

Data Development for Regional Policy Analysis

David Roland-Holst
UC Berkeley

Development Research Center
State Council of the PRC
Beijing, PRC

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Contact: dwrh@rdrc.net



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Introduction: General Motivation

- 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.

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

			<u>Expenditures</u>			
<u>Receipts</u>	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	

Receipts	Expenditures								
	1. <i>Activities</i> (124)	2. <i>Commodities</i> (124)	3. <i>Factors</i> (13)	4. <i>Private Households</i> (5)	5. <i>Enterprises</i> (3)	6. <i>Recurrent State</i> (1)	7. <i>Investment Savings</i> (1)	8. <i>Rest of World</i> (94+1)	9. <i>Total</i>
1. <i>Activities</i> (124)		Marketed Production							Total Sales
2. <i>Commodities</i> (124)	Intermediate Consumption			Private Consumption		State Consumption	Investment	Exports	Total Commodity Demand
3. <i>Factors</i> (13)	Value Added								Value Added
4. <i>Private Households</i> (5)			Wages, Salaries and Other Benefits		Distributed Profits and Social Security	Social Security and Other Current Transfers to Households		Net Foreign Transfers to Households	Private Household Income
5. <i>Enterprises</i> (3)			Gross Profits					Net Foreign Transfers to Enterprises	Enterprise Income
6. <i>Recurrent State</i> (1)	Indirect Taxes	Consumption Taxes plus Import Tariffs	Factor Taxes	Income Taxes	Enterprise Income Taxes			Net Foreign Transfers to State	State Revenue
7. <i>Investment Savings</i> (1)				Household Savings	Retained Earnings & Enterprise Savings	State Savings		Net Capital Inflows (=Foreign Savings)	Total Savings
8. <i>Rest of World</i> (94+1)		Imports							Imports
9. <i>Total</i>	Total Payments	Total Commodity Supply	Total Factor Payments	Allocation of Private Household Income	Total Enterprise Expenditure	Allocation of State Revenue	Total Investment	Total Foreign Exchange	

SAM Definitions 1

- 1. Activities** **In the activity row, goods and non-factor services (valued at producer prices) are produced for sale in the commodity market. More than one activity can in principle produce the same commodity. This is so when different technologies are used. For example, paddy rice might be produced by small traditional farmers, requiring limited inputs, and more commercially oriented enterprises that employ greater quantities of inputs thus obtaining higher yields. Hence, the commodity paddy can be produced (in the column) by two activities - one traditional and one modern. This possibility is not allowed for in disaggregating the Macro SAM presented here.**
- 2. Commodities** **Commodities are supplied in the column (to the commodity market) by activities in the form of marketed production at producer prices and from the rest of world in the form of imports of goods and non-factor services. Domestic agents demand commodities valued at purchaser prices in the row for intermediate consumption, private consumption, state consumption, and investment. Exports are demanded by the rest of the world at FOB prices. Marketed goods are formed in the commodity column by adding taxes/tariffs to the price of goods supplied at factor cost from domestic production activities and goods imported from the rest of the world at CIF prices.**
- 3. Factors** **Factors typically include labour, capital, and land. But in the case of China the necessary data on returns to land are not available. Total payments to factors from productive activities (in the row) comprise value added at factor cost, whereas the supply of factor inputs enter in the activity column. Factor income is distributed (in the column) as returns to labour and capital in the form of wages, salaries and other benefits, gross profits and factor taxes.**

SAM Definitions 2

4. Households

In more detailed SAMs, households accounts attempt to capture the characteristics of different analytically useful socio-economic groups of the population. Households differ principally in terms of factor endowments owned and consumption patterns. Total income (in the row) consists of wages, including other benefits, distributed profits from enterprises, social security payments, and net transfers from abroad. Income is allocated (in the column) to consumption, income taxes and household savings.

5. Enterprises

Enterprises earn profits and receive foreign transfers (in the row). This income is distributed (in the column) to households, withheld as retained earnings or paid as taxes. Enterprises may State Owned Enterprises (SOEs), private enterprises and foreign invested companies.

6. Recurrent State

The state is an institution which levies a variety of taxes to obtain revenue (in the row) and spends a recurrent budget (in the column). The difference between recurrent spending and total tax revenue represents state savings.

SAM Definitions 3

7. Capital

The capital account captures the balance between investment (in the column) and total savings (in the row). They include household savings, retained earnings, state savings, and net capital inflows (foreign savings) defined below.

8. Rest of World (ROW)

This account reflects the balance between foreign exchange receipts (in the column) and imports of goods and non-factor services from the rest of the world (in the row). The net capital inflow cell captures in principle the sum of balance of payments entries not appearing elsewhere in the row or column.

9. Total

Sums of columns and rows. Row sums must by definition equal column sums.

Disaggregation

Detail is interesting for research, but essential for policy for two reasons.

1. Economic policy may be made from the top down, but the political consequences of economic activity are ultimately felt from the bottom up.
2. In today's modern, market-mediated economy, policy makers relying on intuition and rules-of-thumb alone are unlikely to achieve anything approaching optimality.

For this reason, it is essential to improve understanding of incidence effects that arise from complex linkages in the economic structure. GE models, supported by detailed data, can elucidate these linkages and improve visibility for policy makers.

Receipts	Expenditures								
	1. Activities (124)	2. Commodities (124)	3. Factors (13)	4. Private Households (5)	5. Enterprises (3)	6. Recurrent State (1)	7. Investment Savings (1)	8. Rest of World (94+1)	9. Total
1. Activities (124)		124 x 124							124 x 1
2. Commodities (124)	124 x 124			124 x 5		124 x 1	124 x 1	124 x 95	124 x 1
3. Factors (13)	13 x 124								13 x 1
4. Private Households (5)			5 x 13		5 x 3	5 x 1		5 x 95	5 x 1
5. Enterprises (3)			3 x 13					3 x 95	3 x 1
6. Recurrent State (1)	1 x 124	1 x 124	1 x 13	1 x 5	1 x 3			1 x 95	1 x 1
7. Investment Savings (1)				1 x 5	1 x 3	1 x 1		1 x 95	1 x 1
8. Rest of World (94+1)		95 x 124							95 x 1
9. Total	1 x 124	1 x 124	1 x 13	1 x 5	1 x 3	1 x 1	1 x 1	1 x 95	

Sample National China SAM

- ❑ 40 domestic production activities/commodities
- ❑ 18 factors of production
 - ❑ 3 labour categories
 - ❑ Capital
 - ❑ Land
- ❑ 2 household types (Rural, Urban)
- ❑ 3 enterprises (Private, Public, and Foreign)
- ❑ State (detailed fiscal instruments), could be disaggregated by central and regional government accounts
- ❑ Consolidated capital account
- ❑ Up to 94 international trading partners

Data Sources – Production Accounts

Row	Column	Data source and data compilation
1.Commodities	2.Activities	I/O Table
	4.Households	Final consumption, I/O Table, further disaggregated with household survey data
	6. Recurrent State	Central (and possibly regional) Government Expenditure
	7. Investment/ Savings	Fixed Investment (with our without inventories) I/O Table
	8. ROW	I/O Table, Customs, and UN COMTRADE
	9. Total	Sum of row
2. Activities	1. Commodities	I/O Table



Data Sources - Factors

3. Labour

2. Activities

I/O Table, Detailed data on wages and employment by occupation

3. Land

2. Activities

Estimation from independent sources, NBS

3. Capital

2. Activities

I/O Table

Data Sources - Households

4. Households	3. Labor	T₃₂ in the SAM, LSMS
	3. Land	T₄₂ in the SAM, LSMS
	3. Capital	Flow of Funds
	5. Enterprises	Row residual
	6. Government	NBS, detailed transfer/subsidy data
	8. ROW	Remittances, NBS
	9. Total	Sum of column

Data Sources – Other Domestic Institutions

5. Enterprises	3. Capital	Distributed operating revenue, Flow of Funds
6. Government	1. Commodities	Domestic commodity and import taxes, NBS
	2. Activities	Production taxes, VAT, and subsidies, NBS
	4. Households	Tax payments, NBS
	5. Enterprises	Enterprise taxes, NBS
	9. Total	NBS

Data Sources – Trade and Capital Accounts

7. Investment/ Savings	4. Households	Savings, household survey data reconciled with macro aggregates
	5. Enterprise	Retained and reinvested operating revenue
	6. Government	Net government budget balances
	7. Inventories	Input/output table
	8. ROW	Net foreign capital flows, NBS
8. ROW	1. Commodities	Import flows, COMTRADE, I/O, Customs
	4. Households	Outbound remittances
	5. Enterprises	Profits repatriated by foreigners
	6. Government	New public foreign borrowing
	7. Investment/savings	New private foreign borrowing



Developing Regional SAM Accounts

Three core components of a regional SAM database:

1. National SAM
2. Individual regional/provincial SAMs
3. Inter-regional Flow Data
 1. Trade flows
 2. Private and public distribution margins



Regional/Provincial SAMs

- These are very similar to national SAMs, but may pose special data challenges
- IO tables may be less reliable/detailed
- NIPA accounts are rarely complete at the regional level
- Capital and transfer accounts are likely to be incomplete (financial flows, remittances)



Inter-regional Flow Data

- Very few countries have reliable regional trade data
- This may be imputed from data on administrative taxes, transport, or other proxies
- The results are usually balanced against aggregate control totals, and very approximate

Development Strategy I

Database development should proceed in four steps:

1. An up-to-date national SAM
2. Individual regional/provincial SAMs, including a Residual Economy SAM to account for missing regions
3. National aggregation balancing
4. Trade flow imputation



Three possibilities:

1. 1997 national and provincial
2. 2000 national and updated provincial
3. Updated national and 2002 provincial



Development Strategy II

This approach will support two tiers of model implementation:

1. Individual regional/provincial models.
2. A multi-region national model.

Both types of model will be useful for different kinds of policy research. Generally, both types 2 will be implemented at the ministerial level, while only type 1 will be implemented at the regional level.



Direct SAM Analytical Methods

- In addition to its role as a static database for national accounting and model calibration, the SAM can be used for direct estimation with a variety of multiplier methods.
- We describe one example here.



Regional Multiplier Decomposition

- While trade flow data are revealing, they only capture direct bilateral effects.
- In the real economy, a myriad of interactions delineate the path from initial expenditure to ultimate incomes.
- This is particularly the case with trade in an era of globalization, where international supply chains are ever more elaborate and indirect linkages can represent the majority of value creation.
- To assess these effects empirically, we use the international SAM for multiplier analysis.

Social Accounting Matrix

- Consider an example of three regions, each represented by a social accounting matrix of the form

$$T_k = \begin{bmatrix} T_{kk} & F_k \\ V_k & X_k \end{bmatrix}$$

where the component matrices denote commodity flows (T), final demand (FD), value added (VA), and other domestic accounts (X).

Multilateral Social Accounting Matrix

- Consider SAMs for three regions, compiled into a multi-regional transactions table

T_{11}	<u>T_{12}</u>	<u>T_{13}</u>	F_1
<u>T_{21}</u>	T_{22}	<u>T_{23}</u>	F_2
<u>T_{31}</u>	<u>T_{32}</u>	T_{33}	F_3
V_1	V_2	V_3	X

where the off-diagonal T matrices (underlined) are bilateral trade flows.

Block Decomposition

To elucidate **multi-lateral** regional trade linkages, we carry out the following block multiplier decomposition:

T_{11}	T_{12}	T_{13}	F_1
T_{21}	T_{22}	T_{23}	F_2
T_{31}	T_{32}	T_{33}	F_3
V_1	V_2	V_3	X



$M = M_3M_2M_1$

Block Decomposition (cont.)

$$M_1 = \begin{bmatrix} (I-A_{11})^{-1} & 0 & 0 \\ 0 & (I-A_{22})^{-1} & 0 \\ 0 & 0 & (I-A_{33})^{-1} \end{bmatrix}$$

Linkages

Intra-region

Inter-region (bilateral)

Equilibrium Indirect

$$M_2 = \begin{bmatrix} I & (I-A_{11})^{-1}A_{12} & (I-A_{11})^{-1}A_{13} \\ (I-A_{22})^{-1}A_{21} & I & (I-A_{22})^{-1}A_{32} \\ (I-A_{33})^{-1}A_{31} & (I-A_{33})^{-1}A_{32} & I \end{bmatrix}$$

$$M_3 = \begin{bmatrix} I-D_{12}D_{21}-D_{13}D_{31} & D_{21}D_{12} & D_{31}D_{13} \\ D_{12}D_{21} & I-D_{21}D_{12}-D_{23}D_{32} & D_{23}D_{32} \\ D_{13}D_{31} & D_{23}D_{32} & I-D_{31}D_{13}-D_{23}D_{32} \end{bmatrix}$$

Note: $D_{ij} = (I-A_{ii})^{-1}A_{ij}$

Conclusions

- ❑ SAMs are critically important (consistent) data tools
- ❑ While they must be consistent with macro information, their biggest virtue is detail.
 - ❑ In most cases, indirect effects of economic policy outweigh direct ones, but these are often difficult to ascertain.
 - ❑ Data development for SAMs should be correspondingly ambitious.
- ❑ Overall goal: Improve visibility for policy makers about the detailed incidence of economic decisions and external events.



DISCUSSION



SAM Balancing Methods

Obviously, SAMs are built from very diverse data sources. Since these may be partially conflicting, a reconciliation or balancing process is necessary to produce a consistent, reconciled set of unified accounts.

There are two general approaches, algebraic and statistical. To introduce these concepts, we survey the first approach. For empirical reasons, the more complex latter approach is generally used.

The RAS Procedure

Let \mathbf{R}_0 be a known, initial matrix of transactions and let \mathbf{R} be the unobservable transaction matrix for the year we desire to estimate. Let \mathbf{p} be a vector whose elements are the ratios of desired period prices to initial period prices. Let $\langle \mathbf{z} \rangle$ denote the diagonal matrix having vector \mathbf{z} on its main diagonal. The \mathbf{R} matrix in desired period prices then takes the form:

$$\mathbf{R} = \langle \mathbf{p} \rangle \mathbf{R}_0 \langle \mathbf{p} \rangle^{-1}$$

The next step is to calculate a column vector of intermediate outputs for the desired year as the difference between gross outputs and final demands. Stone and Brown (1965) denote this vector \mathbf{u} . The row vector \mathbf{v} of intermediate inputs for the desired year is the difference between gross outputs and value added.

RAS: continued

The following constraints must be satisfied:

$$\mathbf{R}\mathbf{i} = \mathbf{u}$$

$$\mathbf{i}'\mathbf{R} = \mathbf{v}$$

where \mathbf{i} is the conformable unit column vector. The first equation states that the rows of the new transaction matrix must sum to the observed row totals. The second equation states that the columns must sum to the observed column totals.

RAS: continued

The problem is then to adjust \mathbf{R} to obtain an estimate of \mathbf{R} . The RAS algorithm proceeds as follows:

Step 0 (Initialization): Set $k = 0$ and $\mathbf{R}_k = \mathbf{R}$.

Step 1 (Row Scaling):

$$\text{Define } \mathbf{r}_k = \langle \mathbf{u} \rangle (\mathbf{R}_k \mathbf{i})^{-1}$$

$$\text{and update } \mathbf{R}_k \text{ as } \mathbf{R}^* \leftarrow \langle \mathbf{r}_k \rangle \mathbf{R}_k$$

Step 2 (Column Scaling):

$$\text{Define } \sigma_k = (\mathbf{i}' \mathbf{R}^*)^{-1} \langle \mathbf{v} \rangle$$

$$\text{and define } \mathbf{R}_{k+1} \text{ by } \mathbf{R}_{k+1} = \mathbf{R}^* \langle \sigma_k \rangle$$

Step 3 : Replace $k \leftarrow k + 1$ and return to Step 1.