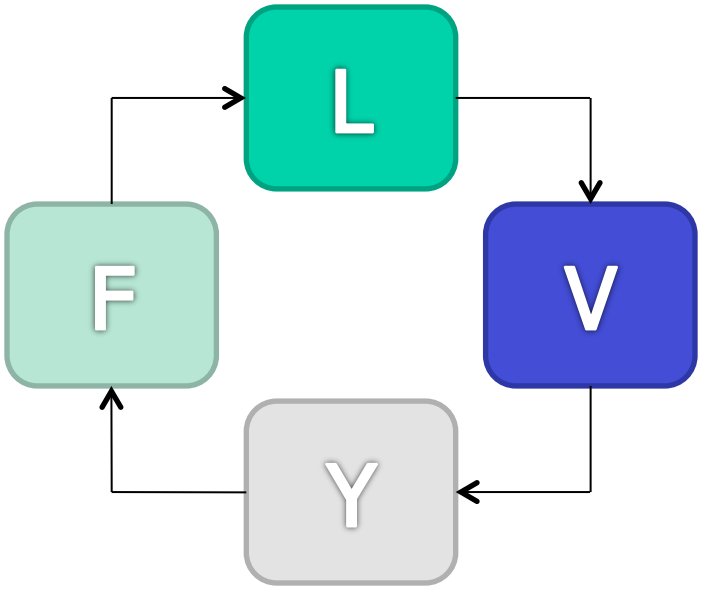
⟶ **SAM**

	L		**F**
	V		
		Y	T

where L is the matrix of I/O intermediate transactions, V is value added, F is final demand expenditure, Y is the domestic income, and T represents institutional transfers.

SAM Circular Flow of Income

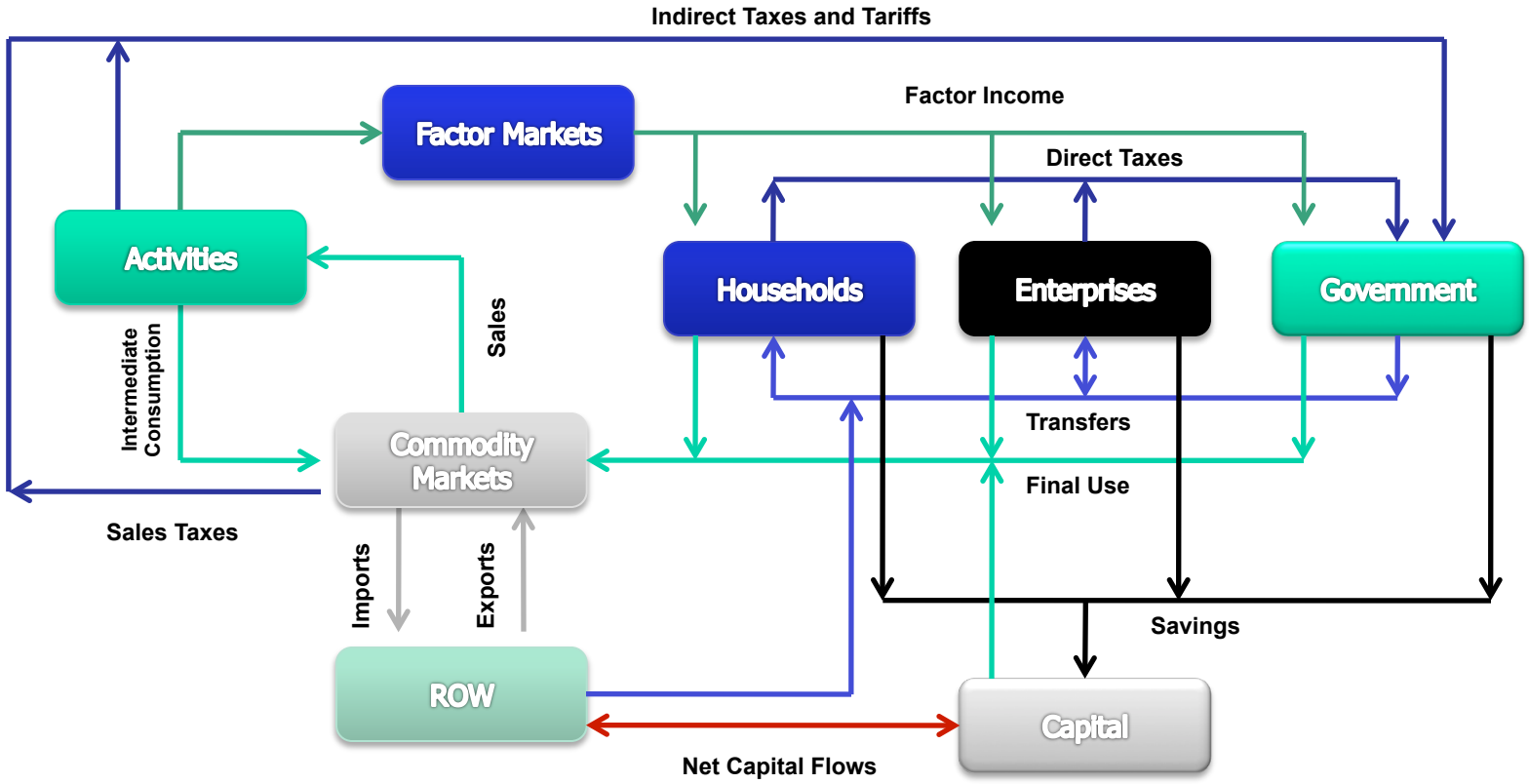
- A simplified circular flow of income is clearly visible from the SAM



- V maps income to factors, Y maps factors to institutions, F maps institutional income to A, A pays V.

SAM Circular Flow of Income

- A more detailed mapping of income flows:



SAM Feedbacks

- The circular flow of income is a very important concept in SAMs. Whereas I/O tables capture indirect linkages through inter-industry structure, SAMs also capture feedback effects because they include the induced effects of circular income flows on production.
- Induced effects refer to the new demand for goods and services caused by institutions spending their new income that results from new output induced by an exogenous shock.

SAM Interdependency

- By bringing together all economic accounts, SAMs contain the full range of interdependencies in a socioeconomic system:
- The SAM connects:
  - Production of goods and services
  - Generation of factor incomes
  - Levels and distributions of income available to institutions
  - Transfer payments and savings by institutions
  - Expenditures on goods and services

Main Features of a SAM

There are three main features of a SAM (Round, 2003)

- Square. SAM accounts are represented as a square matrix (note that the I/O table is typically not), where inflows-outflows for each account are rows-columns; this structure shows interconnections between agents in an explicit way.
- Comprehensive. SAMs portray all economic activities: production, consumption, accumulation, distribution.
- Flexible. SAMs are flexible in aggregation and emphasis.

SAM Uses

SAMs are useful for:

- Data Reconciliation. SAMs provide a coherent and consistent framework for bringing together data from many disparate sources, highlighting potential inconsistencies in data and thus improving data quality.
- Structural Insights. SAMs show clearly the structural interdependencies underlying an economy.
- Modeling. SAMs provide an accounting and analytical framework for fixed price multiplier (FPM) and CGE models.

SAM Construction

- We will begin with a national macro SAM and work our way down to a regional micro SAM.
- Because many of you are working on building sub-national SAMs, this approach is likely the approach that many of you will use in your projects.
- These macro-micro and micro-macro directions are often complementary: We will use the macro SAM as a means to maintain consistency for the micro SAM, and the micro SAM as a means to check the accuracy of our data in the macro SAM.

SAMs from a Macroeconomic Perspective

A macroeconomic SAM is also an extension of basic national income identities:

1. $Y + M = C + G + I + E$ (GNP)
2. $C + T + Sh = Y$ (Income)
3. $G + Sg = T$ (Govt. Budget)
4. $I = Sh + Sg + Sf$ (Savings-Investment)
5. $E + Sf = M$ (Trade Balance)

Schematic Macroeconomic SAM

			Expenditures			
Receipts	1	2	3	4	5	Total
1. Suppliers	-	C	G	I	E	Demand
2. Households	Y	-	-	-	-	Income
3. Government	-	T	-	-	-	Receipts
4. Capital Acct.	-	S_h	S_g	-	S_f	Savings
5. Rest of World	M	-	-	-	-	Imports
Total	Supply	Expenditure	Expenditure	Investment	ROW	

More General SAM

	ACT	COM	VA	HH	GOV	INV	ROW	TOTALS
ACT		Gross Output						Receipts
COM	Intermed. Use			Household Consumption	Government Expenditure	Gross Investment	Exports	Demand
VA	GDP at Factor Cost							Factor Income
HH			GDP at Factor Cost				ROW Trans. to HH	Household Income
GOV	Net Indirect Taxes			Household Taxes			Government Borrowing	Government Revenue
INV				Household Saving	Government Saving		Current account balance	Savings
ROW		Imports						ROW
TOTALS	Payments	Supply	Factor Allocation	Household Expenditure	Government Expenditure	Investment	ROW	

Two Mongolian SAMs

An independent estimate:

http://are.berkeley.edu/~dwrh/ERINA_NSO_UCB_Mongolia/

Submitted to GTAP 8:

http://are.berkeley.edu/~dwrh/ERINA_NSO_UCB_Mongolia/

SAM to CGE

- The SAM provides a snapshot of the economy at equilibrium (columns equal rows), but it is a static equilibrium with fixed prices, no substitution, and typically average behavior.
- On the contrary, in many cases what we are interested in examining is how economic actors respond to changes in relative prices.
- CGE allows for flexible prices, substitution, and marginal behavior, at the same time meeting the accounting constraints enforced by SAM structure.

SAM to CGE

- To put this another way, CGE models overcome the shortcomings of a SAM by specifying a functional form for every cell in the SAM.
- Each cell in the SAM can be represented by a price and quantity, so the model must be able to determine both prices and quantities.
- Let's start with a VERY simple CGE model, then work our way to something a bit more complicated.

Very Basic CGE

- To see how we go from a SAM to a CGE model, let's begin with a 2-sector, 2-factor really simple SAM (RSS):

	Producers		**Factors**		**Institutions**	**ROWSUM**
	AG	OTH	L	K	HH	
AG					150	150
OTH					500	500
L	100	200				150
K	50	300				150
HH			300	350		650
COLSUM	150	500	300	350	650	

Our Simple Economy

- Note that the government is not an economic actor, the economy is closed, factor costs are the only input to production, and households spend all their income.
- In this case, we have three economic actors
  - Producers (2; AG and OTH)
  - Factors (2; L and K)
  - Households (1)
- Let's further assume that labor and capital are fully mobile across sectors (1 wage and rental rate).

Side Note

- (Let's maintain our convention of having i be rows and j be columns; this means that i will reflect the income side of the economy and j will reflect the expenditure side of the economy).

Supply

- On the supply side, at a minimum we need to specify how producers behave (e.g., minimize costs), how they choose inputs (factor demands), and how their decisions determine aggregate supply. Using a Cobb-Douglas form, we can describe production within our economy as:

Labor Demand $$LD_j = \frac{\alpha_j P_j XS_j}{w}$$

Capital Demand $$KD_j = \frac{(1-\alpha_j) P_j XS_j}{r}$$

Total Supply $$XS_j = A_j {LD_j}^{\alpha_j} {KD_j}^{1-\alpha_j}$$

Demand

- On the demand side, we need to specify the level of household income, and how households decide to spend that income. Household income is the sum of factor incomes:

$$Y = w \sum_j LD_j + r \sum_j KD_j$$

(Remember that we are decomposing SAM transactions into prices and, in this case, volumes.)

Demand

- Household consumption is modeled with a constant elasticity of substitution (CES) utility function:

$$U = \left[\sum_i \delta_i C^{\rho}\right]^{1/\rho}$$

Maximizing U s.t. a budget constraint gives us the two reduced form consumption functions:

$$C_{AG} = \frac{Y}{P_{AG} + P_{OTH}\left[\left(\frac{1-\delta}{\delta}\right)\frac{P_{AG}}{P_{OTH}}\right]^{\sigma}} \qquad C_{OTH} = \frac{Y}{P_{OTH} + P_{AG}\left[\left(\frac{\delta}{1-\delta}\right)\frac{P_{OTH}}{P_{AG}}\right]^{\sigma}}$$

Equilibrium

- Lastly, we need to define some sort of equilibrium conditions for the economy, which in our case we can represent by supply = demand in product and factor markets.

Commodity Market $$XS_i = C_i$$

Labor Market $$LS = \sum_j LD_j$$

Capital Market $$KS = \sum_j KD_j$$

Endogenous Variables

- In 13 equations we have built a simple general equilibrium model.
- Our 13 endogenous variables include:
  - P_i – prices for AG and OTH goods
  - r – rate of return on capital
  - w – wage rate
  - LD_j – labor demand for AG and OTH producers
  - KD_j – capital demand for AG and OTH producers
  - XS_j – aggregate supply
  - C_i – household consumption of AG and OTH goods
  - Y – household income

Exogenous Variables

- We have left 2 variables exogenous:
  - LS – Aggregate labor supply
  - KS – Aggregate capital supply

Initializing Prices

- Prices are going to be endogenous in our simple CGE model, but we are going to represent prices in a price index rather than as absolute values. Prices can be initialized to any level, but 1 is generally the most obvious choice.
  - $P_{AG} = 1$ $P_{OTH} = 1$
- We select P_{AG} as the numeraire, which fixes our economy-wide relative price as
  - $P = P_{OTH} / P_{AG}$

Initializing Prices

- We represent factor prices in the same way (as an index). In contrast to goods, however, we might want to initialize wages and rental rates at different levels to represent a factor price ratio that differs from unity
  - $w = 0.8$
  - $r = 1$
  - (i.e., capital is more expensive in relative terms than labor)

Initializing Endogenous Variables

- We can assign values to endogenous variables based our SAM:
  - $LD_{AG0} = 100$ $LD_{OTH0} = 200$
  - $KD_{AG0} = 50$ $KD_{OTH0} = 300$
  - $XS_{AG0} = 150$ $XS_{OTH0} = 500$
  - $C_{AG0} = 150$ $C_{OTH0} = 150$
  - $Y_0 = 650$

SAM Check

	Producers		Factors		Institutions	ROWSUM
	AG	OTH	L	K	HH	
AG					150	150
OTH					500	500
L	100	200				150
K	50	300				150
HH			300	350		650
COLSUM	150	500	300	350	650	

Discussion?