Social Accounting Matrices for CGE

Short Course on CGE Modeling, United Nations ESCAP

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Introduction

- A CGE model of any real economy will have to be based on actual data representing said economy.
- In this module we discuss, through the use of several simple examples, how we can conceptualize and organize the equilibrium data representing the economy of interest into a 'social accounting matrix' or SAM.
- We will also discuss sources of SAMs and show how we can use GAMS to help us in the process of constructing a consistent SAM.

Session Outline

1. SAM Concepts
2. SAM Examples
   - Closed Economy SAM
   - Open Economy SAM
   - Intermediates, Government and Investment
   - Indirect Taxes
3. Getting a SAM
4. Balancing a SAM

SAM Concepts

- A social accounting matrix is a systematic method of representing the flows of goods/services and factors and the corresponding payments in an economic system.
- The SAM is a square matrix, with the same column and row headings. The rows represent flows of goods/factors, while the columns represent the flows of payments.
- Each heading represents the activities of an economic agent, some of which are artificial.
- Because every payment by an agent in the economic system represents a receipt to some other agent in the system, the row and column sums of the SAM must be equal at an equilibrium.
- Once we have a balanced SAM, we can calibrate a CGE model to it.

Example: Closed Economy SAM

- The easiest way to understand how the SAM works is to construct some simple examples. We begin with a closed 2×2 economy.
- In this case, the real agents are the firms (1 and 2) and the household (H), which is the only source of final demand.
- We also introduce a virtual agent for factors (K and L). We can think of this as an agent that buys factors from the household and sells them to firms.
- We will refer to cells by their row name first, column name second.

Closed Economy SAM

		Activities		Factors		Final Demands	
		1	2	K	L	H	Total
Activities	1					100	100
	2					100	100
Factors	K	80	20				100
	L	20	80				100
Final Demands	H			100	100		200
Total		100	100	100	100	200	

Example: Open Economy SAM

- To construct a SAM for an open economy, we add a new artificial agent to represent the transactions involving the rest of the world. We label this agent X.
- The X column tracks payments from the rest of the world, so entries in the activities rows represent exports.
- The X row tracks payments to the rest of the world, so entries in the activities columns represent imports.
- In Armington type models an activity may have both row and column X entries.
- Repatriated earnings of capital and labor appear in the X column and factor rows (inward) and X row factor columns (outward).
- A current account deficit/surplus would appear in the H-X/X-H entry.

Open Economy SAM

		Activities		Factors		Final Demands		
		1	2	K	L	H	X	Total
Activities	1					50	50	100
	2					150		150
Factors	K	80	20					100
	L	20	80					100
Final Demands	H			100	100			200
	X		50					50
Total		100	150	100	100	200	50	

Example: Intermediates, Government and Investment

- Intermediate goods (goods used in production) appear in the Activities-Activities section of the SAM.
- For government we introduce a new agent labeled G. Government consumption appears in the G column. Government production (e.g., provision of services) is defined as an activity.
- In this example, government spending is financed by the household. We can think of this as borrowing or direct taxes.
- For investment, we introduce another artificial agent, I, which collects money from households (H-I) and spends it on activities (1-I and 2-I).

SAM with Intermediates, Government and Investment

		Activities		Factors		Final Demands				
		1	2	K	L	H	G	I	X	Total
Activities	1	40	10			30	10	10	50	150
	2	10	40			130	10	10		200
Factors	K	80	20							100
	L	20	80							100
Final Demands	H			100	100					200
	G					20				20
	I					20				20
	X		50							50
Total		150	200	100	100	200	20	20	50	

Example: Indirect Taxes

- We can introduce indirect taxes on economic activities of various types (tariffs, production taxes, consumption taxes and so on) by adding new tax agents to the SAM.
- Tax agents collect tax revenue from other agents (activities or factors) and pay it back to the government.
- We can account for subsidies by using entries in the opposite diagonal.

SAM with Indirect Taxes

		Activities		Factors		Taxes			Final Demands				
		1	2	K	L	T	TP	TC	H	G	I	X	Total
Activities	1	40	10						35	20	10	50	165
	2	10	40						135	20	10		215
Factors	K	80	20										100
	L	20	80										100
Taxes	T	0	5										5
	TP	10	10										20
	TC	5											5
Final Demands	H			100	100					10			210
	G					5	20	5	20				50
	I								20				20
	X		50										50
Total		165	215	100	100	5	20	5	210	50	20	50	

Sources of SAMs

- A new SAM is constructed from national statistics. Most of the data comes from the input-output table. The balance of payments balance of payments statistics are used to complete the entries in the ROW column/row.
- Other sources (e.g., household expenditure surveys) may also be used.
- The Global Trade Analysis project (GTAP, `www.gtap.org`) provides GAMS codes for constructing social accounting matrices from the GTAP database. McDonald and Thierfelder (2004) provide further details. The current version of the data, version 8, covers 129 regions and 57 commodities with dual base years of 2004 and 2007.
- The International Food Policy Research Institute (IFPRI, `www.ifpri.org`) makes available a series of fully documented social accunting matrices, often at a quite detailed sectoral level and with information for multiple households.

SAM Balancing

- When you construct a SAM from multiple sources, or attempt to update an existing SAM with more recent data, the SAM will generally need to be balanced.
- There are several techniques, the most common of which is the RAS procedure, or biproportional scaling. This is simple to implement.
- Other possibilities include minimizing the sum of squared deviations subject to the adding up constraints.
- Different techniques will yield slightly different SAMs.
- Exact balance can be achieved in calibration once errors are small enough.

Summing Up

- The SAM is quite a flexible tool, we can always add more rows and columns to track other transactions, and can create artificial agents to represent a variety of economic activities.
- For example, we may use household survey data to split households into different groups. Or, we may use international trade data to split the rest of the world into multiple groups (perhaps for the study of a free trade agreement).
- The SAM organizes only the flow data, and is essentially mute on the underlying theoretical structure of the model, functional form, and closure. These have to be determined through other means.

Further Reading

- These examples are from Gilbert and Tower (2013), chapter 25.
- Classic papers on social accounting matrices include Pyatt and Round (1977) and (1979). A more recent overview is Reinert and Roland-Holst (1997).
- Hosoe *et al*. (2010) give a simple step-by-step example of constructing a SAM using data from the Japanese economy.
- On the various data manipulations, Bacharach (1970) gives a comprehensive overview of the RAS procedure, while Robinson et al. (2001) is a detailed account of using 'cross entropy' methods as an alternative.