Introduction to Social Accounting Matrices and Computable General Equilibrium Models

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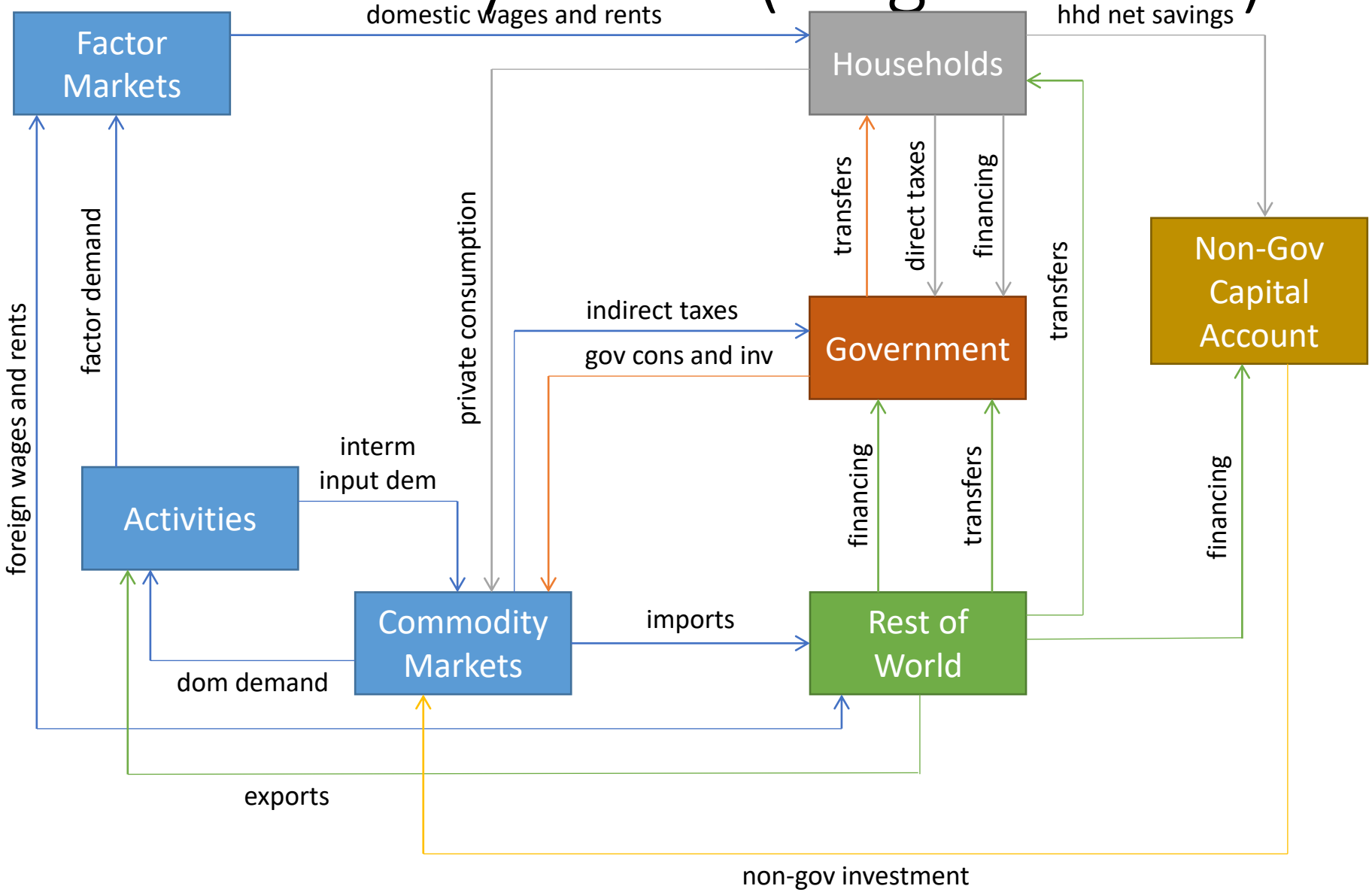
- Computable General Equilibrium (CGE) Models
- Social Accounting Matrix (SAM)
  - Relation between I/O Matrix and SAM

What is a CGE model?

- A CGE model is the computer representation of a real economy; links between
  - (multiple) productive sectors, factors, households, government, and BoP
- Mathematically, a CGE model is a system of simultaneous non-linear equations.
- Types of equations:
  - behavioral (e.g., profit maximizing producers)
  - balance/equilibrium (e.g., savings = investment)
  - definitions (e.g., household income)

Circular Flow of Payments (Single Period)



What is a CGE Model? – cont.

- In general, models have a common core and details depend on context.
- For each agent, explicit decision rules, subject to budget and resource constraints, acting in markets.
- SAM (Social Accounting Matrix) is the major data source.
- Typically, used for ex-ante simulation analysis in a wide range of policy areas
  - trade, taxation, sector, poverty/inequality, natural resources and environment, labor, demography

What is a SAM?

- A SAM is
  - a comprehensive, economy-wide data framework
  - a square matrix with identical row and column accounts where each cell shows payment (at current prices) from its column account to its row account
  - used for descriptive purposes and as the key data input for CGE models (which explain SAM payments)

Definitions: GDP and Non-GDP Sectors

- GDP (or SNA) [this session] =
  - market
  - non-market production, typically by government
  - home production for home consumption of goods, also non-market
  - e.g., production of food for self-consumption
- Non-GDP (or non-SNA) [next session] =
  - home production for home consumption of services, also non-market
  - e.g., unpaid domestic and care work

SAM Construction: Top-Down Approach and Main Data Sources

- Typically, we will begin with a national macro SAM and work our way down to a “meso” SAM
  - we use the macro SAM to maintain consistency for the “meso” SAM
- Ideally, the main data sources are Supply and Use Tables (SUTs) and Integrated Economic Accounts (IEA)
  - most countries produce SUTs yearly or every 5/10 years. It is possible to update an existing SUTs using techniques such as cross entropy.
  - not all countries produce IEA; they might be replaced with data on
    - (a) government receipts and expenditures, and
    - (b) balance of payments.

How to Build a SAM: Main Data Sources Korea 2018

- 2018 Supply and Use Tables (SUTs) – 78 activities and 83 commodities
- 2018 Integrated Economic Accounts (IEA)
- To single out various labor categories and representative households,
  - Labor Force Survey
  - Household Income and Expenditure Survey

Standard (GDP) Meso (2-sector) SAM Korea 2018 (GDP%)

	a-oth		a-repr-gdp		c-oth	c-repr-gdp	marg	f-lab-m	f-lab-f	f-cap	tax-indir	tax-dir	hhd	gov	row	sav-inv	to
a-oth			219.6														219.6
a-repr-gdp				1.7													1.7
c-oth	129.3	0.5			13.7								47.5	15.0	42.0	31.4	279.4
c-repr-gdp													1.7				1.7
marg			13.7														13.7
f-lab-m	34.2	0.1													0.0		34.3
f-lab-f	14.1	0.8													0.0		14.9
f-cap	40.9	0.3															41.3
tax-indir	1.0	0.0	8.5														9.6
tax-dir													9.4				9.4
hhd								34.2	14.9	38.3				7.3	0.4		95.1
gov										3.0	9.6	9.4	8.6		0.0		30.6
row			37.6					0.1	0.0				0.2	0.2			38.0
sav-inv													27.7	8.2	-4.5		31.4
total	219.6	1.7	279.4	1.7	13.7			34.3	14.9	41.3	9.6	9.4	95.1	30.6	38.0	31.4	

Notation in SAM

Account	Descrption
a-oth	activities - all other
a-repr-gdp	activities - reproductive/care GDP
c-oth	commodities - all other
c-repr-gdp	commodities - reproductive/care GDP
f-lab-m	labor - male
f-lab-f	labor - female
f-cap	capital
tax-indir	tax - indirect
tax-dir	tax - direct
hhd	institutions - households
gov	institutions - government
row	institutions - rest of the world
sav-inv	savings-investment

Relation between I/O Matrix and SAM

- SAMs “close” the input/output tables by adding
  - income-expenditure relationships
  - institutional detail
- (In fact, it is the institutional detail that is responsible for the “social” part of the social accounting matrix name. Indeed, a SAM without detailed factor and household accounts has little “social” information in it.)

Relation between I/O Matrix and SAM – cont.

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

I/O Matrix

	sect	hhd
sect	A	F
fac	V	

Social Accounting Matrix

	sect	fac	hhd
sect	A		F
fac	V		
hhd		Y	T

where A = matrix I/O coefficients, V = dist value added, F = dist expenditure, Y = dist income, and T = dist institutional transfers.

Relation between I/O Matrix and SAM – cont.

- I/O tables usually present information
  - separately for domestic and imported purchases – useful (required) to assess value chains
  - alternatively, total (domestic + imported) purchases
- Typically, SAM only records total purchases – as in use matrix (see below).
- Besides,
  - I/O tables → industry by industry basis
  - SAMs → industry by product basis.

Feedback Effects in SAM

- The circular flow of income is a very important concept in SAMs – difference with respect to I/O tables.
  - 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

Interdependencies in SAM

- By bringing together all economic accounts, SAMs contain the full range of interdependencies in a socioeconomic system:
  - 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

Three Main Features of a SAM (Round, 2003)

- **Square**. SAM accounts are represented as a square, 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, and distribution.
- **Flexible**. SAMs are flexible in aggregation and emphasis.

SAM Uses

- **Data Reconciliation**. SAMs provide a coherent and consistent framework for bringing together data from many disparate sources
  - may highlight inconsistencies in data – improvement in 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
  - calibration; e.g., distribution parameters

Data Reconciliation

- Typically, economic data is collected by different government agencies, and often there is little attempt to reconcile it even though the individual data is used without question; e.g.,
  - national income accounts data is usually based on production surveys
  - household survey data often show results that conflict with national data
- Thus, data reconciliation is one of the most valuable uses of SAMs
  - highly relevant in the case of several developing countries

CGE Model Calibration – Cobb-Douglas Production Function

$$Q_a = \phi_a \cdot K_a^{\delta_a^k} \cdot LM_a^{\delta_a^{lm}} \cdot LF_a^{\delta_a^{lf}}$$

where

a = activities

Q_a = output

LM_a = male labor

LF_a = female labor

ϕ_a, δ_a^k, δ_a^{lm} y δ_a^{lf} = calibrated parameters

CGE Model Calibration – CES Production Function

$$Q_a = \phi_a \cdot \left(\delta_a^k \cdot K_a^{\frac{\sigma_a - 1}{\sigma_a}} + \delta_a^{lm} \cdot LM_a^{\frac{\sigma_a - 1}{\sigma_a}} + \delta_a^{lf} \cdot LF_a^{\frac{\sigma_a - 1}{\sigma_a}} \right)^{\frac{\sigma_a}{\sigma_a - 1}}$$

where

a = activities

Q_a = output

LM_a = male labor

LF_a = female labor

ϕ_a, δ_a^k, δ_a^{lm} y δ_a^{lf} = calibrated parameters

σ_a = elasticity of substitution; free parameter

Macro SAM with Cell Interpretations

Receipts	Expenditures Activities	Commodities	Factors	Households	Government	Rest of World	Savings-investment	Totals
Activities		Sales						Activity revenue
Commodities	Intermediate inputs			Consump-tion	Consump-tion	Exports	Investment	Commodity demand
Factors	Value added					Wages, rents		Factor income
Households			Wages, rents		Transfers	Transfers		Household income
Government	Taxes	Taxes (incl. tariffs)	Taxes, rents	Taxes		Transfers		Government income
Rest of World		Imports	Wages, rents	Transfers	Transfers			FOREX outflow
Savings-investment				Savings	Savings	Savings (cur. acc't deficit)		Savings
Totals	Activity spending	Commodity supply	Factor spending	Household spending	Government spending	FOREX inflow	Investment	