Analyzing Some Economic Relations Based on Expansion Input-output Model

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Abstract

This paper is trial attempt for introducing the concept of Leontief inverse matrix and the Leontief extended system for Keynes multipliers, which can analyze the relationship between income groups and consumer groups, respectively. The model is also used to analyze the structure of income in order to describe quantitatively the relationship between income from production and income not from production. The empirical study used the Vietnam input-output table, 2005.

Keywords: demographic-economic, input-output, matrix, multipliers, backward linkages and forward linkages

1. Introduction

In the previous decades, it was a lot of studies in extension of basic I/O model, including Social Accounting Matrix-SAM (Richard Stone, 1961), System of National Account – SNA, Demographic Model-economic modeling (Miyazawa, 1966), and inter – regional model (Miyazawa and other authors, 1976). These extension I/O models were built and applied by most countries in the world for analyzing and forecasting the economy (Pyatt and Roe, 1977; Cohen, 1988; Pyatt and Round, 1985). There are many different uses on this model such as I/O analysis, SAM analysis and CGE model. These analyzes are based mainly on the basic relationships in I/O model and SAM.

Along with the development of I/O model into a SAM table of Richard Stone (1961), Miyazawa expanded I/O model into a demographic model-economic modeling and this model has been completed by Batey and Madden (1983). The model introduces the concept of Leontief inverse matrix and expand Leontief extended system for Keynes multipliers, which can analyze the relationship between income groups and consumer groups, respectively. The model is also used to analyze the structure of income in order to describe quantitatively the relationship between income from production and income not from production. In which case, it is classified according to the system of national accounts published by the United Nations (UN "System of National Accounts-SNA", 1993), non-production income includes income from property and income from transfer.

Currently, Vietnam has made a number of I/O models through years as follow:

• National I/O model in 1989 with the sector size (54x54), competitive type, this table was made by the System of National Account Department– General statistic office of Vietnam.

• National I/O model in 1996 with sector size (97x97), competitive type, the System of National Account Department – General statistic office of Vietnam.

• National I/O model in 2000 with sector size (112x112), competitive type, the System of National Account Department – General statistic office of Vietnam.

• National I/O model in 2005 with sector size (112x112), competitive type and non competitive type, this model was created by a team of the Ministry of Finance of Vietnam, 2007. This model then developed into Social Accounting Matrix (SAM) with 112 sectors and five regions including households, government, state enterprise, non-state enterprise, enterprise with foreign capital investment (FDI), in which revenue is divided by tax type and transfer.

• National I/O model in 2007 with sector size (138x138), competitive type, the System of National Account Department – General statistic office of Vietnam.

2. Methodology

2.1 Demographic–Economic Model

Demographic-Economic model is created by Miyazawa (1966), it's a similar form to the Social Accounting Matrix, in order to describe the distribution and redistribution of the economy. Essentially, the Demographic–Economic model and the Social Accounting Matrix are similar and it could easily be changed from one model to another depending on other study purposes. In this study, Demographic–Economic model is developed in institutional regions (households, other type of enterprise, State region is divided by type of tax). These institutional regions are considered as endogenous variables: saving and relations with foreign countries are considered as exogenous variables. This model is a combination between the notion of inter-regional I/O model and demographic-economic model, as presented in matrix form below:

$$\begin{bmatrix} A & c_1 & g_1 & 0 \\ h & 0 & g_2 & e_1 \\ g & c_2 & 0 & e_2 \\ e & c_3 & g_3 & e_3 \end{bmatrix} \cdot \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + \begin{bmatrix} f_1 \\ f_2 \\ f_3 \\ f_4 \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} \tag{1}$$

With: A is the coefficient matrix direct costs;

x_1 is the vector of the output value of economic activity;

x_2 is the total income of households;

x_3 is the total income of the state sector;

x_4 is the total income of enterprise type;

h is the matrix (vector) of income coefficient from the production of the group of households, income from production is understood as workers' income from production divided by 2 types of household;

g is the matrix (vector) of coefficient on revenues from production (added value tax, special consumption tax, other taxes and fees);

e is the coefficient matrix of income from the production of various types of enterprises (state enterprises, state owned enterprises and enterprises with foreign investments), income from the production here is understood including producer surplus and depreciation of fixed assets;

c_1 is the coefficient matrix of consumption by household groups corresponding to income groups;

g_1 is the vector of consumption coefficients of the State corresponding to type of state budget revenues;

c_2 is the coefficient matrix represented by the redistribution of income between State sector and household sector;

c_3 is a coefficient matrix represented by the redistribution between the enterprise sector and household sector;

g_2, g_3 represented by state expenditures transfer to the household sectors and enterprise sector;

e_1, e_2, e_3 is a coefficient matrix represented by the redistribution from the enterprise sector to the household sector, the State sector and to the other types of enterprises.

And $f_1, f_2, f_3 f_4$ are the exogenous variables.

2.2 Symbols

$$\begin{bmatrix} A & c_1 & g_1 & 0 \\ h & 0 & g_2 & e_1 \\ g & c_2 & 0 & e_2 \\ e & c_3 & g_3 & e_3 \end{bmatrix} = \begin{bmatrix} A & c \\ v & B \end{bmatrix} \tag{2}$$

In which, vector v, c and B could be refined as follows:

$$v = \begin{bmatrix} h \\ g \\ e \end{bmatrix} \tag{3}$$

$$c = \begin{bmatrix} c_1 & g_1 & 0 \end{bmatrix} \tag{4}$$

$$B = \begin{bmatrix} 0 & g_2 & e_1 \\ c_2 & 0 & e_2 \\ c_3 & g_3 & e_3 \end{bmatrix} \tag{5}$$

$$x' = \begin{bmatrix} x_2 \\ x_3 \\ x_4 \end{bmatrix} \tag{6}$$

$$f' = \begin{bmatrix} f_2 \\ f_3 \\ f_4 \end{bmatrix} \tag{7}$$

From that, relation (1) could be rewrite in form:

$$\begin{bmatrix} A & c \\ v & B \end{bmatrix} . \begin{bmatrix} x_1 \\ x' \end{bmatrix} + \begin{bmatrix} f_1 \\ f' \end{bmatrix} = \begin{bmatrix} x_1 \\ x' \end{bmatrix} \tag{8}$$

Based on the theory of the Miyazawa and development of demographic-economic model of Batey and Madden (1983), relation (8) represent as:

$$\begin{bmatrix} x1 \\ x' \end{bmatrix} = \begin{bmatrix} \Delta_1 & \Delta_1.c.(I-B)^{-1} \\ \Delta_2.v.(I-A)^{-1} & \Delta_2 \end{bmatrix} . \begin{bmatrix} f1 \\ f' \end{bmatrix} \tag{9}$$

In which: Δ_1 is consider as Leontief extended matrix, each element of matrix Δ_1 includes: direct costs, indirect costs, dispersion effect by final consumption of households and spending for usual activities of the Government. These elements are greater than corresponding elements of popular Leontief's matrix $(I-A)$ -1, because it includes the requirement of more production to meet production affect cause of requirement of final consumption. Δ_2 is known as extended multiplier Keynesian matrix and it can be decayed as follows:

$$\Delta_2 = (I - (I-B)^{-1}.v.(I-A)^{-1}.c)^{-1}.(I - B)^{-1} \tag{10}$$

Of which: $(I–B)^{-1}$ is considered as multiplier matrix and internally spread in redistribution processes: if the matrix B is the direct expenditure matrix of regions to create a unit income from redistribution, matrix $(I–B)^{-1}$ represents total expenditure, direct redistribution to create 1 unit of income from redistribution (influence between regions). Factor $(I–(I-B)^{-1}.v.(I-A)^{-1}.c)^{-1}$ represents the external spread from the manufacturing process to the redistribution process, which means income from redistribution not only depends on the internal relations in the redistribution process but also depends on income from the production of each region caused by the influence of final consumption.

$\Delta_1.c$ is matrix showing the influence of production by final consumption.

$v.(I-A)^{-1}$ is an income matrix received from production.

Note that Equation (9) can be rewritten as follows:

$$\begin{bmatrix} x1 \\ x' \end{bmatrix} = \begin{bmatrix} \Delta_{11} & 0 \\ 0 & \Delta_{22} \end{bmatrix} \cdot \begin{bmatrix} I & (I-A)^{-1}.c \\ (I-B)^{-1}.v & I \end{bmatrix} \cdot \begin{bmatrix} (I-A)^{-1} & 0 \\ 0 & (I-B)^{-1} \end{bmatrix} \qquad (11)$$

In which: $\Delta_1 = \Delta_{11}.(I-A)^{-1}$ and $\Delta_2 = \Delta_{22}.(I-B)^{-1}$

Equation (11) introduced the level of various type of effects, first of all is the influence of production regional and redistribution region, second of all is the effect of final consumption to production and income spread from production to non-production, and finally the external spread effect to areas of production and distribution regions.

In addition this model also allows quantification of the inversed effect from redistribution to production areas. From formula (8), (9) and (11), this relationship between X_1 and X' is represented as follows:

$$X' = (I-B)^{-1}.v. \; X_1 \qquad (12)$$

$$X_1 = (I-A)^{-1}.c.X' \qquad (13)$$

Equation (12) and (13) describes the inverse relationship inter-regional (between sectors and regions and between production and non-production).

Above is the general model, in addition to depending on purposes of researches, internal and external variable could be changed. For example, to consider the impact of taxes, relations (1) can be rewritten as follows:

$$\begin{bmatrix} A & c_1 & 0 \\ h & 0 & e_1 \\ e & c_3 & e_3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_4 \end{bmatrix} + \begin{bmatrix} f'_1 \\ f'_2 \\ f'_4 \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \\ x_4 \end{bmatrix} \qquad (14)$$

In which, f'_1, f'_2, f'_4 is external variable including f_i (i=1,2,4)- is the matrix of tax.

$$\text{Set:} \begin{bmatrix} A & c_1 & 0 \\ h & 0 & e_1 \\ e & c_3 & e_3 \end{bmatrix} = L$$

Then relations (14) can be rewritten:

$$\begin{bmatrix} x_1 \\ x_2 \\ x_4 \end{bmatrix} = (I-L)^{-1}. \begin{bmatrix} f'_1 \\ f'_2 \\ f'_4 \end{bmatrix} \qquad (15) \quad \text{Or} \quad \begin{bmatrix} x_1 \\ x_2 \\ x_4 \end{bmatrix} = (I-L')^{-1}. \begin{bmatrix} f''_1 \\ f''_2 \\ f''_4 \end{bmatrix} \qquad (16)$$

Here: L 'is the matrix transpose of the matrix L;

f'' i include taxes and other external variables.

3. I/O analysis

In an economy, changes in the structure of the sectors are often closely related to each other: some sectors heavily depend on other sectors while a few of them not depend on others too much. Thus the change of some sectors will affect to the economy more than other sectors.

I/O analysis is usually based on the backward Linkages and forward linkages. These linkages are tools to measure the relationship of a sector with other sectors, with the role of a sector using the input or supplying the input.

Reverse link is used to measure the relative importance of a sector as the role to use products and services to be the input for the entire production system. Reverse link is defined as the ratio of the sum of the elements (by column) of the Leontief matrix compared to the average of the entire production system. This ratio is called the index of the power of dispersion and is defined as follows:

$$\mu_j = \frac{\sum_{i=1}^{n} \ell_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} \ell_{ij}}$$

Where: ℓ_{ij} – elements of Leontief's matrix. The higher rates mean larger backward linkages of the industry. And when the industry developed, it will lead to the growth of the entire system. The policy makers can rely on this index as an important reference in decision making.

Forward linkages implies that the importance of the sector as a source of material products and services for the entire production system is seen as the sensitivity of the economy, which is measured by the sum of the elements in row of the Leontief inverse matrix compared to the average of the entire system.

There are 2 type of I/O table: competitive–import type and non–competitive–import type. In competitive–import I/O table, coefficient matrix of intermediate direct costs includes: import cost as domestic product and imported product. So that, Analyzing the power of dispersion and the sensitivity of the economy will be confused with the import path. A sector with a high power of dispersion doesn't mean that the sector affects well to production, but stimulating import. In the non–competitive–import I/O table, coefficient matrix of intermediate direct cost does not include import cost as import products, so that, the survey of the power of dispersion and sensitivity of an industry will reflect the impact of that industry to domestic product.

3.1 Analysis of Interaction Impact between the Activities of Economic Factors Based on Demographics–economic Model

3.1.1 Impacts of Non-production Income to Savings by Institutional Regions

The calculation of impacts of non-production income to savings of five institutional regions is based on the multipliers in the Keynes matrix of the model. Calculation results are presented in Table 1:

Table 1. Calculation results of Keynes extended multiplier (Δ_{22})

	Keynes multipliers (Δ_2)
Household	2.207
Government	2.210
State enterprises	1.7336
Private enterprises	1.8364
Foreign direct investment enterprises	1.7205

Picture 1. Backward linkage of Keynes extended matrix

Calculation results of Keynes extended matrix shows the impact of non-production income to saving of each institutional region (Household region, Government region, and industrial regions). In which, the most clearly effect in Government region is 2.21, then Household region is 2.207 and the less one in FDI industry is 1.72. This suggests that if the Government region received 2.21 units of income from non – production, they will have 1 unit of saving. While if FDI industry region received 1.72 units of property and transfer, they will have 1 unit of saving and transfer capital broad.

Picture 2. Impacts from production to income redistribution

In addition, values of Δ_{22} (analysis of Δ_2) shows impacts from production to income redistribution. This table shows that the household region is most affected from the production process with a coefficient of 2.13, and then the state with 1.36.

3.1.2 Income Impacts of Non- production to the Production Process

This impact is calculated based on the formula $\Delta_1.c. (I-B)^{-1}$ in relation (9). This formula shows the impact of our distribution outside the manufacturing process to final consumption and spread to the production process. For

example, if the Government region obtained 1 unit from non-production, including direct taxes (personal income tax and corporate income tax), collection of social insurance and health insurance will lead to budget changed and stimulate on production is 1.20 units. The calculated result of income effects from non-production income to the production process in each institutional regions are presented in Table 2.

Table 2. Impact of non–production income to the production process by institutional regions

Code	Sectors	H	G	E1	E2	E3
1	Paddy (all kinds)	0.1186	0.0540	0.0186	0.0193	0.0168
2	Raw rubber	0.0001	0.0001	0.0000	0.0000	0.0000
3	Coffee beans	0.0006	0.0003	0.0001	0.0001	0.0001
4	Sugarcane	0.0077	0.0035	0.0012	0.0012	0.0011
5	Tea	0.0020	0.0009	0.0003	0.0003	0.0003
6	Other plants	0.0822	0.0371	0.0128	0.0133	0.0116
7	Pork (all kinds)	0.0602	0.0271	0.0094	0.0097	0.0084
8	Beef (all kinds)	0.0024	0.0011	0.0004	0.0004	0.0003
9	Poultry	0.0252	0.0114	0.0040	0.0041	0.0036
10	Other pets	0.0235	0.0106	0.0037	0.0038	0.0033
11	Irrigation service	0.0032	0.0015	0.0005	0.0005	0.0005
12	Other agriculture service	0.0110	0.0050	0.0017	0.0018	0.0016
13	Forestry	0.0077	0.0040	0.0013	0.0014	0.0012
14	Fishing	0.0350	0.0160	0.0055	0.0057	0.0050
15	Aquaculture	0.0954	0.0430	0.0149	0.0154	0.0134
16	Mines	0.0107	0.0056	0.0019	0.0020	0.0017
17	Foods	0.3601	0.1638	0.0566	0.0585	0.0509
18	Other manufacturing foods	0.0829	0.0375	0.0130	0.0134	0.0117
19	Other building materials	0.0254	0.0152	0.0051	0.0053	0.0045

20	Fertilizers, pesticides and veterinary medicines	0.0111	0.0051	0.0017	0.0018	0.0016
21	Plastics and rubber processing, rubber products	0.0241	0.0119	0.0041	0.0042	0.0036
22	Soap, detergent, perfume, other hygiene items and medicines	0.0507	0.0263	0.0089	0.0093	0.0080
23	Cars, motorcycles, bicycles and spare parts	0.0725	0.0349	0.0120	0.0124	0.0107

The results showed that this impact of the household region is the largest, next is the Government region, however, the impact of industry structure from the two regions is different. While 1 unit of non – production is used for "food, tourist, and travel…" by the household region, the Government region focuses on "military", "management" and "food". But 3 regions of industry got quite small index of this impact, and it's nearly the same.

From past till now, Vietnam government always has expected the State (E1) and FDI (E3) are 2 main regions for helping and directing other institutional regions. However, The calculated result in Table 02 also showed one special thing: in 3 institutional regions, FDI (E3) is the smallest impact of non - production income to the production process. The second region is E1, and the third is E2.

3.1.3 Impacts of Production to Income Redistribution of Institutional Regions

This section calculates the ability of income redistribution from production to institutional regions (Households, Government and enterprises) by sector groups (combined for 30 sectors). The calculation based on formula $\Delta_2.v.(I-A)^{-1}$ and results showed in table 3. Results showed that the household region has the highest ability of income redistribution among most sectors. However, income redistribution between institutional regions and sectors are not even. This may suggest that the Government should tax personal income tax evenly at a certain level, while industrial income tax should be charged depend on type of industry.

Table 3. The ability of income redistribution of institutional regions

Code	Sectors	H	G	E_1	E_2	E_3
1	Paddy (all kinds)	91.42%	1.91%	3.63%	1.53%	1.52%
2	Raw rubber	39.03%	15.19%	22.56%	16.22%	7.00%
3	Coffee beans	63.13%	13.99%	8.88%	9.94%	4.06%
4	Sugarcane	78.47%	12.88%	3.42%	3.47%	1.76%
5	Tea	65.59%	12.16%	9.60%	7.68%	4.96%
6	Other plants	67.96%	4.94%	13.93%	10.96%	2.21%
7	Pork (all kinds)	72.43%	7.70%	8.22%	6.75%	4.90%

8	Beef (all kinds)	62.73%	10.52%	10.80%	8.66%	7.29%
9	Poultry	70.28%	5.84%	6.85%	12.68%	4.34%
10	Other pets	77.70%	7.41%	5.89%	6.40%	2.60%
11	Irrigation service	67.33%	7.94%	11.10%	9.52%	4.10%
12	Other agriculture service	66.82%	9.41%	11.57%	7.67%	4.53%
13	Forestry	48.43%	24.54%	10.62%	14.45%	1.96%
14	Fishing	52.75%	10.41%	15.61%	15.99%	5.24%
15	Aquaculture	65.51%	7.51%	10.74%	11.31%	4.93%
16	Mines	30.08%	20.18%	5.71%	1.82%	42.21%
17	Foods	64.56%	12.15%	8.96%	4.41%	9.92%
18	Other manufacturing foods.	55.85%	11.88%	13.31%	6.36%	12.60%
19	Other building materials	38.62%	13.35%	17.00%	5.06%	25.97%
20	Fertilizers, pesticides and veterinary medicines	42.95%	9.88%	17.41%	5.13%	24.62%
21	Plastics and rubber processing, rubber products	48.14%	11.17%	15.84%	4.74%	20.11%
22	Soap, detergent, perfume, other hygiene items and medicines	52.78%	12.72%	13.25%	3.93%	17.32%
23	Cars, motorcycles, bicycles and spare parts	49.01%	17.08%	13.29%	3.97%	16.65%
24	Textiles and leather products	42.41%	22.20%	13.94%	4.28%	17.17%
25	Electricity, gas and water	48.86%	6.89%	17.19%	5.06%	22.00%
26	The other industries	44.49%	14.36%	15.76%	5.28%	20.11%
27	Trade	45.44%	18.07%	14.79%	4.26%	17.45%
28	Tourism, transport, banking, insurance, telecommunication	49.95%	10.99%	16.50%	4.72%	17.84%
29	Science, education, training, culture, sports, health, status management, protection, social security and related	76.11%	4.19%	13.09%	1.98%	4.63%
30	Other Services	53.43%	14.87%	18.65%	3.68%	9.37%

H: household region; G: the Government region, E1: State enterprises, E2: non–State enterprises, E3: enterprise of foreign direct investment (FDI).

The result in Table 03 showed that the ability of income redistribution of FDI - E3 is the smallest among 3 regions (E1-E2-E3) and in almost economic activities. However, the ability of FDI - E3 in **16.Mines** is high, because of this calculation included income which have to refund to foreign investors in crude-oil exploitation.

3.1.4 Interactive Impacts of Economic Activities in the Production Process (Analysis Leontief Expanded Inverse Matrix).

Using relation (11) and formula $\Delta_I = \Delta_{I1}.(I-A)^{-1}$, we can calculate internal impacts in production process and external impacts from activities of non – production to the production process. Activities of non – production is

understood as spending of institutional regions (Households, Government, enterprises), including final consumption, transfer and ownership. The calculation results are presented in **appendix 3**. The results showed that the production of products for consumption purposes and the processing industry often have higher level of external impacts than internal impacts.

Especially, industries with very high inter-impacts in production such as food processing industry, textile industry and parts production of motorcycle. This is an interesting point for policy makers, particularly industrial policy. Calculation results of this impact for 30 combined sectors are reported in **appendix 3**.

3.2 I/O Analysis for Sector's Impacts

As we presented in Section II, Part 2, here are results of calculations of backward linkage - BL of two I/O model in 2000 and 2005 in Appendix 1. I/O model in 2000 represents the economic structure of the period 1998-2002 and I/O model in 2005 represents the period from 2003 to 2007. Through Appendix 2, we can clearly see the structural change of the economy through changes in the index of power of dispersion of sectors (112 sectors). In theory, the sectors with large index of power of dispersion should be preferred because it has a strong impact over an entire production. However, due to the index of power of dispersion change over time, prioritized policy have to change to suit: many industry sectors may be the key sector in this period but is not the key sector in the next period. Compare two I/O models, shows that indexes of power of dispersion of the key service industries in the period 2005 I/O model are increased compared to the previous period. This is a good sign: does it the expression of modernization and industrialization to the service sectors?

If you look at the index of power of dispersion in competitive types and non-competitive types, you could see an interesting thing in competitive types (including imports in import cost), the index of power of dispersion is larger than 1 unit in sectors. Sectors such as: medicine, rubber and rubber products, chemicals (all kinds), precision equipment, home tools, machine tools, common machine, specialized machinery, transport equipment, transformer machine, electrical equipment, broadcasting equipments, black metal, thread (all kinds), textiles and leather have index of power of dispersion to domestic products is smaller than 1 unit; This means if these sectors are developed, it will stimulate stronger on import than domestic production. In contrast, sectors with import cost including imported products have index of power of dispersion smaller than 1 unit, but in non-competitive type (input only include domestic products), it's larger than 1 unit. According to Rasmussen- Hrishman, the industry in non-competitive types with the higher index of power of dispersion should be as key sectors. Appendix 2 shows that these sectors belong to industry group of meat processing and meat products, processed fruits and vegetables, sugar, coffee, tea types, alcohol, tobacco, seafood processing, other foods...

4. Conclusion and Policy Suggestion

The analysis of I/O models and demographic - economic model showed the changes of the economy cause of different impacts to sectors and institutional regions. So, calculation on this element is necessary to plan the tax policy and other policies. Such as, analyze the index of power of dispersion shows that this index of the sector is very large, then, if you stimulate development of this sector, it highly impacts other sectors in the economy. Calculations show that these sectors are almost processing sectors: meat processing, vegetable, coffee, seafood, etc… For example on coffee, mainly used to export but in raw form. Fruit and vegetable processing industry in Vietnam is still very weak, so there is no production stimulated and it created low "added value". Thus, the potential of processing industry is great, the scale as well as the economic impacts, calculated in terms of the overall economy. On the other hand, the development of these sectors helps to stimulate and enlarge the value of agricultural labor, to minimize the negative impact of the integration process on the lives of more than 10 million rural households in Vietnam.

Acknowledgements

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Appendix 1. Economic structure changed through the index of power of dispersion

		I-O,2000		I-O,2005		*Structure change of 2000, 2005*
		Competitive type	Non-competitive type	Competitive type	Non-competitive type	
		BL	BL	BL	BL	
1	Paddy (all kinds)	0.9329	0.9721	0.8897	0.9475	-0.0253
2	Raw rubber	0.8510	0.8240	0.8135	0.8648	0.0495
3	Coffee beans	0.9815	0.8436	0.9639	0.9743	0.1549
4	Sugarcane	0.8249	0.8921	0.7759	0.8836	-0.0096
5	Tea	1.0186	0.9026	1.1311	1.0157	0.1253
6	Other crops	0.7651	0.8463	0.7066	0.8269	-0.0228
7	Pig (All kinds)	1.1979	1.3014	1.1766	1.2578	-0.0335
8	Cow (All kinds)	1.1626	1.2320	1.1250	1.1383	-0.0761
9	Poultry	1.0075	1.1315	0.9768	1.0878	-0.0386
10	Other Livestock	1.0360	1.1858	1.0513	1.1556	-0.0255
11	Irrigation service	1.0444	1.0032	1.0529	1.0002	-0.0030
12	Other Agricultural services	1.1819	1.1121	1.1890	1.0918	-0.0183
13	Forestry	0.8115	0.8659	0.7331	0.8334	-0.0375
14	Fishery	1.3071	0.9274	1.4549	0.8865	-0.0442
15	Fish Farming	0.8771	0.9599	0.9599	1.0358	0.0791
16	Coal	0.7869	0.9138	0.8402	0.9463	0.0355
17	Metallic ore	0.9207	1.1204	0.8326	1.0436	-0.0685
18	Stone	0.9533	1.0221	0.9237	0.9855	-0.0358
19	Sand, Gravel	0.8117	0.9200	0.7981	0.9306	0.0116
20	Other none-metallic minerals	0.8375	0.9588	0.8290	0.9459	-0.0135
21	Crude oil, natural gas (except exploration)	0.5938	0.8367	0.5461	0.8115	-0.0301
22	Processed preserved meat and by-products	1.0376	1.4231	0.9467	1.4203	-0.0019
23	Processed vegetable, and animals oils and fats	0.8043	1.0946	0.6804	0.8833	-0.1930
24	Milk, butter and other dairy products	1.1111	1.2139	1.0483	1.1987	-0.0125

25	Cakes, jams, candy, coca, chocolate products	1.1144	1.2160	1.0542	1.2575	0.0341
26	Processed and preserved fruits and vegetables	0.8885	1.1142	0.8481	1.0942	-0.0180
27	Alcohol, beer and liquors	0.8827	1.0641	0.8041	1.0589	-0.0049
28	Beer and liquors	0.9361	1.1032	0.9022	1.1167	0.0123
29	Non-alcohol water and soft drinks	1.1023	1.0932	1.0844	1.0498	-0.0398
30	Sugar, refined	0.9870	1.2473	0.9607	1.2166	-0.0246
31	Coffee, processed	0.8812	1.1322	0.7955	1.1980	0.0581
32	Tea, processed	0.9105	1.1374	0.8739	1.2578	0.1059
33	Cigarettes and other tobacco products	0.8319	1.0344	0.7698	1.0563	0.0212
34	Processed seafood and by products	1.1412	1.3852	1.0946	1.3329	-0.0378
35	Rice, processed	1.0278	1.4727	0.8885	1.4311	-0.0282
36	Other food manufactures	1.0453	1.3506	0.9568	1.2692	-0.0603
37	Glass and glass products	1.0080	0.9567	0.9920	0.9358	-0.0219
38	Ceramic and by products	1.1046	0.9795	1.0694	0.9807	0.0012
39	Bricks, tiles	1.0415	1.0454	1.0144	1.0601	0.0140
40	Cement	1.1919	1.2489	1.2262	1.2975	0.0390
41	Concrete, mortar and other cement products	1.0839	1.1074	1.1138	1.1135	0.0055
42	Other building materials	1.0389	1.0914	1.0596	1.1080	0.0151
43	Paper pulp and paper products and by products	1.1425	1.1214	1.1517	1.0935	-0.0249
44	Processed wood and wood products	0.9374	1.1483	0.8591	1.0952	-0.0462
45	Basic organix chemicals	1.0107	1.0899	1.0223	1.1311	0.0378
46	Basic inorganix chemicals	0.9740	0.8632	0.9880	0.8770	0.0159

47	Chemical fertilizer	1.0401	1.0155	1.0704	1.0246	0.0089
48	Fertilizer	0.9232	0.9463	0.9504	0.9888	0.0449
49	Pesticides	0.9431	0.8688	0.9638	0.9081	0.0452
50	Veterinary	0.9022	0.9129	0.9187	1.0122	0.1088
51	Health medicine	1.0314	0.8880	1.0573	0.8997	0.0132
52	Processed rubber and by products	1.0165	0.9985	1.0315	0.9087	-0.0900
53	Soap, detergents	1.1383	0.8466	1.1291	0.8623	0.0186
54	Perfumes and other toilet preparation	1.0679	0.8951	1.0853	0.8277	-0.0753
55	Plastic (including semi-plastic products)	1.2140	0.8848	1.2381	0.8518	-0.0373
56	Other plastic products	1.1425	0.8999	1.1898	0.8459	-0.0600
57	Paint	1.1936	0.9459	1.2356	0.8472	-0.1043
58	Ink, varnish and other painting materials	0.9950	0.8847	1.0144	0.9034	0.0211
59	Other chemical products	1.0992	0.9932	1.1185	0.9354	-0.0581
60	Health instrument and apparatus	1.0026	0.9201	1.0635	0.8893	-0.0335
61	Precise and optics equipment, meter (all kinds)	1.1242	0.9672	1.1595	0.9390	-0.0291
62	Home appliances and its spare parts	1.1742	1.0453	1.2609	0.9053	-0.1340
63	Motor vehicles, motor bikes and spare parts	1.4822	1.1199	1.6632	1.4525	0.2970
64	Bicycles and spare parts	1.4771	0.9902	1.5715	1.3248	0.3379
65	General -purpose machinery	1.2316	0.9977	1.2823	0.9653	-0.0326
66	Other general -purpose machinery	1.2234	0.9062	1.2680	0.8564	-0.0549
67	Other special -purpose machinery	1.2666	0.9216	1.3669	0.9445	0.0249
68	Automobiles	1.0087	1.0001	1.0918	0.9169	-0.0832

69	Other transport mean	1.0325	0.9304	1.1013	0.8941	-0.0389
70	Electrical machinery	1.2403	1.0072	1.3102	0.8984	-0.1080
71	Other electrical machinery and equipment	1.3478	0.9772	1.4817	0.8953	-0.0839
72	Machinery used for broadcasting, television and information activities	1.4310	0.8819	1.5952	0.9812	0.1126
73	Non-ferrous metals and products (except machinery equipment)	1.4753	1.1415	1.5975	0.8882	-0.2219
74	Ferrous metals and products (except machinery equipment)	1.3411	0.9799	1.4734	1.0849	0.1072
75	Weaving of cloths (all kinds)	1.2173	1.0597	1.2291	1.0086	-0.0482
76	Fibers, thread (all kinds)	1.0672	0.9514	1.0780	0.9784	0.0285
77	Ready -made clothes, sheets (all kinds)	1.3409	1.0889	1.3740	1.0327	-0.0516
78	Carpets	1.1046	0.9562	1.1061	0.9784	0.0232
79	Weaving and embroidery of textile -based goods (except carpets)	1.0283	0.9723	1.0401	0.9915	0.0197
80	Products of leather tanneries	1.1264	1.0136	1.1460	0.9477	-0.0650
81	Leather goods	1.3284	1.1929	1.3867	1.2314	0.0323
82	Animal feeds	1.0955	1.3902	1.0193	1.3527	-0.0270
83	Products of printing activities	1.1834	0.9839	1.2426	1.2088	0.2286
84	Products of publishing house	1.0741	1.1490	1.1243	1.2459	0.0844
85	Other physical goods	1.2574	1.0060	1.3222	1.1664	0.1595
86	Gasoline, lubricants (already refined)	1.0354	0.8593	1.0940	0.8352	-0.0281
87	Electricity, gas	0.6962	0.7680	0.7073	0.7640	-0.0053
88	Water	0.6120	0.8018	0.6024	0.8096	0.0098

89	Civil construction	1.2253	1.1289	1.2110	1.0585	-0.0624
90	Other construction	1.2088	1.1236	1.1824	1.0193	-0.0928
91	Trade	0.8527	0.9434	0.7946	0.9661	0.0240
92	Repair of small transport means, motorbikes and personal household appliances	0.9820	0.8717	0.8738	0.8491	-0.0259
93	Hotels	0.7759	0.9458	0.7185	0.9430	-0.0030
94	Restaurants	0.8190	1.0154	0.7524	0.9829	-0.0320
95	Road Transportation	0.7055	0.7513	0.6742	0.7392	-0.0160
96	Railway transport services	0.6552	0.7940	0.6127	0.7938	-0.0003
97	Water transport services	0.8559	0.7517	0.8318	0.7626	0.0146
98	Air transport services	1.0296	1.0452	0.9928	1.0399	-0.0051
99	Communication services	0.6590	0.7706	0.6631	0.8042	0.0437
100	Tourism	0.7517	0.9358	0.6901	0.9887	0.0565
101	Banking, credit, treasury	0.6283	0.8076	0.5820	0.8656	0.0718
102	Lottery	0.6349	0.8708	0.5714	0.8748	0.0046
103	Insurance	0.7620	0.8910	0.6964	0.9016	0.0119
104	Science and technology	0.8551	0.9589	0.8453	0.9967	0.0394
105	Real estate	0.7060	0.9037	0.6396	0.8551	-0.0538
106	Real estate business and consultancy services	0.6941	0.8679	0.6270	0.8556	-0.0142
107	State management, defence and compulsory social security	0.8048	0.8963	0.7594	0.9242	0.0311
108	Education and training	0.6790	0.8350	0.6313	0.8360	0.0012
109	Health care, social relief	0.7418	0.8251	0.7707	0.8436	0.0224
110	Culture and sport	0.7318	0.8804	0.7056	0.9082	0.0316
111	Association	0.7236	0.9178	0.7226	0.9525	0.0378

112	Other services	0.6458	0.8019	0.7149	0.8379	0.0448

Appendix 2. Analysis of extended Leontief Matrix

Code	Sectors	Total impact	External impact	Internal impact	Ratio of External impact/Internal impact
1	Paddy (all kinds)	2.89545	2.36841	1.29031	1.8355
2	Raw rubber	2.15968	1.88670	1.18137	1.5970
3	Coffee beans	2.57657	2.08914	1.32989	1.5709
4	Sugarcane	2.79318	2.40526	1.20927	1.9890
5	Tea	2.53508	1.93438	1.38254	1.3992
6	Other plants	2.51995	2.29109	1.13117	2.0254
7	Pork (all kinds)	2.84386	1.81896	1.62328	1.1205
8	Beef (all kinds)	2.62030	1.78873	1.50200	1.1909
9	Poultry	2.71999	2.03823	1.41532	1.4401
10	Other pets	2.93268	1.97080	1.54111	1.2788
11	Irrigation service	2.60867	1.99771	1.36194	1.4668
12	Other agriculture service	2.64396	1.83359	1.47792	1.2407
13	Forestry	2.38846	2.13237	1.14284	1.8658
14	Fishing	1.97128	1.61056	1.24766	1.2909
15	Aquaculture	2.70624	1.94850	1.41975	1.3724
16	Mines	2.11024	1.68313	1.24585	1.3510
17	Foods	3.04670	1.29950	1.92420	0.6753
18	Other manufacturing foods.	2.77661	1.22413	1.86035	0.6580
19	Other building materials	2.36667	1.27225	1.75835	0.7235

20	Fertilizers, pesticides and veterinary medicines	2.07664	1.35089	1.47054	0.9186
21	Plastics and rubber processing, rubber products	1.77572	1.34505	1.28587	1.0460
22	Soap, detergent, perfume, other hygiene items and medicines	1.86134	1.39414	1.30472	1.0685
23	Cars, motorcycles, bicycles and spare parts	2.29775	1.34383	1.68250	0.7987
24	Textiles and leather products	2.08483	1.22523	1.63164	0.7509
25	Electricity, gas and water	2.06165	1.81444	1.15044	1.5772
26	The other industries	2.11542	1.31318	1.54351	0.8508
27	Trade	2.36445	1.75503	1.39411	1.2589
28	Tourism, transport, banking, insurance, telecommunication	2.30297	1.73678	1.34544	1.2909
29	Science, education, training, culture, sports, health, status management, protection, social security and related	2.54450	2.00841	1.32092	1.5205
30	Other Services	2.34670	1.90923	1.27407	1.4985