

# Introduction to CGE Modeling

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# Outline

1. Introduction
2. Definition of CGEs
3. Why use CGEs not PEs?
4. Benefits and Drawbacks of CGEs
5. CGE Mechanism
6. Theory and Walras' Law
7. CGE Steps

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# Brief Definition

- CGEs:
  - Computable: to use them in policy making
  - General: all the economy: sectors, institutions and factors of productions
  - Equilibrium: for all the markets
  - Models: a system of equations

# Difference between CGEs and Econometrics?

<b>Econometrics</b>	<b>CGE Modeling</b>
<b>Ex-post</b>	<b>Ex-ante</b>
<b>Regression Estimation</b>	<b>Simulation and Deviation from Benchmark equilibrium</b>
<b>Simultaneous equations and Time series method</b>	<b>System of several equations: behavioral and accounting relationships</b>
<b>Relies on data size</b>	<b>Benchmark Data</b>
<b>Identification problem</b>	<b>Forms of equations</b>
<b>Econometric tests for robustness checks</b>	<b>Sensitivity analysis on key parameters, macroeconomic closures and forms of equations.</b>
<b>Not appropriate for welfare analysis</b>	<b>Welfare analysis and Inter-industry analysis</b>

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# What is (C)GE Analysis?

- An analytical approach looking at the economy as a complete system of interdependent components (industries, households, investors, government, importers, exporters)
- Recognize economic shocks on one component creating ripple effects throughout the system
- Representative of producer and consumer behaviors
- “Computable” => a system providing quantitative analysis by solving the GE numerically.

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# Why use GE Analysis?

- **Economy wide impact analysis**
  - global, multi-regional, multi-sectoral economies
  - backward/forward impacts on other sectors from “shocks”
- **Tracing distributional impacts of consumer income changes**
  - factor and commodity markets
- **Broad scope**
  - institutions, production sectors, households
- **Flexible to handle broad range of policy issues**
  - tax, trade, pollution, ghg emission, etc

# Why not use Partial Equilibrium?

- PE assumes that a “shock” produces direct price changes that do not have meaningful income effect and thus other prices are constant.
- Welfare measures are for direct price changes.
- Not consider resource endowments (subsidy pulls resources away from other sectors)
- Not capture income effects endogenously (no link between factor incomes and expenditures)

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# Benefits of CGEs

- **Accounting and theoretical consistency:**
  - Accounting consistency: expenditures cannot exceed incomes
  - Consistent factor allocation making sure that factor markets clear.
  - Conceptual and computational consistency Walras' Law:
    - households are on their budget constraints
    - zero profit conditions for firms
    - supply = demand
  - Tracking consequences of policy choices (e.g. taxes)

# Benefits of CGEs

- **Inter-industry or multi-sector backward / forward linkage:**
  - Agriculture to Non-agriculture and vice versa
  - Interactions between different sectors: e.g. farmers are consumers in input sectors (i.e. fertilizer or energy markets) but are also producers in output sectors (i.e. cotton market).

# Benefits of CGEs

- **Welfare analysis:**
  - A policy analysis focuses on changes in real income resulting from changes in prices.
- **Data requirements:** a SAM and not a long time series.
- **Individual level:** Can be replicated at the Microeconomic level: A microsimulation analysis.

# Drawbacks of CGEs

- **Difficulties of model selection, parameter specification, and functional forms (CES vs. Cobb)**
  - Benchmark equilibrium =>functional forms =>choice of elasticities and other parameter values are based on empirical work
- **Data consistency –calibration problem**

# Drawbacks of CGEs

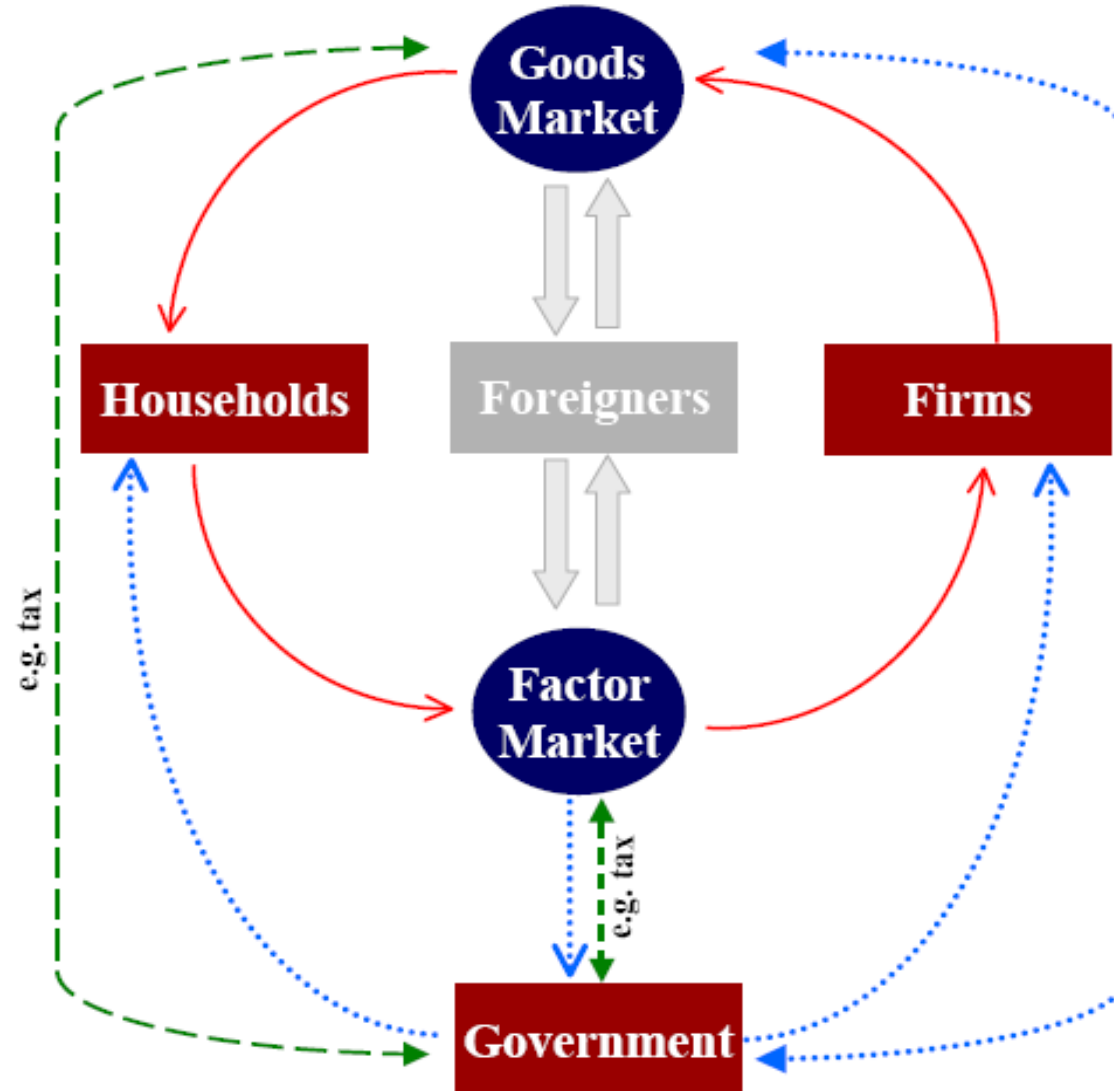
- **Not a statistical test of the model specification**
  - deterministic calibration
- **Not good for monetary or fiscal policies**
  - focuses on the relationship between **relative price changes and the flow of goods and services, not levels of prices**
- **Complexity and require skill to maintain the model**



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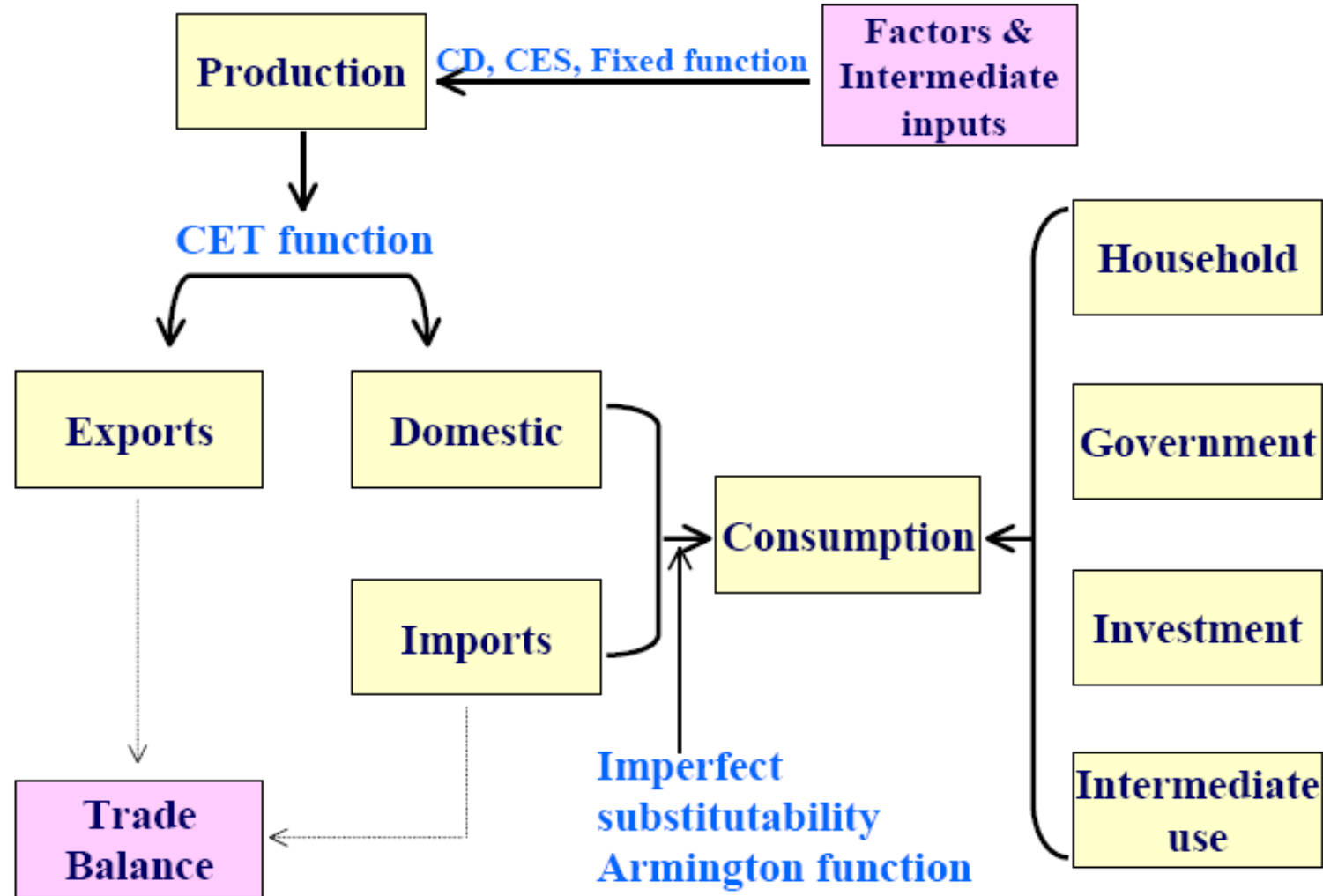
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# CGE Mechanism



Adapted from  
Krauss, M. B.  
and H. G.  
Johnson.  
"General  
Equilibrium  
Analysis: A  
Micro-  
Economic  
Tex." Figure  
1.2, page 27,  
1974

# CGE Structure



**Reference:** Lofgren, H., R. L. Harris, S. Robinson, M. Thomas, and M. El-Said. "A Standard computable general equilibrium (CGE) model in GAMS, IFPRI, Washington, D.C."

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# Theory: Walras' Law

- In 1874 and 1877 Walras published Elements of Pure Economics, a work that led him to be considered the father of the general equilibrium theory “Competitive General Equilibrium”.

# Theory: Walras' Law

- Walras' Law implies that the sum of the values of excess demands across all markets must equal zero, whether or not the economy is in a general equilibrium.
- This implies that if positive excess demand exists in one market, negative excess demand must exist in some other market. Thus, if all markets but one are in equilibrium, then that last market must also be in equilibrium.

# Theory: Walras' Law

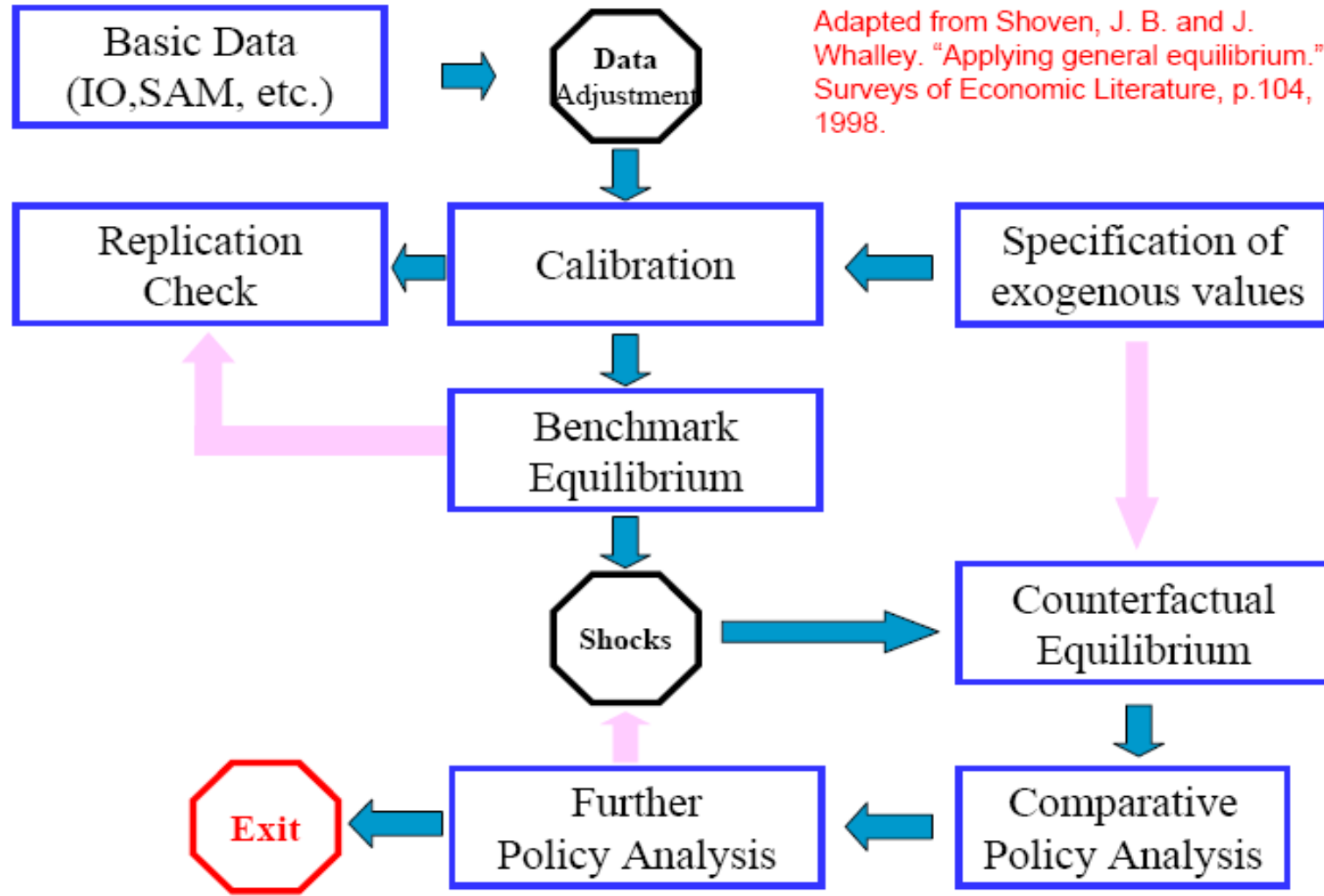
- To characterize general equilibrium in a model with  $m$  agents and  $n$  commodities, we may impose market clearing for  $n - 1$  commodities and "drop the  $n^{th}$  market-clearing condition." In this case, we should include the budget constraints of all  $m$  agents (with equality). Imposing the budget constraints for all  $m$  agents ensures that Walras' Law holds, rendering the  $n^{th}$  market-clearing condition redundant.

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# CGE Steps



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**Thanks for your attention!**