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Some Trends on Change in Direct Input Coefficient of China*

By

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Introduction

In input output analysis direct input coefficient plays a very important role. In order to study the trends on change in direct input coefficient it is necessary to have a time-series of input-output table with same sector classification and constructed at constant prices.

Under the support of the World Bank the Joint Research Team of the Institute of Systems Science, Chinese Academy of Sciences, and Shaanxi Institute of Economics and Finance, directed by Professor Chen Xikang, constructed a time series of comparable input-output tables, including 1981, 1987, 1990, 1992 and 1995 input output tables at 1990 producers' prices and comparable regional input-output tables.

1). Constructing 1981, 1987, 1990, 1992 and 1995 comparable input-output tables of China for 18 sectors at current prices and at 1990 constant prices.

The 1981 table of China for 18 sectors was constructed on the basis of 1981 table for 26 sectors. The latter was compiled according to Material Production System (MPS) followed the Russian practice, rather than the System of National Accounts (SNA), by the Forecasting Centre of the State Planning Commission of China and the State Statistical Bureau of China. (Karen R. Polenske and Chen Xikang, 1991).

The 1987 table of China for 18 table was reconstructed on the basis of 1987 table of China for 117 sectors, which was constructed by the Department of Balances of National Economy of State Statistical Bureau and Office of the National Input-Output Survey. (Department of Balance of the National Economy of the State Statistical Bureau and Office of the National Input-Output Survey 1991)

Using the improved RAS methods, 1990 statistical data and the 1987 direct input coefficients, the Input-Output Research Team compiled the 1990 table of China for 18 sectors.

The 1992 table of China for 18 sectors was reconstructed on the basis of 1992 table of China for 118 sectors, constructed by the Department of Balances of National Economy of State Statistical Bureau (Department of National Economic Accounting of the State Statistical Bureau 1996)

The 1995 input-output table of 18 sectors was constructed by the team, using the improved RAS methods, 1995 statistical data and the 1992 direct input coefficients.

2). Constructing 1987 input-output table of 18 sectors for developed region of China, including Guangdong Province, Shanghai and Beijing, the table for middle developed region of China, including Shaanxi Province and Henan Province, and the table for underdeveloped region of China, including Inner Mongolia and Ningxia Province. These tables are also constructed for 18 sectors at current prices and 1990 constant prices

Besides, in order to do the comparative analysis the team reconstructed the 1965, 1975 and 1985 input-output table of Japan for 18 sectors and get a time series of direct input coefficients.

The sector classification (Appendix 1) of these input-output tables was decided in October of 1992 at Stanford Meeting. Dr. Todd M. Johnson (Industry and Energy Operations Division, China and Mongolia Department, The World Bank), Professor Lawrence J. Lau, Jiang Zhongxiao (Economic Department, Stanford University), Professor Chen Xikang (Institute of Systems Science, Chinese Academy of Sciences), Professor Zhao Dianwu (Eco-Environment Center, Chinese Academy of Sciences), and Lu Gensheng (State Planning Commission of China) attended the meeting. The sector classification are specified for the United Nations Development Programme (UNDP) technical assistance study, " China, Issues and Options in Greenhouse Gas Emissions Control ", supported by the Global Environment Facility and executed by the Industry and Energy Division, China and Mongolia Department, of the World Bank.

Because energy consumption is very important to calculate the amount of greenhouse gas emissions, the most important characteristic feature of these tables is to include 5 energy sectors: coal, crude oil, refined oil, natural gas and electricity. In these input-output tables the energy sectors were expressed not only in value unit, but also in physical units (horizontal direction).

The direct input coefficients are not stable. With the rapid development of Chinese Economy, direct input coefficients of China changed very quickly. There are five important factors that produce a great influence to the change of the coefficients:

1. Technology progress
2. Improvement of management
3. Change in products-mix within each sector
4. Change in production scale. In China about 40% gross output in industry were produced by township and village enterprises, which increased more quickly than the State owned enterprises. The production scale of the most township and village enterprises is in small or median size.
5. Change in prices.

Some Trends of the Direct Input Coefficients Change in China

Horizontally we found there are following important trends of the direct input coefficients:

1. Agriculture input coefficients for sectors have a decreasing tendency. We define A_{1o} as average agriculture input coefficient for all sectors

$$A_{1o} = \frac{\sum_{j=1}^{n} X_{1j}}{\sum_{j=1}^{n} X_j}$$

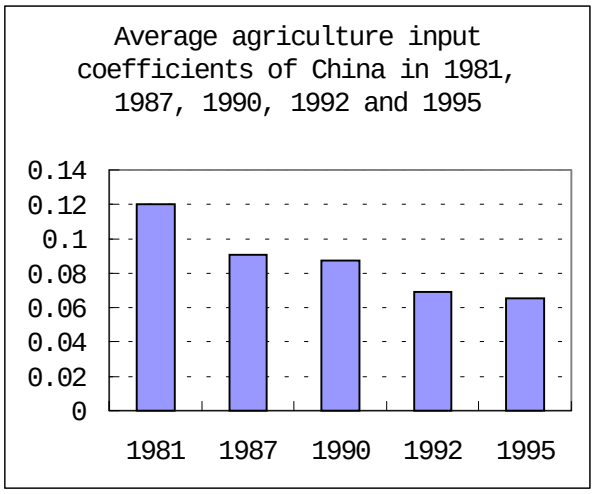
where X_{ij} represents interindustrial flow and X_j represents gross output of sector j.

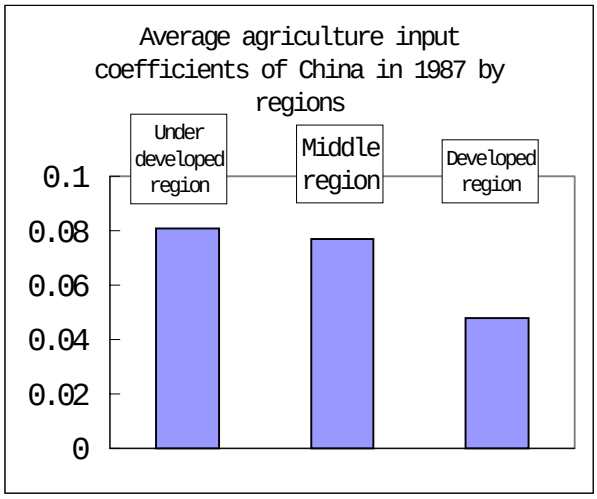
From input-output tables of 1981, 1987, 1990, 1992 and 1995, we find the average agriculture input coefficients for all sectors in 1981, 1987, 1990, 1992 and 1995 are 0.12017, 0.090417, 0.087191, 0.069397 and 0.065696 respectively. The coefficients for underdeveloped region of China, middle region and developed region are 0.080626, 0.076934 and 0.047761 respectively.

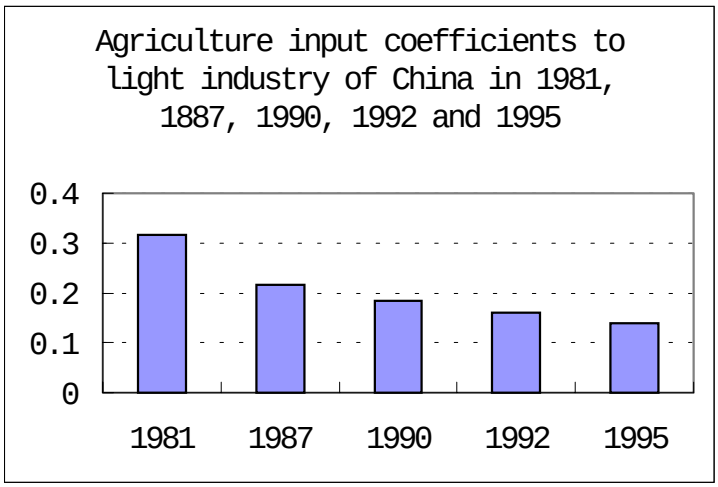
In Japan the coefficients for 1965, 1975 and 1985 are 0.06110, 0.037051 and 0.025042 respectively.

The most agricultural products in intermediate demands used in light industry (food industry). The agriculture input coefficient for light industry has a drastically decreasing tendency. The coefficients of China in 1981, 1987, 1990, 1992 and 1995 are 0.316505, 0.216727, 0.184125, 0.161250 and 0.139325 respectively. The coefficients for underdeveloped region, middle region

and developed region of China in 1987 are 0.218748, 0.168167 and 0.094411 respectively. The coefficients of Japan in 1965, 1975 and 1985 are 0.247863, 0.203955 and 0.137148 respectively.







2.The energy input coefficients to most sectors of China decreased in period 1981-1995

The most important characteristic feature of the development of the Chinese economy is the very low elasticity of GDP with respect to energy consumption, rather than the high growth rate of the economy. From table 1 we find that in period 1981-1995 the average annual growth rate of GDP is 10.44%, and the average growth rate of total energy consumption is 5.31%. The total energy consumption in 1981 is 594.47 million tons of standard coal equivalent (SCE), and that in 1995 is 1227.37 million tons of SCE. From 1981 to 1995 the elasticity of GDP with respect to the energy consumption in China is 0.51.

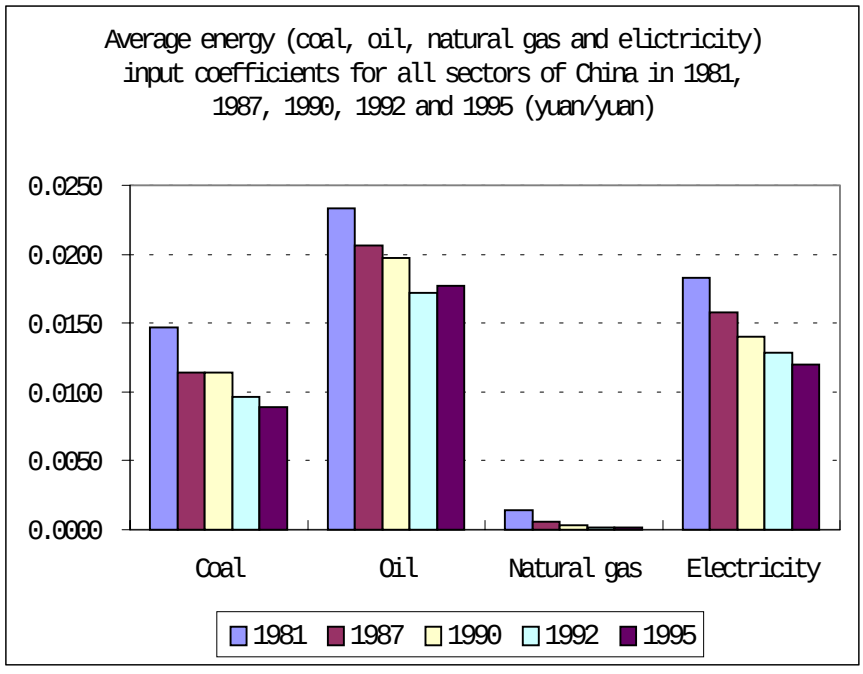
Coal is the most important energy in China. It occupies about 74% in total energy consumption of China. According to these input-output tables average coal input coefficients for all sectors in 1981, 1987, 1990, 1992 and 1995 (yuan/yuan) are 0.014709, 0.011443, 0.011380, 0.009682 and 0.008878 respectively and these coefficients in physical-value unit are 0.287, 0.224, 0.201, 0.149 and 0.133 (kg/yuan) respectively.

Average oil input coefficients for all sectors in 1981, 1987, 1990, 1992 and 1995 are 0.023322, 0.020643, 0.019741, 0.017239 and 0.017707, respectively. Average natural gas for all sectors in 1981,1987, 1990, 1992 and 1995 are 0.001459, 0.000602, 0.000346, 0.000151 and 0.000186 respectively.

Table 1 Annual Average Growth Rate of China From 1981 to 1995

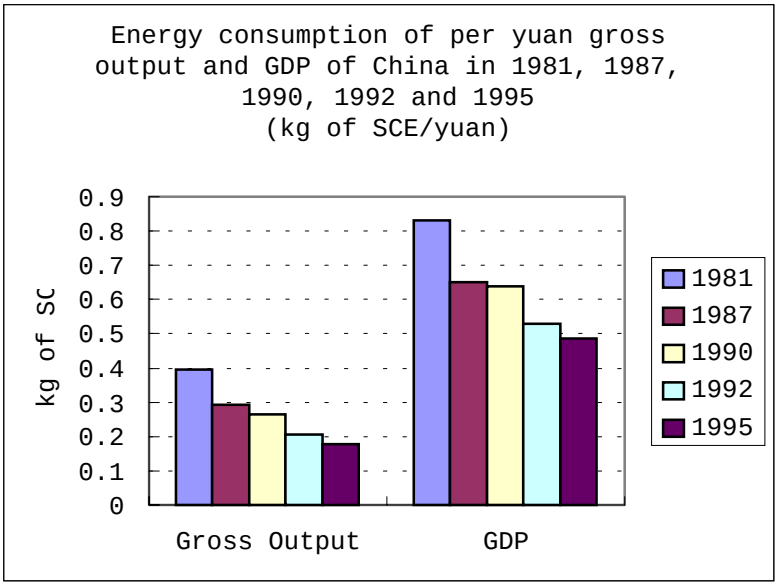
		Value Added of 1981 (10000 yuan)	Value Added of 1995 (10000 yuan)	Annual Average Growth Rate (1981-1995) (%)
		(At 1990 Constant Producer's Price)		
1	Agriculture	29396858	61541809	5.42
2	Coal	1951213	4615396	6.34
	Coal *	621.64	1360.73	5.76
3	Oil & Refineries	2779965	4597265	3.66
	Crude Oil *	101.22	150.05	2.85
	Refined Oil *	60.75	103.28	3.86
4	Natural Gas	204132	283555	2.38
	Natural Gas**	12740	17947	2.48
5	Electricity	2402465	4606299	4.76
	Electricity ***	309270	1007726	8.80
6	Ferrous Metals	2507321	6898593	7.50
7	Non-ferrous Metals	867926	7023258	16.11
8	Chemical Fertilizers	1071037	1062142	-0.06
9	Chemical Industries	1563318	24809745	21.83
10	Cement	921555	4988747	12.82
11	Building Materials	2068901	12204075	13.52
12	Heavy Mach. & Electronics	3473996	30678038	16.83
13	Light Industry	8430105	53913406	14.17
14	Construction	3776432	17304006	11.49
15	Transport & Communications	3435564	15681494	11.45
16	Commerce	5758988	20318688	9.42
17	Passenger Transport	1046328	3626602	9.28
18	Other Services	9882651	53480405	12.82
	Sub-total	81538755	327633525	10.44
	Total Energy Consumption****	594.47	1227.37	5.31

(Note: * denotes million tons; ** denotes million cubic meters; *** denotes million KWH; **** denotes million tons of standard coal equivalent (SCE)



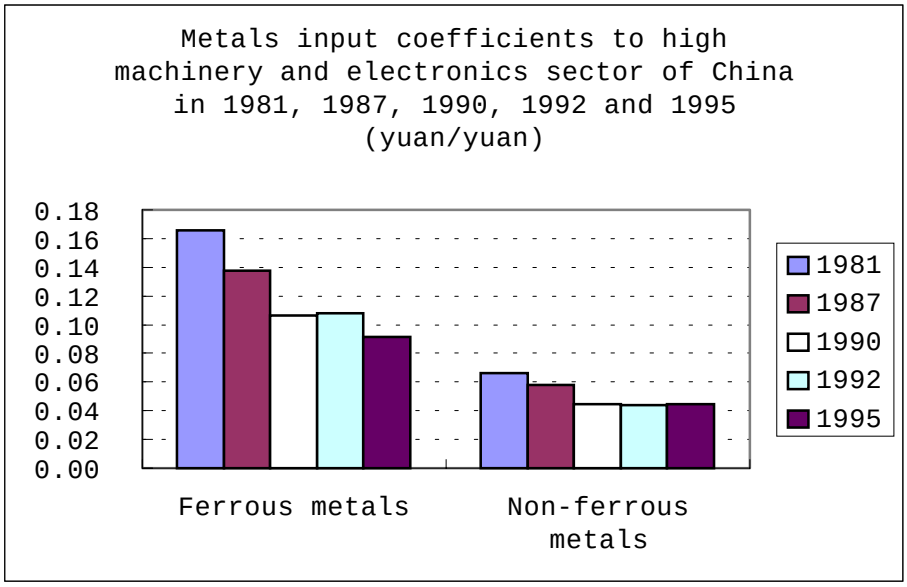
In most developing countries the growth rate of electricity consumption is higher than the growth rate of GDP, but in China the growth rate of electricity consumption is less than that of GDP. From 1981 to 1995 the growth rate of electricity consumption is 8.76 % (the electricity consumption of 1981 and 1995 is 309.3 and 1002.3 billion kwh respectively), and the average electricity input coefficients for all sectors in 1981, 1987, 1990, 1992 and 1995 are 0.018250, 0.01577, 0.014028, 0.012865 and 0.011999 respectively. In some sectors the electricity input coefficients increased, for example, because electricity locomotive spreads from year to year instead of steam locomotive and diesel locomotive, the electricity input coefficient in transport sector increased. The coefficients in 1981, 1987, 1990, 1992 and 1995 are 0.0461, 0.0598, 0.0599, 0.0639 and 0.0664 kwh/yuan, respectively.

The energy consumption per yuan of GDP in 1981, 1987, 1990, 1992 and 1995 is 0.831, 0.652, 0.639, 0.529 and 0.486 kg of SCE respectively, and the energy consumption of gross output in 1981, 1987, 1990, 1992 and 1995 is 0.396, 0.292, 0.265, 0.204 and 0.177 kg of SCE, respectively.



Up to the present in China the growth rate of secondary industry (industry and construction) is higher than that of tertiary industry. From 1981 to 1997 the annual growth rate of secondary industry is 12.6%, and that of tertiary industry is 11.1%. According to the experience of many countries we predicate that in the next two decades the growth rate of tertiary industry will be greater than the industry and construction. Because the energy consumption coefficients in tertiary industry are less than that in secondary industry, we forecast that the energy elasticity of China from 2000 to 2020 will remain in about 0.5, and the most energy coefficients in input-output tables of China will decline in period 2000-2020.

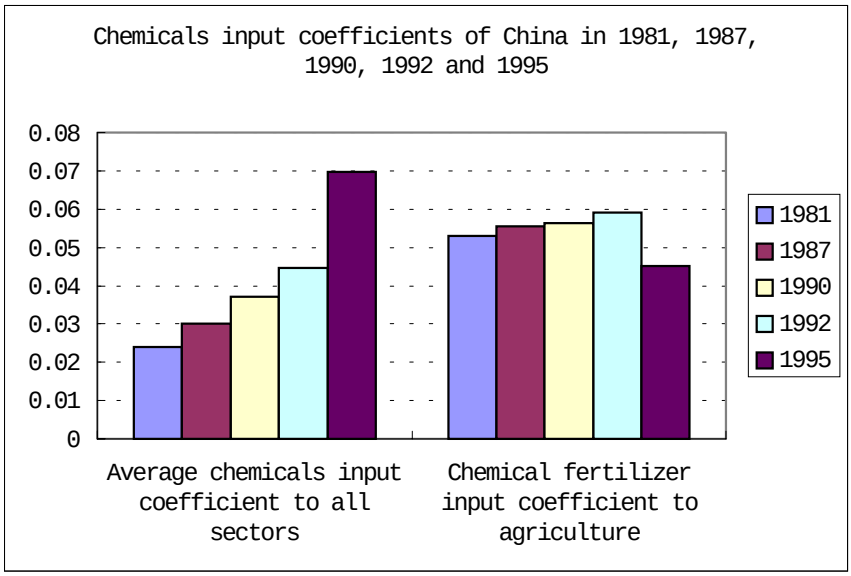
3. General speaking, material input coefficients will be decreasing. For example, the ferrous metals input coefficient to high machinery and electronics of China in 1981, 1987, 1990, 1992 and 1995 are 0.165763, 0.137560, 0.106697, 0.107939 and 0.091639 respectively. The non-ferrous metals input coefficients to high machinery and electronics in these five years are 0.066035, 0.057658, 0.044809, 0.044070 and 0.044571 respectively.



In Japan the ferrous and non-ferrous metals input coefficients for most sectors are decreasing also. For example, the average ferrous metals input coefficients to all sectors in 1965, 1975 and 1985 are 0.058424, 0.051536 and 0.043584 respectively. The average non-metals input coefficients in these years are 0.017371, 0.012167 and 0.006009 respectively.

Cement input coefficient to construction also has decreasing tendency. The coefficients in above 5 years are 0.098778, 0.112501, 0.102310, 0.107746 and 0.084966, respectively.

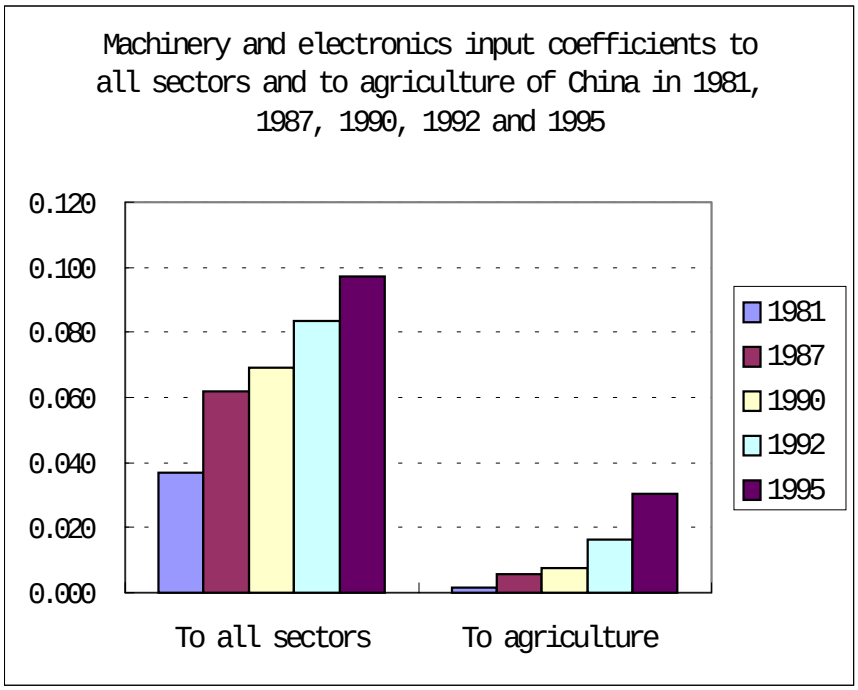
4. In China Chemicals input coefficients from 1981 to 1995 go up quickly. The average chemicals input coefficients (excluding fertilizer) to all sectors in above 5 years are 0.024044, 0.030174, 0.037008, 0.044523 and 0.069728, respectively. In Japan the coefficient in 1965, 1975 and 1985 are 0.025862, 0.028633 and 0.031400, respectively. Because the effect of law of decreasing returns, in Japan from 1965 to 1985 the chemical fertilizer input coefficients to



agriculture went down. The coefficients in 1965, 1975 and 1985 are 0.0378, 0.0304 and 0.0207. In China the coefficient went up before 1992, and after 1992 the coefficients goes down. The coefficients in above 5 years are 0.052840, 0.055542, 0.056186, 0.059011 and 0.045172, respectively.

5. Because of the technological progress, in China the average input coefficients of machinery and electronics sectors to all sectors increased drastically. The coefficients in five

years are 0.036830, 0.062039, 0.069290, 0.083372 and 0.097343, respectively. Particularly the coefficient in agriculture went up very quickly. The coefficients in agriculture of above 5 years are 0.001558, 0.005742, 0.007597, 0.016437 and 0.030254, respectively. It is noticed that up to the present the mechanization level of agriculture in China is very low, and the coefficients will go up in the recent 20 years.



6. Commerce input coefficients are stable in Japan, but they increased in China before 1992. According to our data the average commerce input coefficients to all sectors of Japan in above 3 years are 0.030057, 0.037300 and 0.033040, respectively. The coefficients of China in 1981, 1987, 1990, 1992 and 1995 are 0.020208, 0.033515, 0.028478, 0.053280 and 0.038903, respectively.

7. In Japan the input coefficients of service sector, excluding commerce and transport is increasing drastically. The average input coefficients of other service sector to all sectors in 1965, 1975 and 1985 are 0.060221, 0.068527, and 0.094269, respectively. In 20 years the coefficients increased by 56.5%. Because in a long period service sectors were neglected in China, proportion of tertiary industry in GDP of China was less by 10 % than other developing countries with same per capita GNP. The average input coefficients of other service sector to all sectors of China are less than in Japan. The coefficients of China in 1981, 1987, 1990, 1992 and 1995 are 0.039273, 0.035034, 0.035817, 0.045556 and 0.046659, respectively. In 14 years the coefficients increased by 19%, and the coefficients of China is much less than that of Japan in 1965 and 1975. It is predicated that the service input coefficients will increase drastically in coming 20 years.

References

Karen R. Polenske and Chen Xikang (editors) (1991), Chinese Economic Planning and Input-Output Analysis, Oxford University Press, Hong Kong.

Forsell D. (1972), Explaining Change in Input-Output Coefficients of Finland, in Input-Output Techniques, edited by A. P. Carter and A. Brody. North-Holland, Amsterdam, pp.343-369

C. Milana (1985), Direct and Indirect Requirements for Gross Output in Input-Output Analysis, Metroeconomica, Vol. XXXVII, No.3, pp.283-292

Vaccara, B. N. (1986), Changes Over Time in Input-Output Coefficients for the United States, in Readings in Input-Output Analysis: Theory and Applications, edited by I. Sohn, Oxford University Press, Oxford.

Sawyer J. A. (1992), Forecasting with Input-Output Matrix: Are the Coefficients Stationary? Economic Research Systems Research, Vol.4, No.4, pp.325-348

Ostblom G. (1992), Technological Change, Projection of the Technology Matrix and the Hypothesis of Negative Coefficient Changes: Parametric and Non-parametric tests with Swedish Input-Output Data. Economic Systems Research, Vol.4, No.3, pp.235-243

Xiaonnuan Lin & Karen R. Polenske (1995), Input-Output Anatomy of China's Energy Use Changes in the 1980s, Economic Systems Research, Vol.7, No.1, pp.67-84

Economic Forecasting center of the State Planning Commission and Department of National Economic Accounting of the State Statistical Bureau (1986), Input-Output Table of China for 1981, China Statistical Publishing House, Beijing.

Kimio Uno (1990), Annual Input-Output Tables in Japan 1975-1985, Institute of Socio-Economic Planning, The University of Tsukuba, Tsukuba.

Department of Balance of the National Economy of the State Statistical Bureau and Office of the National Input-Output Survey (1991), Input-Output Table of China for 1987, China Statistical Publishing House, Beijing.

Department of National Economic Accounting of the State Statistical Bureau (1996), Input-Output Table of China for 1992, China Statistical Publishing House, Beijing.

Appendix 1 Sector Classification of the Input-Output Tables of China

Sector Code and Title	*Contents*
1. Agriculture	Crop cultivation, Forestry, Livestock, Fishing, Other agricultural production
2. Coal (with coal in physical unit)	Coal mining, Coal cleaning and screening, Coking, Manufacture of gas and coal products
3. Oil & Refineries (with crude oil and refined oil in physical unit)	Crude petroleum production, Petroleum refineries
4. Natural Gas (with natural gas in physical unit)	Natural gas production
5. Electricity (with electricity in physical unit)	Electricity, steam and hot water production and supply
6. Ferrous Metals	Ferrous ore mining; Primary iron and steel manufacturing
7. Non-ferrous Metals	Non-ferrous ore mining Primary non-ferrous metals manufacturing
8. Chemical Fertilizers	Manufacture of chemical fertilizers
9. Chemical Industry	Chemical industries, excluding chemical fertilizers Manufacture of rubber product and plastic products for production use
10. Cement	Manufacture of cement, cement products and asbestos products
11. Building Materials	Quarrying of building materials and non-metal minerals Manufacture of building materials and other non-metallic mineral products, excluding cement, cement products and asbestos products
12. Heavy Machinery & Electronics	Manufacture of metal products for production use Manufacture of machinery, excluding that for daily use; Transport equipment; Electric machinery and instrument, excluding that for daily use Electronic and communication equipment, excluding that for daily use Instruments, meters and other measuring equipments Repair of machinery and equipment, other products for production use
13. Light Industry	Salt mining, Logging and transport of timber and bamboo Production and supply of water; Food manufacturing; Manufacture of textiles Manufacture of wearing apparel, leather and products of leather and fur Sawmills and manufacture of furniture, Papers, cultural and educational articles Chemical products, plastic products and rubber products for dail use Manufacture of medicines; Chemical fibres; Metal products and machinery for dail use; Manufacture of household electrical appliances; Electronic appliances for dail use; Other products for dail use
14. Construction	Construction
15. Transport & Communication	Freight transport and communications
16. Commerce	Commerce; Resturants
17. Passenger Transport	Railway, highway, water and air passenger transport
18. Other Service	Public utilities and services to household; Cultural, education, health and scientific research institutions; Finance and insurance, Public administration