# China's Input-Output Table Compilation and its Extensions

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**Abstract:** This paper introduced the features and compilation method of China national input-output (I-O) table. Different from the national benchmark ones, State Information Center (SIC) has updated the non-competitive import type I-O tables for each five-year since 1985 under the support and cooperation with Institute of Developing Economies (IDE), Japan. In 2002, SIC has started to compile China multi-regional I-O table (CMRIO) at 8-region and 30-sector classification for each 5-year. This paper explained the methods of compilation of China non-competitive import type I-O tables and CMRIO in SIC.

**Key words:** China input-output table, non-competitive import type input-output table, inter-regional input-output table, China's economic development

## 1. Introduction of China's Input-Output table

In 1974, the first physical I-O table of China for 1973 was compiled. This table includes 61 products. In 1982, the first monetary I-O table with 26 intermediate sectors and physical I-O table with 146 products for 1981 were compiled by the Forecasting Center of National Planning Commission (the Department of Economic Forecasting of SIC after 1987) and National Bureau of Statistics (NBS). All of those tables were on the basis of the MPS (Material Product System).

Since 1987, the Chinese government decided to compile the I-O table every five years. Up to now, the benchmark tables for year 1987, 1992, 1997 and 2002 were compiled, while the 1990, 1995, 2000 and 2005 tables are the updated ones. All these tables are published by NBS (see detail in Table 1).

**Table 1: the NBS I-O tables**

| Year | Type of the Table | Number of Commodity Sectors | Criterion of Industry Classification |
|---|---|---|---|
| 1987 | Benchmark table | 139 | (GB/T 4754-1984) |
| 1990 | Annual table | 33 | (GB/T 4754-1984) |
| 1992 | Benchmark table | 119 | (GB/T 4754-1984) |
| 1995 | Annual table | 33 | (GB/T 4754-1984) |
| 1997 | Benchmark table | 124 | (GB/T 4754-1994) |
| 2000 | Annual table | 40 (17) | (GB/T 4754-1994) |
| 2002 | Benchmark table | 122 | (GB/T 4754-2002) |
| 2005 | Annual table | 42 (17) | (GB/T 4754-2002) |

### 1.1 Framework and structure of the China I-O tables

Each IO table consists of three parts, normally called intermediate transaction, final demand, and primary input, the structure is shown in Table 2. Intermediate transaction is the core part of the IO table that adequately reflects the inter-related and mutually dependent economic and technological relations among different industries of the

national economy. Final demand describes the quantity and structure of goods and services produced by different industries that are allocated to final users, representing the distribution and redistribution of the gross national product beyond the production process. Primary input illustrates the component of value-added of various industries, representing the primary distribution of the gross national product.

**Table 2: China I-O table structure**

(current producer's price)

| OUTPUT / INPUT | | Intermediate Use | | | | Final Use | | | | | | | | | Imports | Errors | Gross Output |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Final Consumption | | | | | Gross Capital Formation | | | Exports | Total Final Use | | |
| | | | | | | Household Consumption | | | Government | Total Final Consumption | Gross fixed capital formation | Change in inventories | Sub-total | | | | |
| | | Agriculture | … | Public administration and other sectors | Total intermediate use | Rural | Urban | Sub-total | | | | | | | | | |
| Intermediate Inputs | Agriculture | intermediate transaction | | | | final demand | | | | | | | | | | | |
| | … | | | | | | | | | | | | | | | | |
| | Construction | | | | | | | | | | | | | | | | |
| | … | | | | | | | | | | | | | | | | |
| | Public administration and other sectors | | | | | | | | | | | | | | | | |
| | Total Intermediate Inputs | | | | | | | | | | | | | | | | |
| Value Added | Depreciation of fixed capital | primary input | | | | | | | | | | | | | | | |
| | Compensation of employees | | | | | | | | | | | | | | | | |
| | Net taxes on production | | | | | | | | | | | | | | | | |
| | Operating surplus | | | | | | | | | | | | | | | | |
| | Total Value Added | | | | | | | | | | | | | | | | |
| Total Inputs | | | | | | | | | | | | | | | | | |

### 1.2 Features of the China I-O tables

Currently the 2002 China I-O table includes 122 sectors, of which there are 6 sectors for agriculture, 6 sectors for mining, 71 sectors for manufacturing, 1 sector for scrap and waste, 3 sectors for electricity, gas and water production and supply, 1 sector for construction, 9 sectors for transport and warehouse, 1 sector for post, 1 sector for wholesale and retail trade services, 1 sector for food serving services, and 22 sectors for other services.

This table is valued at producers' prices[1], which deducted wholesale and retail margin, and transportation cost from the purchasers' prices value. As for the trade vectors, imports are valued by the c.i.f. plus customs duty and exports are valued at f.o.b.

Besides, since import is included in the intermediate and final uses, the China I-O tables are competitive import type.

## 2. Compilation of non-competitive import type China I-O tables

Since 1988, SIC has joined IDE (Institute of Developing Economies) projects to compile Asian Input-Output Table, which request us to compile the non-competitive import type China I-O tables. From that time we have compiled the China import matrices and updated the national I-O tables each five year, which can be seen from Table 3.

**Table 3: the SIC Non-competitive import type China I-O tables**

| Year | Non-competitive import type I-O tables |
|---|---|
| 1985 | √ (106 sectors, updated table) |
| 1990 | √ (106 sectors, updated table) |
| 1995 | √ (78 sectors, updated table) |
| 2000 | √ (142 sectors, updated table) |
| 2002 | √ (122 sectors import matrix) |
| 2005 | √ (133 sectors, updated table) |

### 2.1 Compilation of China's import matrix

Regarding to compile China's import matrix, the fast expansion of China's external trade, particularly imports, totally enlarges the inconsistency among different data sources, which makes us to face big challenges in the current stage. With other related problems, such as the consolidation of distribution survey data and Customs trade data with the input structure survey data, we have made some progress on the compilation methodology of import matrix step by step.

[1] It should be noted that the definition of producers' price is not the same as that of 1993 SNA, which does not include the value-added tax.

### 2.1.1 Special survey on distribution of 1985 import goods

China adopted the "central planned commodity economy" in 1985. Same as other activities, the distribution of import commodities was under control by the government. In this case, we conducted the special survey focus on distribution of import goods to the Ministry of Material and Equipment, Ministry of Chemistry, Ministry of Commerce etc. and some state-owned large external trade companies. It covered over 80% of the import goods.

### 2.1.2 Special survey on distribution of 1990 import goods

There were about 2000 items of imported commodities at the classification level of 6-digit SITC code covered in this survey. The commodities include grain, meat, oil and other food and beverage, chemical products, iron, steel and metallic products and electronic products, etc. The focus of the special survey was mainly on some selected ministries and large scale external trade companies (Table 4).

**Table 4: The 1990 Special Survey of Commodity Import Distribution**

| Commodity | Organizations which be surveyed | Coverage of SITC code |
|---|---|---|
| Chemicals and related products | 1. China National Chemical Import and Export Ltd. Co.<br>2. Ministry of Chemical Industry<br>3. China General Petro-Chemical Company | (1) 23****<br>(2) 25****<br>(3) 264***--267***<br>(4) 269***--278999<br>(5) 43***<br>(6) 3345**--3414<br>(7) 5***** |
| Iron and steel and metallic products | 1. Ministry of Metallurgical Industry<br>2. China National Non-ferrous Metal Import and Export Ltd. Co.<br>3. China National Machinery Import and Export Ltd. Co. | (1) 67****--6901 |
| Electronic products | 1. Ministry of Electronics Industry<br>2. China National Electronic Import and Export Ltd. Co. | (1) 76111--77889 |
| Grain, meat, oil and other food and beverage and etc. | 1. China National Grain, Oil and Food Import and Export Ltd. Co. | (1) 00111--2239 |

### 2.1.3 The enterprises' imported production input survey of 2000

Until 2000, driven by the economic reform and opening policy, China had been achieved fast economic development. The economic system had shifted to the market

mechanism. The external trade and the distribution and usage of import commodities were not controlled by the government. In this case, we selected 549 state-owned enterprises (SOEs) and group companies regarding the importance in terms of size and activity, and distributed questionnaires to them concerning their producing inputs of import goods for 2000.

### 2.1.4 The large-scale enterprises import origin survey of 2002

The 2002 input-output survey conducted by NBS included one questionnaire regarding the large-scale enterprises import origin by commodity. Import origins were classified by the important trade partners with China. The survey result became the basic information to adjust the import matrix compiled by SIC based on the distribution structure.

### 2.1.5 The compilation method for 2005 China's import matrix

With the fast development of the Chinese economy, particularly the expansion of external trade which directly highlights the significance of Chinese economy in the global trade and so as the international economic inter-dependencies, it is no doubt of the importance of the compilation of China import matrix currently. In this case, we have to consider following problems in the compilation exercise of China's 2005 import matrix:

- The inconsistency between the distribution of import goods and the domestic products. During the compilation of 2000 and 2002 China import matrices, we had found that increasingly amount of elements in the preliminary import matrix, which we originally compile based on the survey results, were greater than the corresponding ones in the national table.
- The consolidation of distribution survey data and Customs trade data with the input structure survey data.
- The treatment of the processing purpose imported goods in China's Customs statistics cannot fully meet the request of compiling import matrix. At the same time, the HS code is not as detailed to distinguish those commodities' usage.

- The possible discrepancies of the import vectors between NBS I-O table and Customs data.

This fact reminds us that we should make some adjustment of the import matrix compilation methodology. Similar to previous experience, we conducted two special surveys on China's commodity import. First, Cooperating with NBS, we conducted the enterprises' imported production inputs structure survey, focusing on the production input of the large-scale and some selected medium and small-scale enterprises. Second, SIC has made a small scale sample survey on some selected large-scale trading enterprises on the distribution of import goods. And then, the cross entropy approach was applied to modify the primary import matrix based on the distribution information with the enterprises' imported production input survey data.

### 2.2 Compilation of non-competitive import type I-O table

Deducting the import matrix from the competitive import type China I-O table, the non-competitive type table will be estimated. In this table, the intermediate and final uses are divided into two parts: domestic products and import products. If we use subscript *d* to denote the domestic products, and *m* to imports, the equation can be written as follows:

$$X = A^d X + F^d = (I - A^d)^{-1} F^d$$
$$M = A^m X + F^m$$

## 3. Compilation of multi-regional I-O model for China

During the last two decades, the Chinese economy has continually attained high growth, while the disparity of regional development has become a crucial topic not only for academic researchers but also for policy makers. In order to supply an analysis tool for regional economy research, we launched a joint project with IDE to compile an inter-regional I-O model for China in 2001. As the result, *Multi-regional Input-Output Model for China 1997* was published by SIC in 2004. Recently, the 2002 Multi-regional Input-Output Model for China was compiled by SIC and will be

published soon, with some advanced estimation methods, especially on the estimation of inter-provincial commodity flow.

### 3.1 The model

It is impossible for us to construct the inter-regional input-output model of China in full-survey base because it needs huge amount of primary data, fund and manpower, which are far beyond our capacity. We mainly considered 4 models established in classic previous researches. Those are (1) column coefficient model, namely multi-regional input-output (MRIO) model (Moses 1955 etc.) (2) row coefficient model (Polenske, 1970), (3) gravity model (Leontief and Strout, 1966) and (4) linear programming model (Moses, 1960). We concluded that the column coefficient model (Chenery-Moses model) is best for our object. So we adopted the MRIO model, which request to estimate inter-regional trade coefficients.

In MRIO settings, the technical input structure of production in each region and inter-regional trade structure of various products are separately built into model. Therefore, the primary data needed to implement a MRIO model is usually less than that for the direct construction of an IRIO model. In addition to this huge merit, the separation of regional technical structure and trade structure also allows us to update the model easier.

Assuming that there are two regions, region 1 and region 2 in China and the regional value added, final demand, total output, technical coefficient and trade coefficient are given, the multi-regional input-output model can be represented as:

$$\begin{bmatrix} \hat{T}^{11} & \hat{T}^{12} \\ \hat{T}^{21} & \hat{T}^{22} \end{bmatrix} \begin{bmatrix} A_d^1 & 0 \\ 0 & A_d^2 \end{bmatrix} \begin{bmatrix} X^1 \\ X^2 \end{bmatrix} + \begin{bmatrix} \hat{T}^{11} & \hat{T}^{12} \\ \hat{T}^{21} & \hat{T}^{22} \end{bmatrix} \begin{bmatrix} F^1 \\ F^2 \end{bmatrix} + \begin{bmatrix} E^1 \\ E^2 \end{bmatrix} = \begin{bmatrix} X^1 \\ X^2 \end{bmatrix}$$

Here, $X^r$ , $F^r$ and $E^r$ are the total output, final Demand and export to other country of region *r*, $A_d^r$ is the domestic technical coefficient matrix of region *r*, $\hat{T}^{rs}$ is trade coefficient matrix from region *r* to region *s*, it is a diagonal matrix of coefficients (*r*, *s* = 1 and 2).

The elements of trade coefficient matrix, denoted by $c_i^{rs}$, showing the proportion of

all good $i$ used in region *s* that comes from each region *r*. And, trade coefficient are derived from the transaction from *r* to *s* divided by the total inflow of *s*, defined as

$$c_i^{rs} = \frac{t_i^{rs}}{\sum_r^n t_i^{rs}} \qquad \text{(n=1,2)}$$

$t_i^{rs}$ shows the amount of good $i$ moved from region *r* to region *s*. In this background, there is the assumption that each sector in the region purchases the commodities and services from other region at the same ratios.

By using the above formulae, it was developed to the format of Multi-regional Input-Output Model for China, which is shown in Figure 1.

**Figure 1: Layout of the Multi-regional Input-Output Model for China**

| | | | Intermediate Use | | | | | | | Domestic Final Use | | | Export | Total Output |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Region 1 | | | … | Region m | | | Region 1 | … | Region m | | |
| | | | sector1 | … | Sector n | | sector1 | … | Sector n | | | | | |
| Intermediate Input | Region 1 | Sector 1 | $x_{11}^{11}$ | … | $x_{1n}^{11}$ | … | $x_{11}^{1m}$ | … | $x_{1n}^{1m}$ | $F_1^{11}$ | … | $F_1^{1m}$ | $E_1^1$ | $X_1^1$ |
| | | … | … | … | … | … | … | … | … | … | … | … | … | … |
| | | Sector n | $x_{n1}^{11}$ | … | $x_{nn}^{11}$ | … | $x_{n1}^{1m}$ | … | $x_{nn}^{1m}$ | $F_n^{11}$ | … | $F_n^{1m}$ | $E_n^1$ | $X_n^1$ |
| | … | … | | … | | … | | … | | … | … | … | | … |
| | Region m | Sector 1 | $x_{11}^{m1}$ | … | $x_{1n}^{m1}$ | … | $x_{11}^{mm}$ | … | $x_{1n}^{mm}$ | $F_1^{m1}$ | … | $F_1^{m1}$ | $E_1^m$ | $X_1^m$ |
| | | … | … | … | … | … | … | … | … | … | … | … | … | … |
| | | Sector n | $x_{n1}^{m1}$ | … | $x_{nn}^{m1}$ | | $x_{n1}^{mm}$ | … | $x_{nn}^{mm}$ | $F_n^{m1}$ | … | $F_n^{m1}$ | $E_n^m$ | $X_n^m$ |
| | Import | | $M_1^1$ | … | $M_n^1$ | … | $M_1^m$ | … | $M_n^m$ | $FM^1$ | … | $FM^m$ | | |
| Value Added | | | $V_1^1$ | … | $V_n^1$ | … | $V_1^m$ | … | $V_n^m$ | | | | | |
| Total Input | | | $X_1^1$ | … | $X_n^1$ | … | $X_1^m$ | … | $X_n^m$ | | | | | |

### 3.2 Estimation of inter-regional commodity flows

In China, there are very few related statistics with regard to the inter-regional shipments of commodity by region, so that we applied 2 methods to estimate the inter-regional commodity flow both by survey and by the model.

#### 3.2.1 The survey

First, Cooperating with NBS, we conducted the enterprises' production inputs structure survey, focusing on the production input of the large-scale and some selected medium and small-scale enterprises.

Second, we selected some local typical enterprises in some provinces with the help of our local information system (provincial information center), and made a sample survey on their inputs origin and products destination.

Because of the limitation of survey scale and response ratio, some sectors like service sector and some regions like northwest region do not have enough data on commodity flow. However it has provided us very important information on the commodity shipment over the region.

#### 3.2.2 Estimation model

The following model is proposed to estimate China's inter-provincial trade coefficient matrix:

$$T_i^{rs} = A_i^r B_i^s X_i^{ro} X_i^{os} f(^k D_i^{rs})$$

Subject to:

$$A_i^r = [\sum\nolimits_s B_i^s X_i^{os} f(^k D_i^{rs})]^{-1}$$

$$B_i^s = [\sum\nolimits_r A_i^r X_i^{ro} f(^k D_i^{rs})]^{-1}$$

Where $X_i^{ro}$ and $X_i^{os}$ are respectively the total outflow of commodity *i* from region *r* and the total inflow to region *s*. For applying the above model, the important issue is how to determine the function form of *f(d)*. Based on the existing literature reviews and our experiences, the following distance deterrence equation can be considered.

$$f({}^{k}D_i^{rs}) = \sum_k {}^{k}M_i ({}^{k}D_i^{rs})^{-{}^{k}\alpha_i}$$

Where ${}^{k}M_i$ represents the share ratio of freight mode *k* in the transportation of commodity *i* from *r* to *s*. ${}^{k}D_i^{rs}$ is the time-distance from region *r* to *s* by commodity and transportation mode. ${}^{k}\alpha_i^{r}$ is the power parameter, reflecting the influence magnitude of time-distances for trade activities.

There are five transportation modes for commodity, which include railway, road, waterway, air and pipeline. Since the ratios of freight by air and pipeline are rarely small, we only calculate railway, road and waterway transportation distance power parameters ${}^{k}\alpha_i^{r}$ for each province at commodity level. The average freight transport distance by three kind transportations is applied in this calculation.

The transportation statistics, particularly the road transportation statistics is still remain some in-perfection due to the primary data collection process. It is recognized that the average fright transportation distance is under-estimated. In this case, in the estimation of ${}^{k}\alpha_i^{r}$ for road transportation, we relax the corresponding average distance in order to get the solution.

## 4. Closing remarks

This paper firstly introduced the features and compilation method of China national input-output table constructed by NBS. Then we discussed the 2 extensions conducted by SIC. The first one is the non-competitive import type I-O table construction for each five-year since 1985 under the support and cooperation with IDE, Japan. The second one is the compilation of China multi-regional I-O table for 1997 and 2002.

It is no doubt of the importance of the compilation of China's import matrix currently. Regarding to compiling China's import matrix exercise, the fast expansion of China's external trade, particularly imports, totally enlarges the inconsistency among different data sources, which makes us to face big challenges in the current

stage and future studies. In this case, we are doing the research work on improving the compilation method.

Based on the literature review and our previous studies, we propose a more detailed model to compile 2002 China multi-regional input-output table. Since the compilation technique of 2002 provincial input-output table has been broad improved and the available of transport data and Customs statistical data, they become the main primary data sources. The outcome can be improved if we employ more primary data, for example the survey result, under cooperation with NBS in the future.

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