



RESEARCH ARTICLE

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BACKWARD AND FORWARD LINKAGES FOR VIETNAM ECONOMY

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ABSTRACT

Backward linkage (BL) and forward linkage (FL) in Input-Output analysis has been widely used in many countries to measure the importance and level of influence of an industry on others and the whole economy. The objective of this paper is to examine the production structure of Vietnam economy by using the result of input-output table for 2012 based on two methods developed by Rasmussen and Ghosh. The results show that oils and fats processing, dairy, meat processing and fish processing sectors are those with the largest BL that need to be selected to implement demand stimulus policies. Dairy, basic metals, other chemicals, oils and fats processing sectors are those with the largest FL that need to be selected to implement investment policies. Oils and fats processing, yarn and other fibers, textiles, paper products, petroleum products, other chemicals, basic metals, metal products, machinery are key sectors in Vietnam.

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INTRODUCTION

Identifying influential sectors that have wide spread to other sectors is one of the most important missions of policy-makers (Temurshoev and Oosterhaven 2013) (Bui Trinh, 2011). Linkage analysis is an important analysis for an economy to show the importance of sectors. For sectors that have strong impact on other industries through the purchase of inputs for the production process or backward linkage (BL), macroeconomic policies for such sectors must be directed to stimulating consumption and exporting to create a strong spread throughout the economy. In contrast, for sectors which strongly impact other sectors through the supply of raw materials and other inputs or forward linkage (FL), economic policies should aim to attract investment to create a driving force not only for the development of such industries themselves but also for the development of the whole economy (Nguyen and Nguyen 2014) (Nguyen ManhToan, 2014). The identification of indexes for measuring the relationship among sectors is based on the theoretical basis of Rasmussen (1956)^[10], Chenery and Watanabe (1958), and Ghosh (1958). There are many different research based on these theories to determine the relationships among industries (Rao and Harmston 1979; Cella 1984; Kamaruddin *et al.* 2008).

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Based on these research, this paper follows arguments about the relationships between industries in the economy as following: Each sector in the economy has a very close relationship with other industries through the purchase of inputs. As a result, the expansion production of a specific industry will lead to the increasing demand for products of other industries to be the input for their production. Such sectors that have conditions to increase production, in turns, will create demands for products of other industries and will spread through many rounds in the whole economy. On the other hand, each sector in the economy carries out the production and supply its products to other industries. Increasing investment and expanding production of an industry will positively impact other industries through the provision of additional inputs. Other sectors, in turn, have the conditions to expand production and supply more products as inputs to other industries. This spread is also experienced through many rounds in the economy with a smaller scale of influence. Besides, the growth in the production scale of the industries also raises the demand for labor and employment; therefore, the income of workers is increased. These additional incomes will increase the consumption. The increasing in consumption, in turn, continues to stimulate the development of the production. The linkage indexes were calculated and published in Vietnam in the recent years by Bui *et al.* (2011), Nguyen and Nguyen (2014) and Nguyen (2015), mainly focus on calculating the linking indexes through output multipliers. In

each development period in Vietnam, due to the influence of various factors, each industry has different advantages for their development. In the condition of inadequate resources, policy-makers need to have information to choose the sectors that need the priority for development with the goal of bringing the highest output to the economy. This study calculates and compares the linkages of forty sectors based on the latest Input-Output table for 2012. BLs defined as the column sums of the Leontief inverse matrix from the demand-driven Input-Output model. FL is defined as the row sums of the Ghosh inverse matrix from the supply-driven Input-Output model. By analyzing linkages, this research suggests selecting several industries that need suitable priority for development with the current economic conditions in Vietnam.

RESEARCH METHOD

Backward linkages based on Rasmussen method: This research uses the Rasmussen method to measure inter-sectoral linkages. The BL based on the Leontief inverse matrix is defined as the column sums of the inverse matrix.

$$BL_j^R = \sum_{i=1}^n l_{ij} \dots\dots\dots(1)$$

Where

n is the number of industries, l_{ij} is the ij^{th} element of Leontief inverse matrix that is denoted by $L = (I - A)^{-1}$

BL_j^R can be interpreted as the total increase in output from the entire system of industries needed to cope with an increase in the final demand for the products of industry j by one unit (Rasmussen 1956)^[10].

Forward linkages based on Ghosh method: This research uses the Ghosh method to measure inter-sectoral linkages. The FL based on the Ghosh inverse matrix is defined as the row sums of the inverse matrix.

$$FL_i^G = \sum_{j=1}^n \beta_{ij} \dots\dots\dots(2)$$

Where

n is the number of industries, β_{ij} is the ij^{th} element of Ghoshian inverse matrix that is denoted by $G = (I - B)^{-1}$

β_{ij} shows the effect of a unit change in primary inputs of sector j on the level of total products of sector i.

FL_i^G can be interpreted as the total increase in output from the entire system of industries needed to cope with an increase in the value added for the products of industry i by one unit (Ghosh 1958).

Normalized values of linkage indicators

To facilitate for the comparison, the linkage indicators are usually normalized by using the following formulas:

$$NBL_j^R = \frac{BL_j}{\frac{1}{n} \sum_{j=1}^n BL_j} \dots\dots\dots(3)$$

Where

n is the number of sectors in the I/O table.

$NBL_j^R > 1$: a unit increase in the final consumption of sector j will create an above the average value increase in the production value of the whole economy.

$$NFL_i^G = \frac{FL_i}{\frac{1}{n} \sum_{i=1}^n FL_i} \dots\dots\dots(4)$$

Where

n is the number of sectors in the I/O table.

$NFL_i^G > 1$: a unit increase in the value-added of sector i will create an above the average value increase in the production value of the whole economy.

Key sectors for the economic development of a country have been defined as sectors with above average backward and forward linkages

Data: Linkage analysis has been calculated for Vietnam economy using the results of 2012 input-output tables. This is the latest IO table in Vietnam that has 164 sectors level (GSO 2015)^[4], aggregated 40 sectors level.

EMPIRICAL RESULTS

Calculation results of Backward Linkage indicators: Based on the data from IO table 2012, direct input coefficients matrix (A) and Leontief inverse matrix (L) were calculated. From these matrices, the Rasmussen BL is simply the column sums of the Leontief inverse matrix. Normalized values of BL are the basic indicators. Table 1 shows the BL, normalized values of backward linkages (NBL) and the summarized ranking of backward linkages of 40 sectors by Rasmussen method. Oils and fats processing has the highest backward linkage. The second, third and fourth rankings in backward linkages are dairy, meat processing and fish processing sectors. Machinery, metal products, livestock and poultry, petroleum products, electrical machinery also have large backward linkages in Vietnam. Therefore, these sectors should be selected to implement demand stimulus policies in order to increase output for Vietnam economy. The industries with the lowest backward linkages are other services, retail and wholesale trade, dairy and other manufacturing.

Calculation results of Forward Linkage indicators: Based on the data from IO table 2012, direct output coefficients matrix (B) and Ghoshian inverse matrix (G) were calculated. From these matrices, the Ghosh FL is simply the row sums of the Ghoshian inverse matrix. Normalized values of forward linkages (NFL) are the basic indicators. Table 2 shows the FL, NFL and the summarized rankings of forward linkages of 40 sectors by Ghosh method. Dairy products has the highest FL. The second, third and fourth rankings in forward linkages are basic metals, other chemicals, oils and fats processing sectors. Petroleum products, machinery, metal products also have large forward linkages in Vietnam.

Table 1. Backward linkages for Rasmussen Method

	Sectors	BL	NBL	Ranking
1	Crop cultivation	2.420	0.752	36
2	Livestock and poultry	3.601	1.119	7
3	Dairy	2.145	0.667	38
4	Fishery	3.383	1.052	18
5	Crude oil	2.608	0.811	34
6	Other mining	2.730	0.849	33
7	Meat processing	3.854	1.198	3
8	Fish processing	3.830	1.190	4
9	Vegetable and fruit processing	3.235	1.006	20
10	Oils and fats processing	5.506	1.712	1
11	Dairy	3.961	1.231	2
12	Rice husking	3.565	1.108	11
13	Other flours	3.208	0.997	24
14	Other food processing	3.573	1.111	10
15	Alcohol, beer, water and soft drinks	2.550	0.793	35
16	Tobacco processing	2.936	0.913	30
17	Yarn and other fibers	3.538	1.100	13
18	Textiles	3.479	1.082	15
19	Clothing	3.134	0.974	26
20	Leather products	3.044	0.946	27
21	Footwear	2.963	0.921	29
22	Wood products	3.306	1.028	19
23	Paper products	3.437	1.069	17
24	Printing products	3.441	1.070	16
25	Petroleum products	3.592	1.117	8
26	Other chemicals	3.232	1.005	22
27	Non-metallic minerals	3.192	0.992	25
28	Basic metals	3.551	1.104	12
29	Metal products	3.611	1.123	6
30	Electrical machinery	3.584	1.114	9
31	Machinery	3.730	1.159	5
32	Vehicles and transport equipment	3.483	1.083	14
33	Furniture	3.224	1.002	23
34	Other manufacturing	2.312	0.719	37
35	Construction	3.235	1.006	21
36	Retail and wholesale trade	1.945	0.605	39
37	Transport services	3.020	0.939	28
38	Communication services	2.765	0.860	32
39	Hotels and catering	2.919	0.907	31
40	Other services	1.832	0.570	40

Source: calculated from 2012 IO table

Table 2. Forward linkages for Ghosh Method

	Sectors	FL	NFL	Ranking
1	Crop cultivation	2.950	0.825	16
2	Livestock and poultry	2.246	0.628	22
3	Dairy	13.493	3.771	1
4	Fishery	1.799	0.503	28
5	Crude oil	4.292	1.200	11
6	Other mining	4.702	1.314	9
7	Meat processing	1.435	0.401	31
8	Fish processing	1.270	0.355	35
9	Vegetable and fruit processing	1.478	0.413	29
10	Oils and fats processing	8.079	2.258	4
11	Dairy	2.177	0.608	24
12	Rice husking	1.903	0.532	27
13	Other flours	1.450	0.405	30
14	Other food processing	2.948	0.824	17
15	Alcohol, beer, water and soft drinks	1.066	0.298	38
16	Tobacco processing	1.003	0.280	40
17	Yarn and other fibers	4.564	1.276	10
18	Textiles	3.666	1.025	12
19	Clothing	1.136	0.317	37
20	Leather products	2.229	0.623	23
21	Footwear	1.055	0.295	39
22	Wood products	2.741	0.766	19
23	Paper products	4.994	1.396	8
24	Printing products	3.234	0.904	14
25	Petroleum products	8.062	2.253	5
26	Other chemicals	9.292	2.597	3
27	Non-metallic minerals	2.821	0.788	18
28	Basic metals	12.429	3.474	2
29	Metal products	6.081	1.700	7
30	Electrical machinery	2.951	0.825	15
31	Machinery	7.957	2.224	6
32	Vehicles and transport equipment	1.410	0.394	32
33	Furniture	1.322	0.370	34
34	Other manufacturing	3.615	1.010	13
35	Construction	1.175	0.329	36
36	Retail and wholesale trade	2.371	0.663	20
37	Transport services	2.296	0.642	21
38	Communication services	2.095	0.586	25
39	Hotels and catering	1.372	0.383	33
40	Other services	1.946	0.544	26

Source: calculated from 2012 IO table

Therefore, these sectors should be selected to implement investment policies in Vietnam in the current period. The industries with the lowest forward linkages are tobacco processing, footwear, and clothing.

Key sectors for Vietnam economy: The letters K, B, F and L denote key sector, strong BL, strong FL and weak linkage categories respectively. Key sectors for the economic development of a country have been defined as sectors with above average backward and forward linkages. Table 3 shows key sectors in Vietnam economy.

Table 3. Identifying key sectors

Sectors	NBL	NFL	Results
1 Crop cultivation	0.752	0.825	L
2 Livestock and poultry	1.119	0.628	B
3 Dairy	0.667	3.771	F
4 Fishery	1.052	0.503	B
5 Crude oil	0.811	1.200	F
6 Other mining	0.849	1.314	F
7 Meat processing	1.198	0.401	B
8 Fish processing	1.190	0.355	B
9 Vegetable and fruit processing	1.006	0.413	B
10 Oils and fats processing	1.712	2.258	K
11 Dairy	1.231	0.608	B
12 Rice husking	1.108	0.532	B
13 Other flours	0.997	0.405	L
14 Other food processing	1.111	0.824	B
15 Alcohol, beer, water and soft drinks	0.793	0.298	L
16 Tobacco processing	0.913	0.280	L
17 Yarn and other fibers	1.100	1.276	K
18 Textiles	1.082	1.025	K
19 Clothing	0.974	0.317	L
20 Leather products	0.946	0.623	L
21 Footwear	0.921	0.295	L
22 Wood products	1.028	0.766	B
23 Paper products	1.069	1.396	K
24 Printing products	1.070	0.904	B
25 Petroleum products	1.117	2.253	K
26 Other chemicals	1.005	2.597	K
27 Non-metallic minerals	0.992	0.788	L
28 Basic metals	1.104	3.474	K
29 Metal products	1.123	1.700	K
30 Electrical machinery	1.114	0.825	B
31 Machinery	1.159	2.224	K
32 Vehicles and transport equipment	1.083	0.394	B
33 Furniture	1.002	0.370	B
34 Other manufacturing	0.719	1.010	F
35 Construction	1.006	0.329	B
36 Retail and wholesale trade	0.605	0.663	L
37 Transport services	0.939	0.642	L
38 Communication services	0.860	0.586	L
39 Hotels and catering	0.907	0.383	L
40 Other services	0.570	0.544	L

Source: calculated from 2012 IO table

There are nine key sectors in Vietnam economy in 2012 based on the calculation of Rasmussen and Ghosh methods. These sectors are oils and fats processing, yarn and other fibers, textiles, paper products, petroleum products, other chemicals, basic metals, metal products, machinery. These sectors can be considered the important ones that need to have the priority for development.

Conclusions

This paper provides the information on key economic sectors in Vietnam economy by using backward and forward linkages of the results of 2012 IO tables based on the calculation of Rasmussen and Ghosh methods. According to the findings, there are nine key sectors in Vietnam in 2012. These sectors are oils and fats processing, yarn and other fibers, textiles, paper products, petroleum products, other chemicals, basic metals, metal products, machinery. In addition, there are several sectors that have very weak forward and backward linkages such as crop cultivation, clothing, leather products, footwear, and non-metallic minerals. Therefore, if there is no significant change in the economic structure in the coming years, the priority for these industries should be carefully taken into consideration because the spreading effect over the economy may not be high.

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