A Research on Series Input-output Tables based on National Standard of Industrial Classification 2002

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Summary

National Input-output tables were published every 5 years in China. However, In some Input-output applications such as dynamic input-output analysis or running multisectoral dynamic model, input-output tables of continuous years were needed. This brings the requirement for input-output tables in series

The Industrial Classification of national economy had revised several times in the past 20 years, so the existed input-output tables were based on different national standards of Industrial Classification. For example, 1987 table and 1992 table based on national standards 84, 1997 table based on national standards 94. On the other hand, the developing 2002 table will be based on national standard 2002. Therefore, there exist inconsistency on sector classification between these input-output tables.

This paper aimed at researching series input-output tables based on National Standard of Industrial Classification 2002. According to our method, the first step is to develop series input-output tables of base years (1987, 1992 and 1997). Tables of 1987, 1992 and 1997 are adjusted and transferred to 92 sector input-output tables based on national standard 2002. We present a matrix algorithm to achieve the above work.

Key Word: Series input-output tables matrix algorithm
Industrial Classification of National Economy

Input-output table describes the input and output of sectors of national economy in certain period (usually one year) and reflects technical and economic relations among sectors scientifically.

In China, Input-output tables were published every 5 years. Extended tables were published in the middle of every 5 years. By now, we have five Input-output tables (tables of 1987, 1990, 1992, 1995, and 1997), the 1990 table and 1995 table are extended tables. At present, 2002 Input-output tables are in the process.

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based on national standard 84, 1997 table based on national standards 94. On the other hand, the developing 2002 table will be based on national standard 2002. Therefore, there exists inconsistency on sector classification between these input-output tables.

The inconsistency on sector classification between these input-output tables restrict the use of input-output tables on dynamic input-output analysis. The aim of this article is to develop series input-output tables based on national standard 2002.

Sector Classification of series input-output tables based on national standard 2002

The outline of sector classifications of 1987, 1992, 1997 and 2002 tables are shown in Table 1.

Table 1 Sector classifications of 1987, 1992, 1997 and 2002 tables

	Primary industry	Secondary industry		Tertiary industry			Total
	Materials Production Sector					Non-material Production Sector	
	Agriculture	Industry	Construction	Transport，Post and Communications	Commerce and Restaurants		
1987 table	6	83	1	6	4	17	117
	1	23	1	1	2	5	33
	1	1	1	1	1	1	6
1992 table	6	84	1	6	4	17	118
	1	23	1	1	2	5	33
	1	1	1	1	1	1	6
1997 table	5	84	1	9	2	23	124
	1	25	1	2	2	9	40
	1	1	1	1	1	1	6
2002 table	6	82	1	12	3	19	123
	1	24	1	3	2	11	42
	1	1	1	1	1	1	6

Our objective is to adjust and transfer 1987, 1992, 1997 and 2002 tables to series input-output tables with the same sector classification. We call them series input-output tables of base years. In order to make series input-output tables more valuable, we follow two principles in adjusting and transferring tables:

(1) To ensure the sector classification of series tables as detailed as possible, we use original tables whose sector classification are most detailed (117 sectors in 1987 table, 118 sectors in1992 table, 124 sectors in 1997 table, 123 sectors in 2002 table).

(2) Sector classification of the series tables should be based on the Industrial Classification of National Standard 2002. In this way, we can ensure the series tables are consistent in sector classification according to the newest standard.

There exist inconsistency on sector classification between these input-output tables. Therefore, we should consider the difference among tables before determining the sector classification of series tables. The steps are as follows.

1. Analyzing differences between input-output tables

We compare the sector classifications of input-output tables of base years (original tables for short) with the sector classification of 2002 table. We can classify different situations for each sector in original tables (1987,1992 and 1997 tables) as follows.

1) There is a sector that has the same name and the same scope of statistics in the 2002 table.
2) There is a sector that has the same scope of statistics but different name in the 2002 table.
3) One sector of the 2002 table is made up of several sectors of the original table.
4) One sector of original table is divided into several sectors of the 2002 table.
5) Other cases. The adjustment process is more complicated, we need do cross adjustment among sectors.

2. Using different methods to deal with the five situations above.

1) As to the first and the second situation, use sector in 2002 table as the sector of the series table.
2) As to the third situation, we aggregate the relevant sectors of original tables into one sector of series tables and change the name.
3) As to the fourth and the fifth situation, the adjustment involves several sectors, and is more complicated and difficult. For those cases we can find reason to divide and reorganize relevant sectors of original tables, we keep the detailed statistical scope based on national standard 2002, otherwise, we use a wider

statistical scope.

3. Determining sector classification of series tables.

Applying the above methods to 1987,1992and 1997 tables and synthesizing the results, we determine sector classification of series tables as 92 sector, Including 6 agriculture sectors, 60 Industry sectors, 1 Scrap and waste sector, 1 Construction sector, 8 transports and Warehousing sectors, 1 Post and Telecommunication sector, 2 Commerce, Eating and drinking places sectors and 13 other services sectors. Detailed 92-sector classification can be found in Appendix.

The data adjustment method of series input-output tables

After we determine sector classification of series input-output tables, we should adjust and process the data of original tables based on new sector classification.

According to the basic assumptions of input-output tables (homogeneity and non-interaction), we can consider that the input structure of subsections of original tables are similar, moreover, it can't effect the balance of input and output after adjusting some sectors of original tables.

The steps to process data are as follows.

Step 1: estimate the weights of subsections of the sector in original tables that needs to be divided. The weight is estimated as the ratio of total output of subsection sector (which need divided) to that of the whole sector.

Step 2: divide the relevant sector by weights estimated. As to Quadrant I, we should divide not only from row but also from column; As to Quadrant II, we divide it from row; As to Quadrant III, we divide it from column.

Step 3: unite relevant sector based on the sector classification of series tables. The same to step 2, as to Quadrant I, we should unite it not only from row but also from column; As to Quadrant II, we unite it from row; As to Quadrant III, we unite it from column.

Matrix algorithm of transferring original tables to series tables

Based on rules of matrix operation in linear algebra, we present a matrix algorithm that can transfer each input-output table. It makes the process of transferring easer. The approach is described as follows.

1. Constructing a correspondence matrix

Firstly, according to the method of adjusting the data of series input-output tables, we construct a correspondence matrix that links the sectors of the objective table (series table) and the source table (original table). There are three columns in correspondence matrix. The figures in the first column of the matrix are the sector sequence numbers of the objective table; the figures in the second column are the sector sequence numbers of the source table; the figures in the third column are the weights, default value is 1. For example, if a comparison matrix is

1	2	
2	3	0.1
3	3	0.9

Then, the first row shows that the first sector of the objective table is composed of the second sector of source table. The second row shows that the second sector of the objective table is composed of 10% of the third sector of the source table. The third row shows that the third sector of the objective table is composed of 90% of the third sector of the source table.

2. Constructing a conversion coefficient matrix

The next step is to construct a conversion coefficient matrix $S=(S_{ij})$. S_{ij} is called conversion coefficient. It represents that the ith sector of the objective table contains S_{ij} % of the jth sector of the source table. The number of rows of the conversion coefficient matrix is number of sectors of the objective table. The number of columns of the conversion coefficient matrix is number of sectors of the source table.

It is easy to understand that:

$$S_{ij} = \begin{cases} s_{ij} & \text{if the ith sector of the objective table contains } S_{ij}\% \text{ of the jth sector of the source table} \\ 1 & \text{if the ith sector of the objective table contains } 100\% \text{ of the jth sector of the source table} \\ 0 & \text{if the ith sector of the objective table doesn't icontains the jth sector of source table} \end{cases}$$

The rows of the conversion coefficient matrix express the composition of the sectors of the objective table, while the columns express the composition of the sector of the source table.

From the definition of S_{ij}, it can be shown that

(1) $0 \le S_{ij} \le 1$

(2) $\sum_i S_{ij} = 1$, the sum of the jth column of the conversion coefficient matrix is 1.

The above conditions can be used to test if the conversion coefficient matrix is correct. For example, if we converse the table of 1997 that has 124 sectors to series table (92 sectors), we should make a conversion coefficient matrix $S_{92\times124}$ which has 92 rows and 124 columns.

3. Calculating Intermediate Input, Final Use and Primary Input respectively.

Suppose that the intermediate input matrix, final use matrix and primary input matrix of the source table are Q, F and V respectively; the intermediate input matrix, final use matrix and primary input matrix of the objective table are Q1, F1, V1 respectively. We have:

$$Q1 = SQS^T \quad ①$$

$$V1 = VS^T \quad ②$$

$$F1 = SF \quad ③$$

Formula ① expresses that the transform process of Intermediate Input matrix not only has change in rows, but also in columns; Formula ② expresses that the transform process of Primary Input matrix has only change in columns; Formula ③ expresses that the transform process of Primary Input matrix has only change in rows.

Using the matrix algorithm described above, we finish the transform of the original input-output tables, and get 1987, 1992 and 1997 series tables that have 92 sectors based on national standard 2002.

Reference

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Appendix

Comparison of 92 sectors, National Standard of Industrial Classification 2002 and input-output sector of original tables

Sector Classification of series input-output tables		Code of NSIC 2002	Sector Code of 2002 table	Sector Code of 1997 table	Sector Code of 1992 table
01	Farming	01	01001	0101001	01101 01109
02	Forestry	02	02002	0102002 0101005	01202 01400
03	Logging and transport of timber and bamboo	022	02003	0512013	05300
04	Livestock	03	03004	0103003	01300
05	Fishing	04	04005	0104004	01500
06	Technical services for agriculture, forestry, livestock and fishing	05	05006	3905122 PT0717027	PT31302 PT07009
07	Coal mining and processing	06	06007	0206006	02100 02200
08	Crude petroleum and natural gas	07	07008	0307007 0307008	03100 03200
09	Ferrous ore mining	08	08009	0408009	04100
10	Non-ferrous ore mining	09	09010	0409010	04200
11	Salt mining	103	10011	0510011	05200
12	Non-metal minerals mining and mining, n.e.c.	10/11	10012	0510021	05100
13	Grain mill products	131	13013	PT0613014	PT06101
14	Forage processing	132	13014	PT0613014	06400
15	vegetable oil processing	133	13015	PT0613014	PT06101
16	Sugar refining	134	13016	0613015	06105
17	Slaughtering , meat processing	135	13017	0613016	06102
18	Prepared fish and seafood	136	13018	0613017	06104
19	Other food products	137/139/14	13019	0614018	06103 06109
20	Wines, spirits and liquors	151/152	15020	0615019	06201

Sector Classification of series input-output tables		Code of NSIC 2002	Sector Code of 2002 table	Sector Code of 1997 table	Sector Code of 1992 table
21	Non-alcoholic beverage	153/154	15021	0615020	06209
22	Tobacco manufacture	16	16022	0616021	06300
23	Textiles	171～176	17023～17027	0717022～0717026 PT0717027	07001～07005 PT07009
24	Wearing apparel	18	18028	0818028	08100
25	Leather, furs, down and related products	19	19029	0819029	08200
26	Wood processing and products of, bamboo, cane, palm, straw, etc.	20	20030	0920030	09100
27	Furniture	21	21031	0921031	09200
28	Paper and paper products	22	22032	1022032	10100
29	Printing and record medium reproduction	23	23033	1023033	10200
30	Culture, education, and sports articles	24	24034 24035	1024034 1024035	PT10300
31	Petroleum refining	251/253	25036	1125036	12000
32	Coking	252	25037	1125037	13001
33	Chemical fertilizers	262	26039	1226039	14102
34	Chemical pesticides	263	26040	1226040	14103
35	Other chemical products	261 264-267	26038 26041 26042 26043 26044	1226038 1226041 1226043 1226042	14101 14104 14105 14106 14109
36	Medical and pharmaceutical products	27	27045	1227044	14200
37	Chemical fibers	28	28046	1228045	14300
38	Rubber products	29	29047	1229046	14401 14402
39	Plastic products	30	30048	1230047	14501 14502
40	Pottery, china and earthenware	315	31051	1331052	15005
41	Fireproof products	316	31052	1331053	15006

Sector Classification of series input-output tables		Code of NSIC 2002	Sector Code of 2002 table	Sector Code of 1997 table	Sector Code of 1992 table
42	Other non-metallic mineral products	311～314 319	31049 31050 31053	1331048～ 1331051 1331054	15001～ 15004 15009
43	Primary iron and steel manufacturing	32	32054～ 32057	1432055～ 1432058	16100
44	Primary non-ferrous metals manufacturing	33	33058 33059	1433059 1433060	16200
45	Metal products	34	34060	1534061	17001 17002
46	Boiler, engines and turbine	351	35061	1635062	18001
47	Metalworking machinery	352	35062	1635063	18002
48	Other general industrial machinery	353-359	35063	1635064 PT2138082	18009 PT23000
49	Agriculture, forestry, animal husbandry and fishing machinery	367	36064	1636065 PT2138082	18004 PT23000
50	Other special industrial equipment	36-367	36065	1636066 PT2138082	18003 18006 PT23000
51	Railroad transport equipment	371	37066	1737067 PT2138082	19001 PT23000
52	Motor vehicles	372	37067 37068	1737068 PT2138082	19002 PT23000
53	Ship building and floating equipment manufacturing	375	37069	1737069 PT2138082 PT1737072	19003 PT23000
54	Aircraft	376	37070	1737070 PT2138082	19004 PT23000
55	Other transport machinery	373/374/379	37071	PT1737072 PT2138082 1737071	19009 PT23000 18005
56	Generators	391	39072	1840073	20001
57	Household electric appliances	395	39073	1840074	20002
58	Other electric machinery and equipment	392/3/4/6/7/9	39074	1840075 PT2138082	20009 PT23000
59	Communication equipment, computer	40	40075～40080	1941076～	21009

Sector Classification of series input-output tables		Code of NSIC 2002	Sector Code of 2002 table	Sector Code of 1997 table	Sector Code of 1992 table
	and other electronic equipment			1941079 PT2138082	21001 21002 PT23000
60	Instruments, meters equipment	411-414/419	41081	2042080 PT2138082	22000 PT23000
61	Cultural and office equipment	415	41082	2042081	18006
62	Arts and crafts products	421	42083	2243083	PT10300
63	Other manufacturing products	422/423/ 424/429	42084	2243084	13002 24101 24102
64	Scrap and waste	43	43085	2343085	24200
65	Electricity, steam and hot water production and supply	44	44086	2444086 2444087	11000
66	Gas production and supply	45	45087	2545088	13002
67	Water production and supply	46	46088	2646089	05400
68	Construction	E	47089	2749090	25000
69	Railway passenger transport	511	51090	3252102	29001
70	Railway freight transport	512/513	51091	2852091 2858096	26101
71	Highway transportation	52	52092	3253103 2853092 2858096	26102 29002
72	Water transportation	54	54094	2855094 3255104 2858096	26103 29003
73	Air passenger transport	5511	55095	3256105	29004
74	Air freight transport	5512/552/553	55096	2856095 2858096	26104
75	Pipeline transportation	56	56097	2854093	26105
76	Warehousing	58	58098	2859097	27100
77	Post and telecommunication	59 60	59099 60100	2960098 2960099	26200
78	Wholesale and retail trade	H	63102	3065100	27201 27202

Sector Classification of series input-output tables		Code of NSIC 2002	Sector Code of 2002 table	Sector Code of 1997 table	Sector Code of 1992 table
79	Eating and drinking places	67	67104	3167101	28000
80	Finance	68/69/71	68105	3368106	32001
81	Insurance	70	70106	3370107	32002
82	Real estate	K	72107	3474108	30100
83	Scientific research	75	75111	3892120	31301
84	Public services, resident services, and other social services	53 61/62/66 73/74 80/81 O 92	53093 61101 66103 73108 74109 74110 80115 82116 92122	3575109 3576110 3584114 3578111 3580112 3581113	30200 30300 PT31302
85	Professional Technology, other Scientific and Technical Services	76/77	76112	3993121	PT31302
86	Geological prospecting and water conservancy	78/79	78113 78114	3950123	PT31302
87	Educational services	P	84117	3789118	31201
88	Health services	85	85118	3685115	31101
89	Social security and Social welfare	86	86119	3687117	31103
90	Culture and arts, radio, film and television	88/89/90	88120	3791119	31202
91	Sports	91	91121	3686116	31102
92	Public administration and other sectors	S	93123	4099124	33000

Note: PT stands for ’ part of ‘