

# Macroeconomics for CGE Modeling

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# Outline

- Introduction
- Measuring Growth
- Volume or Value?
- Social Accounting Matrices
- Calibration
- The Egyptian Case

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# Keynes vs. Classics

<b>Keynes</b>	<b>Classics</b>
Demand	Supply
Short run	Long run
Prices are rigid	Prices are flexible

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# Measuring GDP

- There are two different ways of measuring GDP:
  - a flow-of-product approach
  - an income, earnings or cost approach.
- In a world of perfectly precise measurement, these two methods would arrive at the exact same number for GDP.
- In reality, the two approaches provide a useful check for one another.

# Measuring GDP

**Expenditure approach** A method of computing GDP that measures the total amount spent on all final goods and services during a given period.

**Income approach** A method of computing GDP that measures the income—wages, rents, interest, and profits—received by all factors of production in producing final goods and services.

# Expenditure Approach

There are four main categories of expenditure:

- Personal consumption expenditures ( $C$ ): household spending on consumer goods
- Gross private domestic investment ( $I$ ): spending by firms and households on new capital, that is, plant, equipment, inventory, and new residential structures
- Government consumption and gross investment ( $G$ )
- Net exports ( $EX - IM$ ): net spending by the rest of the world, or exports ( $EX$ ) minus imports ( $IM$ )

$$GDP = C + I + G + (EX - IM)$$



# Income Approach

- **National income** The total income earned by the factors of production owned by a country's citizens.
- **Compensation of employees** Includes wages, salaries, and various supplements—employer contributions to social insurance and pension funds, for example—paid to households by firms and by the government.
- **Proprietors' income** The income of unincorporated businesses.
- **Rental income** The income received by property owners in the form of rent.
- **Corporate profits** The income of corporations.
- **Net interest** The interest paid by business.

# Income Approach

- **Indirect taxes minus subsidies** Taxes such as sales taxes, customs duties, and license fees less subsidies that the government pays for which it receives no goods or services in return.
- **Net business transfer payments** Net transfer payments by businesses to others.
- **Surplus of government enterprises** Income of government enterprises.
- **Net national product (NNP)** Gross national product minus depreciation; a nation's total product minus what is required to maintain the value of its capital stock.
- **Statistical discrepancy** Data measurement error.
- **Personal income** The total income of households.

- **Disposable personal income *or* after-tax income** Personal income minus personal income taxes. The amount that households have to spend or save.
- **Personal saving** The amount of disposable income that is left after total personal spending in a given period.
- **Personal saving rate** The percentage of disposable personal income that is saved. If the personal saving rate is low, households are spending a large amount relative to their incomes; if it is high, households are spending cautiously.

# Different Measures

**GDP at factor cost**

(sum of value added)

Plus Indirect taxes

**GDP at market price**

Plus: Receipts of factor income from the rest of the world

Less: Payments of factor income to the rest of the world

Equals: **GNP**

Less: Depreciation

Equals: **Net national product (NNP)**

Less: Statistical discrepancy

**National income**

Less: Amount of national income not going to households

Equals: **Personal income**

Less: Personal income taxes

Equals: **Disposable personal income**

Less: Personal consumption expenditures

Personal interest payments

Transfer payments made by households

Equals: **Personal saving**

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# Nominal vs. Real

- When we evaluate the nation's current output at current market prices, we measure *nominal GDP*. This is equivalent to multiplying output by price, for all units of every commodity that is produced, and then adding all these numbers up.
- So, nominal GDP is a huge sum of prices times quantities ( $PQ$ ). Therefore, if nominal GDP changes from one year to the next it could be due to a change in  $P$ , or  $Q$ , or both. Since we are very interested in the growth of the economy over time, we need to know which component(s) of GDP is (are) changing.

# Nominal vs. Real

- Suppose, for example, that prices increase from one year to the next, and output decreases such that the result of multiplying  $P$  times  $Q$  remains exactly the same.
- Nominal GDP will be unchanged, and looking only at GDP, it will appear as if the economy is in the same spot it was a year ago.
- In fact, this economy has a couple of new problems.
  - Prices are higher, so there is an increase in inflation.
  - Output is lower, so there is probably an increase in unemployment, too.
- When both inflation and unemployment increase together, economists refer to this situation as stagflation. (The economy slows down or *stagnates* at the same time that prices increase.)

# In CGEs

- We have to normalize prices to 1:
  - To convert all the values of the SAM into volumes.
- We have to choose a *numéraire*
- Since CGEs are real models, only relative prices matter:
  - If all prices increase by 20%, the allocation of resources will not change.



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# SAM Definition

- A social accounting matrix (SAM) is a comprehensive, economy wide data framework, typically representing the economy of a nation.
- More technically, a SAM is a square matrix in which each account is represented by a row and a column.

# Construction of a SAM

- In any real world application, the preferred disaggregation of the SAM and the CGE model depends on data availability and the purposes of the analysis.
- Gather the data
- Adjusting the data coming from different sources
- Adjusting the data since we do not take into account some flows.
- GTAP or national sources

# Basic Structure

- Each cell shows the payment from the account of its column to the account of its row. Thus, the incomes of an account appear along its row and its expenditures along its column.
- The underlying principle of double-entry accounting requires that, for each account in the SAM, total revenue (row total) equals total expenditure (column total).

# Basic Structure

- Standard SAM distinguishes between accounts for activities (the entities that carry out production) and commodities. The receipts are valued at producer prices in the activity accounts and at market prices (including indirect commodity taxes and transaction costs) in the commodity accounts.
- The commodities are activity outputs, either exported or sold domestically, and imports.

# Basic Structure

- This separation of activities from commodities is preferred because it permits activities to produce multiple commodities (for example, a dairy activity may produce the commodities cheese and milk) while any commodity may be produced by multiple activities (for example, activities for small-scale and large-scale maize production may both produce the same maize commodity)

# Basic Structure

- In the commodity columns, payments are made to domestic activities, the rest of the world, and various tax accounts (for domestic and import taxes). This treatment provides the data needed to model imports as perfect or imperfect substitutes vis-à-vis domestic production

# Basic Structure

- The domestic nongovernment institutions in the SAM consist of households and enterprises. The enterprises earn factor incomes (reflecting their ownership of capital and/or land). They may also receive transfers from other institutions. Their incomes are used for direct taxes, savings, and transfers to other institutions.
- As opposed to households, enterprises do not consume. Assuming that the relevant data are available, it is preferable to have one or more accounts for enterprises when these have tax obligations and a savings behavior that are independent of the household sector.



# Basic Structure

Receipts	Expenditures								
	Activities	Commodities	Factors	Households	Enterprises	Government	Savings- Investment	Rest of the World (ROW)	Total
Activities		Marketed outputs		Home- consumed outputs					Activity income (gross output)
Commodities	Intermediate inputs	Transaction costs		Private consumption		Government consumption	Investment	Exports	Demand
Factors	Value-added							Factor income from ROW	Factor income
Households			Factor income to households	Interhousehold transfers	Surplus to households	Transfers to households		Transfers to households from ROW	Household income
Enterprises			Factor income to enterprises			Transfers to enterprises		Transfers to enterprises from ROW	Enterprise income
Government	Producer taxes, value-added tax	Sales taxes, tariffs, export taxes	Factor income to government, factor taxes	Transfers to government, direct	Surplus to Government, direct enterprise taxes			Transfer to Government from ROW	Government income
Savings- Investment				Household savings	Enterprise savings	Government savings		Foreign savings	Savings
Rest of the World (ROW)		Imports	Factor income to ROW		Surplus to ROW	Government transfers to ROW			Foreign exchange outflow
Total	Activity	Supply expenditures	Factor expenditures	Household expenditures	Enterprise expenditures	Government expenditures	Investment	Foreign exchange inflow	

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# Calibration (1)

- **Resolving a CGE:**

Find a solution via the model equations, parameter values, given the value of some exogenous variables.

- **Calibration**

Determine the parameter characterizing the model.

- **Example**

# Calibration (2)

- We use data for one year (base year)
- Calibration is a reversed solution for the model.
- Some parameters are not calibrated but estimated.

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# The Egyptian SAM

- The Social Accounting Matrix (SAM) of Egypt 2000/2001 was built by the National Institute of Planning attached to the Egyptian Ministry of Planning.
- The matrix consists of six major accounts: factors of production, economic agents, industries, composite products, capital and taxes. It incorporates two factors of production: labor and capital, six economic agents: households (rural and urban), firms (private and public), government and the rest of the world.

# The Egyptian SAM

- The SAM includes 17 activities structured as follows: two agricultural sectors (crop production and animal production), eleven industries (oil and mining, tobacco, food industries, spinning and weaving , clothing (including leather), chemical industries, non-metal industries, industries of basic metals, metal industries, machinery and equipment and other industries) and four services sectors (construction and electricity, communication and transport, other productive services and social services).

# The Egyptian SAM

- The composite products account includes the same sectors mentioned above.
- The capital account shows the investment demand by sector.
- The last account is taxes including direct and indirect taxes, subsidies as well as imports tariffs.



# The Egyptian SAM

- Services are the most important sector in Egypt since they contribute by 45% and 50% to total production and value-added respectively. This sector employs 33% of workers and uses half of the national capital stock.
- The contribution of agriculture to total production and value added is 17% and 14% respectively while industry's one is 35% and 25%. Oil and extraction have a small share in production and value added (6% and 8% respectively).
- Most of the sectors are capital-intensive except spinning, chemicals, social services and basic metals

# The Egyptian SAM

Table 1: Descriptive Statistics from the SAM (1): Production

	Share in Tot. Labor	Share in Tot. Capital	Labor Intensity	Capital Intensity	Share in Prod.	Share in V.A.
AGR-VG	15.2%	10.9%	44.8%	55.2%	9.2%	13.5%
AGR-ANM	4.6%	3.3%	44.8%	55.2%	4.5%	4.1%
OIL/EXTR	0.4%	11.6%	1.8%	98.2%	6.0%	8.1%
FOOD-IND	3.8%	2.3%	49.4%	50.6%	7.3%	3.1%
TOBC	0.5%	2.4%	10.9%	89.1%	1.5%	1.8%
SPIN/WEAV	3.7%	1.4%	60.0%	40.0%	4.0%	2.4%
CLOTH	1.7%	5.9%	14.5%	85.5%	5.5%	4.7%
CHEM	5.5%	2.4%	57.3%	42.7%	6.0%	3.8%
NMET	1.9%	1.5%	42.1%	57.9%	2.4%	1.8%
BAS- MET	2.3%	0.9%	59.0%	41.0%	2.4%	1.6%
MET-IND	0.8%	0.3%	61.7%	38.3%	0.6%	0.5%
ENG/MACH	2.6%	1.5%	51.1%	48.9%	2.4%	2.1%
OTR-IND	2.7%	2.7%	36.8%	63.2%	3.0%	2.9%
TRSP/COM	5.9%	12.4%	21.6%	78.4%	8.4%	10.9%
OTR PROD	14.1%	33.9%	19.4%	80.6%	27.5%	28.9%
SER						
SOC-SER	13.1%	6.7%	53.1%	46.9%	9.3%	9.8%
	79%*	100%*	31.4%**	68.6%**	100%*	100%*

Source: Author's calculations from the SAM.

Notes: (i.) Labor and capital intensity are the share of labor and capital respectively in value-added.

(ii.) \* means the total of the column and \*\* means its average.

# The Egyptian SAM

- Only the agricultural and industrial sectors are protected and that the tariff rates are higher for the former. Industries have the highest penetration rate (23%).
- The most importing sectors are machines and equipments (22% of total imports), chemicals (12.5%) and crop production (12%, particularly wheat).

# The Egyptian SAM

- Services are characterized by a high export performance rate (15%) as well the highest share in total exports (72%) followed by industrial ones (24%), especially chemicals, metals, textiles and garments.
- On average, Egypt has a 14.1% penetration rate, a 11.4% export performance index and a 43% openness index Penetration rate is the defined as the ratio of imports to domestic absorption (output - exports + imports), while exports performance is the ratio of exports to output.

# The Egyptian SAM

- Concerning institutions, capital income constitutes the largest source of private firms revenue (88.6%).
- The government's income is mainly composed of direct taxes (57% of the total revenue) and indirect taxes (25.5%).
- Firms are the major contributor aggregate savings (their share in the total savings is 55.5%), followed by urban households (37.5%), who certainly save more than rural ones (27.5%).
- The government being in deficit, public savings are negative, with a share of -20% to total savings

# References

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**Thanks for your attention!**