A Study of Chinese Industry Sector Influence Based on SAM Multiplier Model

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Abstract: This paper first constructs SAMs on the basis of IO table of 1997, 2002 and 2007. Then based on the SAM multiplier model of static value type, the paper introduces the concept of sector output multiplier and influence coefficient within a SAM framework. According to the Chinese SAM of 1997, 2002 and 2007, we calculate the influence coefficient of different industry sector and investigate the change during the period. Meanwhile, the paper also does some calculations about the influence power of every sector in national economy based on IO table and tries to explain the difference between the two sets of results under different data basis. We find that relative to the measuring method based on IO table, the evaluation on the sector influence power based on SAM is more veracious and comprehensive.
Keywords： Social Accounting Matrix, Accounting Multiplier Matrix, Multiplier Analysis

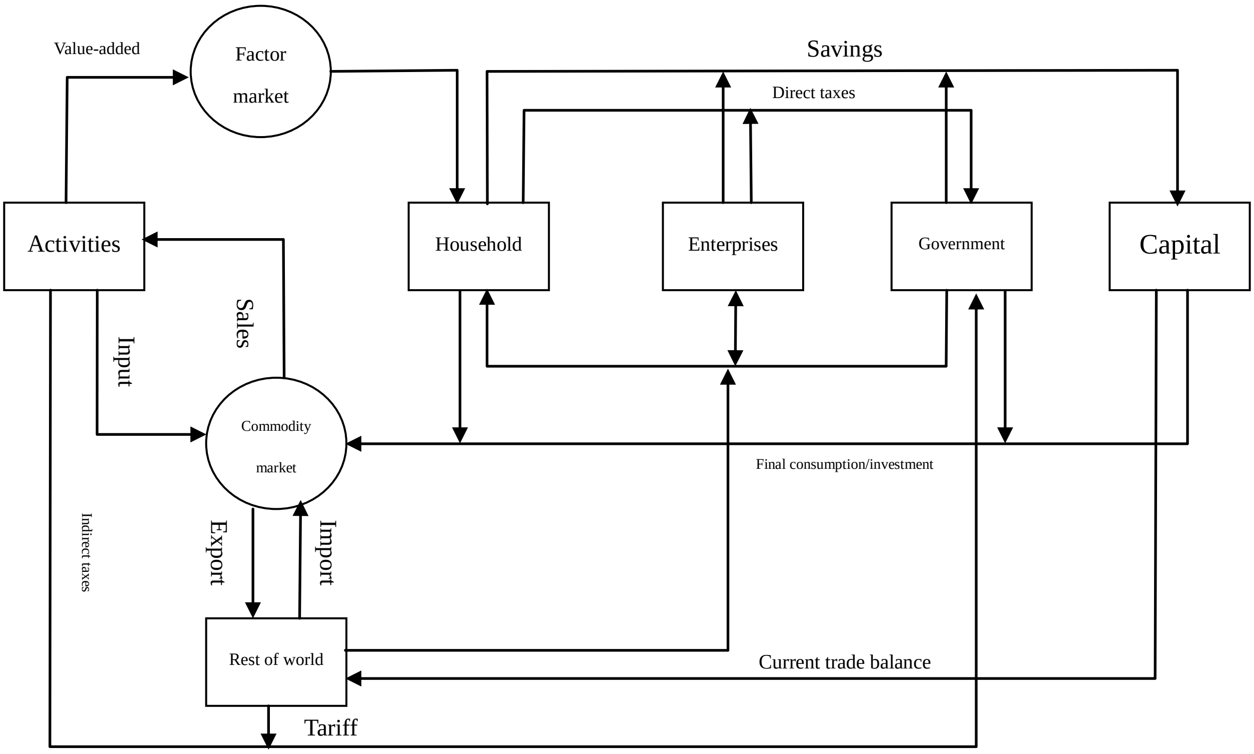
SAM is an important form to exhibit the quantity relationship among national accounts. The System of National Accounting (SNA) that issued by Statistics Office of United Nation in 1993 gives a definition of SAM as follows: It is SNA account in the form of a matrix which depicts the relationship among supplying table, using table and institution accounts, thus reflects all kinds of social-economic relations of a certain period. In contrast with input-output model, SAM not only reflects the relationship among production sectors and the primary distribution of income, but reflects the secondary distribution of income as well. In recent years, SAM is used as database and provides data for constructing economic model more and more frequently. However, SAM itself is a powerful tool for studying industry structure and the interdependence of economy accounts. Multiplier Decomposition is an important analysis method within a SAM framework.

1. Social Accounting Matrix and the Basic Theory of Multiplier Analysis Method

According to the theory of double-entry accounting, SAM takes the form of n×n matrix to reflect the income and expenditure of each account. Every element in the SAM has double meaning, that is, it reflects the income of an account from the perspective of row and the expenditure of another account from the perspective of column. The total of certain row and that of the corresponding column must be equal, which means that total income is equal to total expenditure of each account.

By integrating all kinds of economic flows, SAM reveals the circular links among various economic accounts. The following figure shows the relationships reflected by SAM. The figure is in point not only for a nation but for a region as well[1]. In the figure, each arrowhead represents an element in SAM. Income flows from production to the distribution of factor income, then to final consumption and investment, and then back to production form a simple production cycle. The supplying, consumption and investment of commodity construct the supply-demand relationship of the commodity market. The demand on factor for production and the supply of labor and capital construct the supply-demand relationship of the factor market. With external trade and internal trade and the secondary distribution of income, all above construct the whole social-economic system.

Figure1 Economic relationships reflected by SAM



Note: The arrow head represents income and the arrow tail represents expenditure.
Source：Adapted from Jeffery Round (2002)

1.1 Basic tables and quantity equations in SAM

There are two kinds of SAM, that is, macro-SAM and micro-SAM. On the basis of macro-SAM, according to the requirement of the subject under study and meanwhile taking the availability of data into consideration, micro-SAM partitions certain accounts into more detailed classifications. For the sake of demonstration, on the basis of micro-SAM, table 1 builds up the accounts into several big sets and exhibits the SAM in a simplified form. Thus, we can demonstrate the interaction among accounts through the operation of block matrices.

[1] If the SAM is about a region within a country, then perhaps it is necessary to distinguish the trade partners between “rest of world” and “rest of the nation”.

Table 1 Sketch map of a simplified SAM[1]

Income \ Expenditure		Endogenous accounts			Exogenous accounts	Total
		1．Activities	2．Factors	3．Institutions		
Endogenous accounts	1．Activities	T_{11}		T_{13}	X_1	Y_1
	2．Factors	T_{21}			X_2	Y_2
	3．Institutions		T_{32}	T_{33}	X_3	Y_3
Exogenous accounts		L_1	L_2	L_3	LX	Y_4
Total		Y_1	Y_2	Y_3	Y_4	

It is necessary to partition accounts of SAM into endogenous accounts and exogenous accounts before any quantitative analysis. In the simplified SAM shown by table 1, endogenous accounts include three big sets——activities, factors and institutions (here means households and enterprises specifically). The activities account is the integration of all kinds of production activities. The factors account includes such production factors as labor, land and capital. The institutions account mainly includes enterprises and households, and the households can further be partitioned into several groups according to their residence (i.e. urban or rural) and income level. Such accounts as government, capital and rest of the country[2] are taken as exogenous[3]. In the area of the 3×3 endogenous accounts represented by block matrices, block matrix T_{11} captures the demand on intermediate inputs among production activities, which is virtually the intermediate flow of the input-output table; Block matrix T_{13} captures the expenditure mode on products of various institutions (usually all kinds of households and enterprises); Block matrix T_{21} captures the distribution of value-added created by production activities among factors; Block matrix T_{32} captures the distribution mode of factor income among different households and enterprises; Block matrix T_{33} captures the income transfer within institutions, i.e., among enterprises and various groups of households.

Under such assumptions such as fixed prices, demand orientation (i.e., there exist excess production capacities and resources) and linear relationship among economic accounts, SAM can

1 Generally, the "institutions" in SAM include households, enterprises and government, etc. In this sketch map, the "institutions" in the endogenous accounts specially means households and enterprises, and government is classified into exogenous accounts.

2 It is an account set by an open SAM when taking trade into consideration.

3 Taking capital endogenous means more flexibility in internal resources flow and collocation. Taking the account—— "rest of the country" ——endogenous means that the trade between regions is relatively free.

be used as the basis for simple modeling. Similar to the matrix of direct input coefficients of IO model, a matrix of average expenditure propensities matrix is defined within the SAM framework. To get the numerical value of each element in the matrix, just divide the corresponding element of SAM by the total of the column which contains the element. Using A_n to denote the matrix of average expenditure propensities and then block A_n according to the pattern of 3×3 endogenous accounts matrix in the simplified SAM, we get

$$A_n = \begin{pmatrix} A_{11} & 0 & A_{13} \\ A_{21} & 0 & 0 \\ 0 & A_{32} & A_{33} \end{pmatrix} \tag{1.1}$$

Since the total of column and that of the corresponding row are equal in SAM, the total income of endogenous accounts can be written as following:

$$y_n = A_n y_n + x \tag{1.2}$$

Transform the equation (1.2) and we can get the following equation which captures the relationship between the endogenous incomes y_n and the exogenous injections x.

$$y_n = (I - A_n)^{-1} x = M_a x \tag{1.3}$$

The matrix M_a is called accounting multiplier matrix. This matrix reflects the basic interaction among data flows of SAM. Just as the Leontief inverse matrix in the IO model, accounting multiplier matrix is the core of the method within a SAM framework. The element m_{aji} of the matrix M_a reflects the global effects of the exogenous injection x_i on endogenous account y_j. If we solve the total output y_1 on the basis of (1.1) and (1.2), we can get equation (1.4):

$$y_1 = (I - A_{11})^{-1}(A_{13} y_3 + x_1) \tag{1.4}$$

Compare the equation (1.4) and the total output equation[1] inferred from IO model, we can find that the expression (1.4) generalize the result of IO model. Since A_{13} reflects the expenditure mode of various groups of households, the expression (1.4) demonstrates the influences of income distribution effects on the final output of production activities by including $A_{13} y_3$ into final demands.

1.2 Multiplier analysis method within a SAM framework

Purely depending on accounting multiplier matrix M_a, we can only get limited information.

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[1] The total output expression based on IO model is $y = (I - A)^{-1} x$, within which x is final demand and A is the direct consumption coefficient matrix.

Through decomposing M_a, we can understand the effects resulted from the exogenous account variation more clearly. After introducing a new reversible matrix $\tilde{A}_n$ with the same scale as that of matrix A_n, we can do the following transformation on the expression (1.2).

$$\begin{aligned} y_n &= A_n y_n + x = (A_n - \tilde{A}_n) y_n + \tilde{A}_n y_n + x \\ &= (I - \tilde{A}_n)^{-1}(A_n - \tilde{A}_n) y_n + (I - \tilde{A}_n)^{-1} x \\ &= A^* y_n + (I - \tilde{A}_n)^{-1} x \end{aligned} \tag{1.5}$$

Among it,

$$A^* = (I - \tilde{A}_n)^{-1}(A_n - \tilde{A}_n) \tag{1.6}$$

Simultaneously left-multiply A^* on the two sides of equation (1.5) and substitute the left side with the expression of $A^* y$ obtained from (1.5), we get

$$\begin{aligned} & y_n - (I - \tilde{A}_n)^{-1} x = A^{*2} y_n + A^*(I - \tilde{A}_n)^{-1} x \Rightarrow \\ & y_n = A^{*2} y_n + (I + A^*)(I - \tilde{A}_n)^{-1} x \end{aligned} \tag{1.7}$$

Similarly, simultaneously left-multiply A^{*2} on the two sides of equation (1.5) and substitute the left side with the expression of $A^{*2} y$ obtained from (1.7), we get

$$\begin{aligned} & y_n = A^{*3} y_n + (I + A^* + A^{*2})(I - \tilde{A}_n)^{-1} x \Rightarrow \\ & y_n = (I - A^{*3})^{-1}(I + A^* + A^{*2})(I - \tilde{A}_n)^{-1} x \end{aligned} \tag{1.8}$$

Compare the expression (1.8) with (1.3) and we can see that the accounting multiplier matrix M_a is decomposed into the product of three independent matrices.

According to the pattern of the average expenditure propensity matrix provided by equation (1.1), we define $\tilde{A}_n$ as the following diagonal matrix.

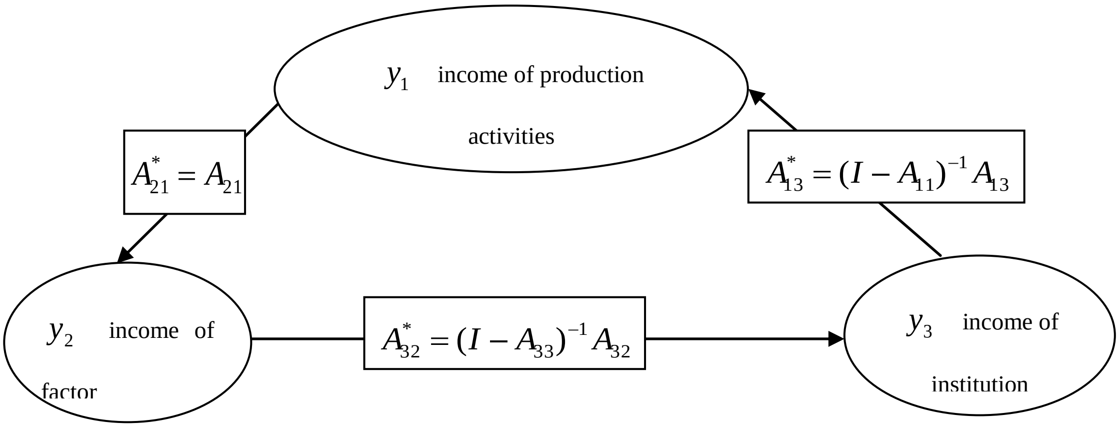
$$\tilde{A}_n = \begin{pmatrix} A_{11} & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & A_{33} \end{pmatrix} \tag{1.9}$$

Among it, the block square matrix A_{11} and A_{33} respectively reflect the expenditure transfer relationship within activities account and institution account. $\tilde{A}_n$ is also a square matrix and the matrix is reversible. On the basis of this, we can get the expression of A^*.

$$A^* = \begin{pmatrix} 0 & 0 & A_{13}^* \\ A_{21}^* & 0 & 0 \\ 0 & A_{32}^* & 0 \end{pmatrix} \quad \text{Among it,} \quad \left\{ \begin{aligned} A_{13}^* &= (I - A_{11})^{-1} A_{13} \\ A_{21}^* &= A_{21} \\ A_{32}^* &= (I - A_{33})^{-1} A_{32} \end{aligned} \right\} \tag{1.10}$$

The location and structure of the non-zero block matrices within the matrix A^* fully reflect the relationship among the endogenous accounts. If we classify the total income y_n of the endogenous account into activities, factor and institution, then the three non-zero block matrices which compose A^* perfectly reflect the circular transfer relationship among the three kinds of income, as shown by figure 2. It is easy to see from the figure that we will finally come back to the start point after three steps of transfer no matter which point we select to start. For example, the income flow goes to factor from production activities, then goes to institution, and finally returns to the production activities in the form of consumption demands.

Figure 2 Close circle of the income flows among endogenous accounts



The decomposed accounting multiplier matrix can reflect this economic relationship more clearly. On the basis of the expression (1.8), we can change the accounting multiplier matrix into the form of the product of three multiplier matrices, that is,

$$M_a = M_{a3} M_{a2} M_{a1} \qquad \text{among it,} \quad \begin{cases} M_{a1} = (I - \tilde{A}_n)^{-1} \\ M_{a2} = I + A^* + A^{*2} \\ M_{a3} = (I - A^{*3})^{-1} \end{cases} \tag{1.11}$$

According to the definition of $\tilde{A}_n$ and A^* by expression (1.9) and (1.10), we can solve the above three expressions and get

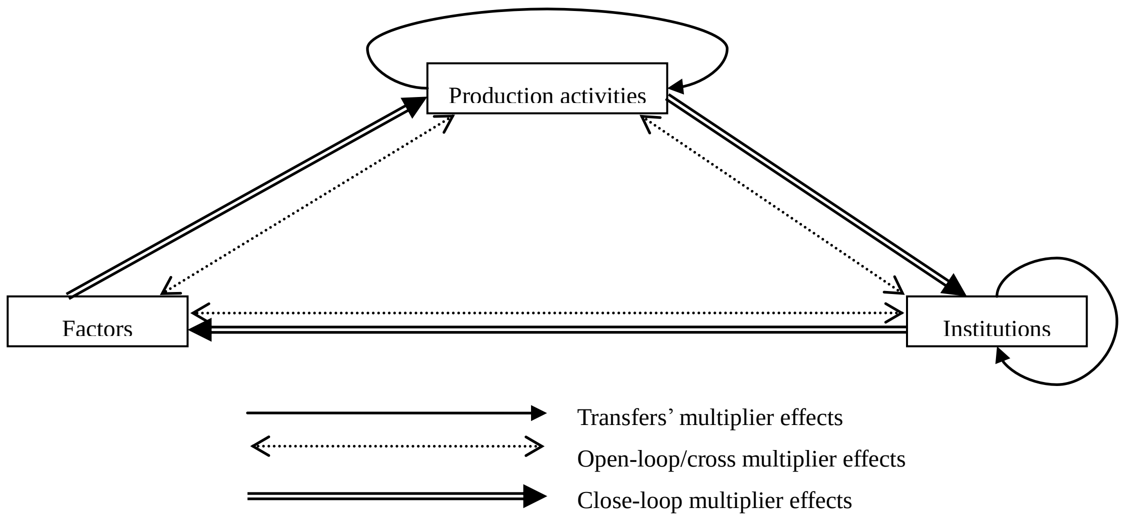
$$M_{a1} = \begin{pmatrix} (I - A_{11})^{-1} & 0 & 0 \\ 0 & I & 0 \\ 0 & 0 & (I - A_{33})^{-1} \end{pmatrix} \tag{1.12}$$

$$M_{a2} = \begin{pmatrix} I & A^*_{13} A^*_{32} & A^*_{13} \\ A^*_{21} & I & A^*_{21} A^*_{13} \\ A^*_{32} A^*_{21} & A^*_{32} & I \end{pmatrix} \tag{1.13}$$

$$M_{a3} = \begin{pmatrix} (I - A^*_{13} A^*_{32} A^*_{21})^{-1} & 0 & 0 \\ 0 & (I - A^*_{21} A^*_{13} A^*_{32})^{-1} & 0 \\ 0 & 0 & (I - A^*_{32} A^*_{21} A^*_{13})^{-1} \end{pmatrix} \tag{1.14}$$

In the above three multiplier matrices, M_{a3} is block diagonal matrix and is called as close-loop multiplier matrix. The three block matrices on its diagonal exhibit the circular transfer relationship among income flows of the endogenous accounts of the matrix A^*. M_{a1} is also a block diagonal matrix. But it doesn't involve the close circle of income flows in the whole economy system. It merely reflects the direct transfer of certain endogenous account. Since there doesn't exist income transfer among different factors, the middle block matrix is identity matrix whereas the first one and the third one respectively reflect the multiplier effects within production activities account and institution account. M_{a1} is called as transfers' multiplier account. M_{a2} is not a diagonal matrix and its diagonal is composed of identity block matrices. Therefore it doesn't involve the circular transfers within and between endogenous accounts, but reflects the interaction among all the endogenous accounts. M_{a2} is called as cross-effect multiplier matrix, and also called open-loop multiplier matrix. Figure 3 demonstrates the three effects after the decomposition of the multiplier matrix. Transfer multiplier effects are contained within the production activities account and institution account. Open-loop multiplier effects are demonstrated between every two different accounts. Close-loop multiplier effects can start from any account and finally come back to the start point after a series of actions.

Figure 3 Three effects reflected by multiplier decomposition



In most studies, equation (1.15) is more frequently used since it is more easily to express and understand than equation (1.11). Moreover, through separating the initial injection matrix I from the global effects, we can get three kinds of net effects, that is, Matrix T represents the net contribution of transfers' multiplier effects; Matrix O represents the net contribution of open-loop multiplier effects; Matrix C represents the net contribution of close-loop multiplier effects.

$$M_a = I + (M_{a1} - I) + (M_{a2} - I)M_{a1} + (M_{a3} - I)M_{a2}M_{a1} = I + T + O + C \quad (1.15)$$

Thus, the SAM-based multiplier matrix is decomposed into the additive form of net multiplier effects.

On the basis of the conclusions of multiplier decomposition method, we can analyze the various effects resulted from the variation of exogenous demands using Chinese SAM of 1997.

2. A Case of Multiplier Analysis Based on Chinese SAM in 1997

2.1 The Structure of Chinese SAM in 1997[1]

The analysis foundation of this part is Chinese SAM in 1997[2]. The micro-SAM contains 57 sectors, 5 production factors, 7 groups of households according to their income level, 1 enterprise account and other macro accounts such as government subsidies, production taxes, import, export and capital, etc. In order to simplify the analysis process and meanwhile make the key problem outstand, this article merges the 57 sectors into 29 big sectors and takes the accounts relating to government, taxes, import, export and capital as a whole exogenous account. Thus, we now have a 50×50 SAM with three groups of endogenous accounts——production activities (including 29 sectors), factors (including 5 production factors), institutions (including 14 groups of households and 1 enterprise). The accounts in detail are shown in the following table.

Table 2 the Schedule of Detailed Endogenous Accounts of Chinese SAM (after aggregation)

<table>
<tr><td rowspan="22">Production Activities</td><td>1. Agriculture</td><td rowspan="5" colspan="2">Production Activities</td><td>25. Banking & Insurance</td></tr>
<tr><td>2. Mining</td><td>26. Real Estate</td></tr>
<tr><td>3. Foodstuff</td><td>27. Social Service</td></tr>
<tr><td>4. Textile</td><td>28. Education & Health</td></tr>
<tr><td>5. Apparel, Leather and Furs Products</td><td>29. Administration & Others</td></tr>
<tr><td>6. Sawmills and Manufacture of Furniture</td><td rowspan="15">Institutions</td><td rowspan="7">Urban</td><td>Lowest</td></tr>
<tr><td>7. Manufacture of Paper & Cultural</td><td>Low</td></tr>
<tr><td>8. Petroleum Refineries and Coking</td><td>Medium-Low</td></tr>
<tr><td>9. Chemical Industries</td><td>Medium</td></tr>
<tr><td>10. Building Materials</td><td>Medium-high</td></tr>
<tr><td>11. Primary Metal Manufacturing</td><td>High</td></tr>
<tr><td>12. Metal Products</td><td>Highest</td></tr>
<tr><td>13. Machinery</td><td rowspan="7">Rural</td><td>Lowest Income</td></tr>
<tr><td>14. Transport Equipment</td><td>Low</td></tr>
<tr><td>15. Electric Machinery and Instrument</td><td>Medium-Low</td></tr>
<tr><td>16. Computers</td><td>Medium</td></tr>
<tr><td>17. Instruments and Meters</td><td>Medium-high</td></tr>
<tr><td>18. Other Manufacturing</td><td>High</td></tr>
<tr><td>19. Electric Power, Steam and Water</td><td>Highest</td></tr>
<tr><td>20. Construction</td><td colspan="2">Enterprise</td></tr>
<tr><td>21. Transport</td><td rowspan="2">Factors</td><td colspan="2">Agriculture Labor</td></tr>
<tr><td>22. Communication</td><td colspan="2">Production Worker</td></tr>
</table>

[1] The Chinese SAM in 1997 used by this article comes from the Department of Development Strategy and Regional Economy of DRC. The SAM is once used as an important data reference in the research on the influences of China's entering into WTO. It is also the data basis for CGE model construction.

[2] To get more information about Chinese SAM in 1997, just see the following website: http://www.drc.gov.cn/hsjz/index1.html.

	23．Commerce		Professionals
	24．Restaurants		Land
			Capital

2.2 Some demonstration studies in the application of multiplier analysis method

On the basis of average expenditure propensity matrix A_n, we can further get the accounting multiplier matrix M_a and the three net effects T, O and C. The matrix M_a reveals some information in industry structure. Through decomposing the multiplier matrix, we can see about what related influences will be resulted by an injection on certain endogenous account.

First of all, we can calculate the output multiplier of every account which reflects the driving action on the whole economic system. Table 3 shows the net effects and the corresponding decomposition effects of all accounts. In addition, from the multiplier calculation results shown in table 4, we can see that the SAM-based multipliers are different from those IO-based multipliers. Thus, the force of various industry sectors in the national economy is also different. We can see this from their ranks. According to the IO-based multiplier, the sector of agriculture, foodstuff, restaurant and education and health ranks 28, 17, 18 and 21 respectively. Whereas according to the SAM-based multiplier, the above 4 sectors rank 2, 4, 3 and 12 respectively. As mentioned in last section, the main difference between SAM-based multiplier and IO-based multiplier lies in that the former contains the influence of income redistribution whereas the latter mainly reflects the influence within production activities account. From table 3 we can see that, the action of the above 4 sectors is limited within the production activities account, whose net transfers' effect is 0.87, 1.44, 1.39 and 1.23 respectively. However, the above sectors show relatively big influence force through the close-loop effects of 2.41, 1.71, 1.78 and 1.66 respectively, which are all bigger than that in the production activities account. Contrary to this, the IO-based multipliers of the sector machinery, transport equipment, electric machinery and instrument, computers, instruments and meters rank 10, 4, 1, 2 and 6 whereas the SAM-based multipliers of them rank only 23, 15, 10, 26 and 27. From table 3 we can see that the above 5 sectors all produce relatively big net transfers' effects but their net close-loop effects are all small, which makes the SAM multipliers low. If we rank the net transfers' effects of various industry sectors, then the result approximately tally with the rank of IO-based multipliers. This is because that both IO-based multiplier and net transfers' effect emphasize the action of certain sector in the production activities account. [1] Since the SAM-based multipliers comprehensively reflect the action of certain sector in the national economy, they frequently provide objective and exact information in the process of establishing development planning and regulating industry structure.

Table 3 Accounting Multiplier net effects and decomposition

[1] The sectors of computers and instruments and meters are two exceptions. Because the import volume of this two sectors is very big. IO table reckons in the import while calculating interim flows; whereas SAM takes it as exogenous and limits production activities account in "domestic". Thus, SAM-based net transfers' effects and multiplier reflect the domestic industry structure more actually.

Account	Net effects		T		O		C
(1)	(2)	=	(3)	+	(4)	+	(5) [1]
1. Agriculture	3.2739		0.8663		0.0000		2.4075
2. Mining	2.2754		0.9788		0.0000		1.2966
3. Foodstuff	3.1521		1.4448		0.0000		1.7073
4. Textile	2.9419		1.5640		0.0000		1.3779
5. Apparel, Leather and Furs Products	3.0735		1.6114		0.0000		1.4621
6. Sawmills and Manufacture of Furniture	3.0640		1.6690		0.0000		1.3950
7. Manufacture of Paper & Cultural articles	2.8567		1.5002		0.0000		1.3565
8. Petroleum Refineries and Coking	2.4631		1.4193		0.0000		1.0438
9. Chemical Industries	2.6768		1.5237		0.0000		1.1531
10. Building Materials	2.9622		1.5897		0.0000		1.3725
11. Primary Metal Manufacturing	2.8865		1.7109		0.0000		1.1755
12. Metal Products	3.0526		1.8173		0.0000		1.2353
13. Machinery	2.3992		1.3399		0.0000		1.0593
14. Transport Equipment	2.8483		1.6868		0.0000		1.1614
15. Electric Machinery and Instrument	2.9618		1.8064		0.0000		1.1554
16. Computers	2.1717		1.3300		0.0000		0.8417
17. Instruments and Meters	2.0694		1.1679		0.0000		0.9015
18. Other Manufacturing	2.5474		1.0025		0.0000		1.5449
19. Electric Power, Steam and Water	2.5063		1.2594		0.0000		1.2470
20. Construction	3.2899		1.7818		0.0000		1.5080
21. Transport	2.4905		1.0496		0.0000		1.4409
22. Communication	2.2682		1.0508		0.0000		1.2174
23. Commerce	2.6003		1.1509		0.0000		1.4495
24. Restaurants	3.1751		1.3951		0.0000		1.7801
25. Banking & Insurance	1.9421		0.8340		0.0000		1.1081
26. Real Estate	1.7515		0.5640		0.0000		1.1875
27. Social Service	2.7654		1.3433		0.0000		1.4221
28. Education & Health	2.8929		1.2364		0.0000		1.6564
29. Administration & Others	3.0068		1.2748		0.0000		1.7320
Agriculture Labor	3.2254		0.0000		1.7484		1.4770
Production Worker	2.6722		0.0000		1.5173		1.1549
Professionals	2.3740		0.0000		1.3790		0.9950
Land	2.9901		0.0000		1.6392		1.3509
Capital	0.9449		0.0000		0.5320		0.4129
rural Lowest	4.0570		0.0000		2.1391		1.9179
rural Low	3.8520		0.0000		2.0341		1.8180
rural Medium-Low	3.6662		0.0000		1.9492		1.7171
rural Medium	3.4425		0.0000		1.8487		1.5938
rural Medium-high	3.1711		0.0000		1.7291		1.4421
rural High	2.8665		0.0000		1.5810		1.2855
rural Highest	2.4754		0.0000		1.3983		1.0771
urban Lowest	3.7537		0.0000		2.1122		1.6415
urban Low	3.0579		0.0000		1.7351		1.3228
urban Medium-Low	2.7811		0.0000		1.5908		1.1903
urban Medium	2.5120		0.0000		1.4501		1.0620
urban Medium-high	2.2930		0.0000		1.3355		0.9575
urban High	2.1276		0.0000		1.2500		0.8776
urban Highest	1.9042		0.0000		1.1351		0.7691

Table 4 Comparison between SAM-based multipliers and IO-based multipliers

[1] Because of the error caused by round, the actual results may be a bit different from the calculations.

Production activities sectors	IO-based multipliers	Rank of IO-based multipliers	SAM-based multipliers	Rank of SAM-based multipliers
1．Agriculture	2.0121	28	4.2739	2
2．Mining	2.3575	23	3.2754	24
3．Foodstuff	2.6971	17	4.1521	4
4．Textile	3.0631	11	3.9419	11
5．Apparel, Leather and Furs Products	3.0340	12	4.0735	5
6．Sawmills and Manufacture of Furniture	3.1026	9	4.0640	6
7．Manufacture of Paper & Cultural articles	3.0157	13	3.8567	14
8．Petroleum Refineries and Coking	2.9784	14	3.4631	22
9．Chemical Industries	3.1650	8	3.6768	17
10．Building Materials	2.9581	15	3.9622	9
11．Primary Metal Manufacturing	3.3363	5	3.8865	13
12．Metal Products	3.3858	3	4.0526	7
13．Machinery	3.1004	10	3.3992	23
14．Transport Equipment	3.3595	4	3.8483	15
15．Electric Machinery and Instrument	3.4936	1	3.9618	10
16．Computers	3.4915	2	3.1717	26
17．Instruments and Meters	3.2026	6	3.0694	27
18．Other Manufacturing	2.2556	26	3.5474	19
19．Electric Power, Steam and Water	2.5900	19	3.5063	20
20．Construction	3.1738	7	4.2899	1
21．Transport	2.3341	25	3.4905	21
22．Communication	2.3570	24	3.2682	25
23．Commerce	2.4926	22	3.6003	18
24．Restaurants	2.6068	18	4.1751	3
25．Banking & Insurance	2.0982	27	2.9421	28
26．Real Estate	1.6871	29	2.7515	29
27．Social Service	2.8060	16	3.7654	16
28．Education & Health	2.5157	21	3.8929	12
29．Administration & Others	2.5182	20	4.0068	8

From the accounting multipliers shown by table 3, we can also see some important characteristics of Chinese industry structure and income distribution. As for the production account, agriculture and construction play an important role in the whole national economy. The relatively small net transfers effects of agriculture show that currently the agriculture of our country is still in the low-grade development stage. However, through the close-loop effects, the driving force of agriculture on the whole national economy is considerable. This is easy to understand since China is a developing country with tremendous agriculture population. A little different from agriculture, the sector of construction ranks first as of net effects, because it produces both high transfers effects and high close-loop effects. On the one hand, the sector of construction has strong relationship with other sectors; on the other hand, it provides large quantity of employment opportunities to drive the development of the whole economy. In addition, currently the driving force of various sectors on the national economy is closely related to the labor factors. Those industries with relatively big driving force incline to be labor-intensive and depend on elementary labor. The multiplier decomposition of factor account shows that agriculture labor and land are the two most important production factors in current China, while the action of capital is far from enough. The action of production workers and professionals is also very limited. This is consistent with the status quo that the share of agriculture labor is relatively high. As for the characteristics of income distribution, the effects produced by the injection on rural households (mainly government subsidy and transfer) are bigger than that produced by the injection on urban households. Moreover, within each kind of households, the driving force decreases along with the increase of income level. Therefore, merely from the perspective of the driving force, the pro-poor transfer policy not only improves the situation of income inequality, but also promotes the whole national economy.

Except the above analysis, another important application of SAM-based multiplier decomposition method is to analyze the point-to-point direct effects between two accounts. Table 5 lists 4 kinds of representative scenarios of multiplier analysis which select two accounts from production activities account and households account respectively as the action end of exogenous injection and see about the influences. The whole effects are shown in the form of decomposition.[1]

Table 5 Application cases of SAM multiplier decomposition method

Case (1)	Start point of injection (2)	End account influenced (3)	Net effects (4)	=	T (5)	+	O (6)	+	C (7) [2]
Ⅰ	Agriculture	Foodstuff	0.4364		0.0989		0.0000		0.3375
		Social Service	0.0783		0.0151		0.0000		0.0632
		Agriculture labor	0.8616		0.0000		0.5630		0.2986
		Production worker	0.2271		0.0000		0.0579		0.1692
		Professional	0.1076		0.0000		0.0314		0.0762
		Urban lowest	0.0185		0.0000		0.0052		0.0133
		Urban medium	0.0669		0.0000		0.0190		0.0479
		Urban-highest	0.0598		0.0000		0.0177		0.0420
		Rural-lowest	0.0611		0.0000		0.0387		0.0223
		Rural-medium	0.1734		0.0000		0.1072		0.0662
		Rural-highest	0.2278		0.0000		0.1369		0.0910
Ⅱ	Computers	Sawmills and Manufacture	0.0149		0.0064		0.0000		0.0086
		Electric Machinery and Instrument	0.1212		0.1015		0.0000		0.0197
		Agriculture labor	0.1016		0.0000		0.0108		0.0908
		Production worker	0.2259		0.0000		0.1633		0.0626
		Professional	0.0921		0.0000		0.0633		0.0288
		Land	0.0138		0.0000		0.0015		0.0123

1 Limited by length, we only choose several accounts as the influenced end in each group of scenario.
2 Because of the error caused by round, the actual results may be a bit different from the calculations.

		Capital	0.3226	0.0000	0.2283	0.0943
		Urban lowest	0.0172	0.0000	0.0123	0.0049
		Urban medium	0.0612	0.0000	0.0435	0.0177
		Urban-highest	0.0528	0.0000	0.0373	0.0155
		Rural-lowest	0.0097	0.0000	0.0028	0.0069
		Rural-medium	0.0340	0.0000	0.0131	0.0209
		Rural-highest	0.0533	0.0000	0.0243	0.0291
Ⅲ	Urban lowest	Agriculture	0.9239	0.0000	0.4984	0.4255
		Restaurant	0.0590	0.0000	0.0322	0.0268
		Social Service	0.1015	0.0000	0.0564	0.0451
		Agriculture labor	0.4160	0.0000	0.2244	0.1916
		Production worker	0.2749	0.0000	0.1565	0.1184
		Professional	0.1324	0.0000	0.0786	0.0539
		Urban medium	0.0790	0.0000	0.0000	0.0790
		Urban highest	0.0694	0.0000	0.0000	0.0694
Ⅳ	Rural lowest	Agriculture	1.2532	0.0000	0.7435	0.5097
		Restaurant	0.0585	0.0000	0.0276	0.0309
		Social Service	0.0974	0.0000	0.0456	0.0518
		Agriculture labor	0.5643	0.0000	0.3348	0.2295
		Production worker	0.2698	0.0000	0.1329	0.1369
		Professional	0.1202	0.0000	0.0581	0.0620
		Rural medium	0.1218	0.0000	0.0000	0.1218
		Rural highest	0.1653	0.0000	0.0000	0.1653

Scenarios Ⅰ and Ⅱ describe the influences on other production sectors, factors and households when there is a unit increase in the exogenous demand of certain sector in the production activities account. The start point of exogenous injection is agriculture and the typical technical-intensive industry, that is, the industry of computers. From the table 5 we can see that the influence of agriculture caused by transfers' effects is very limited and the driving force is mainly produced by the net close-loop effects. If the two production sectors correlate closely, then the proportion of net transfers' effects is relatively big, such as the industry of computers and the industry of electric machinery and instrument, and the industry of foodstuff and agriculture. On the contrary, the proportion of net close-loop effects is relatively big. The influence of production activities account on factor account assumes the following characteristics: the more the input demand of factor in the production activities, the bigger the proportion of net open-loop effects, such as the agriculture labor to agriculture, the production workers and professionals to the industry of computers. On the contrary, the increase of factor income mainly depends on the net close-loop effects, such as the capital to the industry of computers. As for the influence of the increase of product exogenous demand on household income, the driving force produced by agriculture growth received by rural households is bigger than that received by urban households. Moreover, the agriculture-driven income increase of urban households mainly depends on the close-loop effects caused by income flows. The growth of the technical-intensive and capital-intensive industries such as the industry of computers makes the urban households benefit more.

Scenarios Ⅲ and Ⅳ describe the influences on production activities and factor incomes caused by the injection on the household income. Assume that the exogenous injection comes from government, for example, the households with the lowest income receive subsidies from government, and then the driving force on the agriculture output is relatively big if the subsidies are gained by rural households. In the two cases, the driving force received by the industry of restaurant and social service is approximately the same, but the proportion of close-loop effects is bigger if the injection is on rural households and the proportion of open-loop effects is bigger if the injection is on urban households. In the respect of the influence received by factor income, although both the rural household subsidy and the urban household subsidy make the agriculture labor benefit most, the agriculture labor benefits more if the subsidy goes to rural households. The influence on production workers and professionals is nearly the same under the two circumstances.

3. Conclusions and further research suggestions

It is easy to see from the basic structure of SAM and the deduction process of multiplier decomposition that the SAM is the generalization of IO table. The SAM-based accounting multiplier matrix M_a is the extension IO-based multiplier matrix $(I-A)^{-1}$ in which the matrix A is the direct consumption coefficient matrix in IO model. Since the accounts in SAM contain all the sectors of the economic system and meanwhile include the accounting on income redistribution, the SAM integrally reflects the social and economic accounting relationship. The close-loop effects and open-loop effects are both important in exactly judging the role and status of a sector but they can’t be reflected merely through the IO table.

There is some improvement in the SAM-based multiplier analysis, but there are also some limitations in the application of this method because of relatively strong assumptions. Firstly, the linear structure and average expenditure propensity make the analysis process different from reality. Next, we can’t find the details in the economic relationships purely through multiplier analysis. For example, we don’t know the detailed path through which the influence is transmitted. Finally, both the construction of SAM and the multiplier analysis require large-quantity and high-quality data which is not easy to obtain.

For future research, we should strengthen the application study of SAM-based multiplier analysis method. For example, we can analyze the economic linkages among regional industries through SAM of regional level. On the other hand, we should do further research in theory analysis. For example, we can extend the pure multiplier analysis to the SAM-based structural path analysis. In addition, we can modify certain assumptions, such as substituting marginal expenditure propensity for average expenditure propensity and substituting non-linear structure for linear structure, etc.

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