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LINKAGE ANALYSIS OF CEMENT INDUSTRY INTHEINDONESIAN ECONOMY: INPUT-OUTPUT ANALYSIS

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Abstract

This study aims to determine the relations of backward and forward linkages of cement industry on the various economic sectors in Indonesia. In analyzing the relations, Indonesia's input-output table of year 2005 isusedwhich is based ontheIndonesian domestic transactions on the basis of the producer price of 175 sectors classification. The results showed that the cement industry has backward linkages to the 43 sectors (5 sectors that have the biggest backward linkage are: the coal sector, electricity and gas sector, natural gas and geothermal sectors,excavation goods and oil refining goods) and has forward linkages to 15 sectors (5 sectors that have the biggest forward linkage, namely: agricultural infrastructure sector, roads, bridges and ports, goods from non-metallic materials, residential and non-residental buildings, the building sector and the installation of electricity, gas, water and communication), in the direct linkages, both backward and forward linkages of cement industry are still considered as low, and the total linkages of the cement industry has stronger association with upstream sector when compared to the downstream sector. The conditions of the backward linkages of cement industry in 2014 is assumed to be relatively the same as those in 2005, while the forward linkage in 2014 indicates a shift in the sectors that have the biggest linkage to the cement industry.

Keywords: Cement Industry, Input-Output, Direct Linkage and Total Linkages, Backward Linkages, Forward Linkages

1.Introduction

According to Hirschman (cited in Arsyad, 2010), in the productive sector, inducement mechanism is created due to the linkages between industries in providing inputs that are used as raw materials in other industry is divided into two types, namely:

1. Backward linkage effects, where there is a stimulus created by the development of an industry to the development of industries that provide inputs (raw materials) for other industry

2. Forward linkage effects, where there is a stimulus created by the development of an industry to another industries which used the former industry's product as their inputs (raw materials)

According to Arsyad (2010) and Davies and Lyons (1991), the rapid growth of one or more industry can induce the expansion of other industries related to the first growing sector industry. These linkages can be in the form of backward linkage, for example, cement industry can induce the development in coal production or natural gas and geotherrmal sectors that are needed in cement industry. Another form of the linkage is forward linkages in which the growth of domestic cement indsutry can induce the investment in infrastructure sector, roads, bridges and port, the building sector, etc.

2. Problem Formulation

Therefore, it can be concluded that the main reseach problem in this study is: how the backward and forward linkages in Indonesia's cement industry are related to its economic sectors.

3. Study Objectives

Based on the problem formulation, the objective of this study is as follows: to examine the relationship between backward and forward linkages of cement industry in Indonesia to its economic sectors.

4. Literature Review
4.1.Direct Linkage

To analyse the direct linkage of one sector to other economic sectors in Indonesia, analytical techniques that can be used according to Nazara (2005), Purnomo and Istiqomah (2008), and Herlina *et al.* (2011) are as follows:

a. *Direct backward linkage*
   Direct backward linkage shows the increase per unit of the total demand as the result of a particular sector to the sectors that provide input for them. Direct backward linkage is shown by technology matrix A and formulised as follows:

$$B(d)_j = \sum_{i=1}^{n} \mathrm{a}_{ij} \qquad (1)$$

   Where,
   $B(d)_j$: Direct backward linkage
   a_{ij} :Coefficeint matrix technology A

b. *Direct forward linkage*
   Direct forward linkage shows the increase per unit of the total demand as the result of a particular sector to other sectors that use the its output as their inputs.The direct forward linkage is shown by matrix technology A and formulized as follows:

$$F(d)_i = \sum_{j=1}^{n} \mathrm{a}_{ij} \qquad (2)$$

   Where,
   $F(d)_i$: Direct forward linkage
   a_{ij} : Coefficient matrix technology A

4.2. Total Linkage

To analyse total linkage on a particular sector to another economic sectors in Indonesia, according to Nazara (2005), analytical techniques that can be used are:

a. *Total backward linkage*
Backward linkage does not only have direct effect but also indirect effect from additional output (exogenously).Total backward linkage, which include the effects of direct and indirect effects of backward linkages is indicated by the inverse matrix of Leontief and formulated as follows :

$$B(d + i)_j = \sum_{i=1}^{n} \alpha_{ij} \qquad (3)$$

Where,
$B(d + i)_j$: Total backward linkage
α_{ij} : Coefficient of inverse matrix of Leontief

b. *Total forward linkage*
Forward linkage does not only have direct effect but also indirect effect from additional output (exogenously).Total forward linkage, which include the effects of direct and indirect effects of forward linkages is indicated by the inverse matrix of Leontief and formulated as follows :

$$F(d + i)_i = \sum_{j=1}^{n} \alpha_{ij} \qquad (4)$$

Where,
$F(d + i)_i$: Total forward linkage
α_{ij} : Coefficient of inverse matrix of Leontief
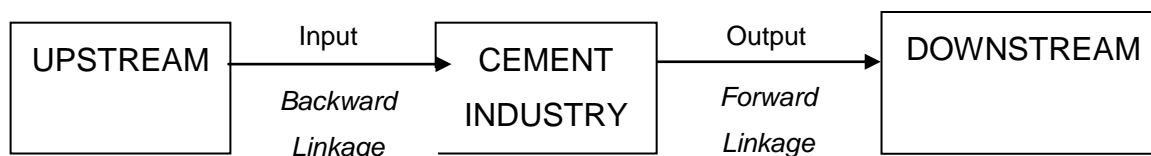
4.3. Research Framework

Figure 1. Research Framework

It can be seen from Figure 1, in backward linkage, the growth of cement industry will pull the upstream sector that provided the input to grow. While in forward linkage, the growth of cement industry will induce downstream industry to develop as well.

5. Research Methods
5.1. Sources of Data

Secondary data from the Central Bureau of Statistics (BPS) Indonesia is used in this research. This data is in form of input-output table Indonesia in 2005 based on domestic transaction of basic producer price with the classification of 175 sectors.

5.2. Analytical Techniques

According to Nazara (2005) and Suryani (2013) in the context of input-output, the movement or flow of goods among the sectors occurs, for example, from sector i to sector j and there is also a possibility of flow of goods within its own sector which is known as intrasector movement. In other words, it can be said that there is a movement from sector i to sector j, where i=j. For instance, the fuel which is the output from oil refining sector, can be used as the input in the process of oil refining itself. Another example is that output of agricultural sector can be used as seed for the next planting. Supposed the total output of sector i is noted as X_i, while the transaction value from sector i to sector j is noted as z_{ij}, and total demand of the last sector is i is noted as Y_i. Therefore, $X_i = z_{i1} + z_{i2} + ... + z_{in} + Y_i$.

In input-output table, coefficient from technology matrix A (a_{ij}) is presented in coefficient input-output domestic table on basic producer price. Coefficient technology matrix A (a_{ij}) is a cross-section between each sectors. As an ilustration in backward linkage, $a_{23} = 0,32$ shows that to produce 1 million output of sector 3, 0.32 million rupiah input from sector 2 is needed. Furthermore, in forward linkage, $a_{23} = 0,32$ shows that to produce 1 million rupiah output of sector 2, 0.32 million input from sector 3 is needed.

Coeffient inverse matrix Leontief Leontief (α_{ij}) is also presented in multiplier matrix table $(I-A^d)^{-1}$ domestic on basic producer price. Coefficient matrix technology A (α_{ij}) is a cross-section of each sectors. In total backward linkage, $\alpha_{23} = 0,32$ means if there is an increase of 1 million demand in sector 3, there will be a growth of output in sector 2 of 0.32 million. Furthermore, in forward linkage, $\alpha_{23} = 0,32$ indicates if if there is an increase of 1 million demand in sector 2, there will be a growth of output in sector 3 of 0.32 million.

6. Results and Discussion
6.1. Direct Linkage
6.1.1. Direct Backward Linkage

Direct backward linkage shows the increase per unit of the total demand as the result of a particular sector to the sectors that provide input for them. Direct backward linkage is shown in the technology matrix A (Nazara, 2005).

Table 1. Five Economic Sectors with Direct Backward Linkage to Cement Industry in Indonesia

No.	Code	Sector	Coefficient	%
1	35	Coal	0,17397	32,7
2	142	Electricity and Gas	0,08416	15,8
3	37	Natural gas and Geothermal	0,08063	15,2
4	48	Excavation goods	0,05101	9,6
5	104	Oil refining goods	0,03645	6,9
Total Direct Backward Linkage Cement Industry			0,5321	

Source: Central Bureau of Statistics Indonesia (2008a).

Based on input-output table Indonesia 2005, there are 43 economic sectors that have direct backward linkage with cement industry. Out of these sectors, 5 sectors have the highest direct backward linkage to cement industry, namely: coal, electricity and gas, natural gas and geothermal, excavation goods and oil refining goods sector.

From Table 1, it can be seen that coal sector has the biggest coefficient of 0.17397 indicating to produce 1 million rupiah of output in cement industry, 0.17397 million rupiah of input is needed from coal sector. Furthremore, cement industry uses 32.7% input from coal industry in its production process.

6.1.2. Direct Forward Linkage

Direct forward linkage shows the increase per unit of the total demand as the result of a particular sector to other sectors that use the its output as their inputs. The direct forward linkage is shown by matrix technology A (Nazara, 2005).

Table 2. Five Economic Sectors with the highest Direct Forward Linkage to Cement Industry in Indonesia

No.	Code	Sector	Coefficient	%
1	145	Agricultural Infrastructure	0,06618	31.8
2	146	Roads, Bridges and Ports	0,04677	22.5
3	114	Other goods from non-metallic materials	0,04225	20.3
4	144	Resisdential and non-residential buildings	0,02193	10.5
5	147	Buildings, and electricity, gas and water installationand communication	0,01872	9.0
Total Direct Forward Finkage to Cement Industry			0,20813	

Source: Central Bureau of Statistics Indonesia (2008a).

Based on input-output table Indonesia 2005, there are 43 economic sectors that have direct forward linkage with cement industry. Out of these sectors, 5 sectors have the highest direct forward linkage to cement industry, namely:agricultural infrastructure, roads, bridges and ports, other goods from non-metallic materails, residental and non-residental buildings, buildings, and electricity, gas and water installation and communication.
Based on Table 2, agricultural infrasturcture sector has the highest coefficient of 0.06618 which means to produce 1 million rupiah of output in agricultural infrastructre sector, 0.17397 million rupiah of input is needed from cement industry. Furthremore, agricultural infrastructure sector uses 32.7% input from coal industry in its production process.

6.2. Total Linkage
6.2.1. Total Backward Linkage

Backward linkage does not only have direct effect but also indirect effect from additional output (exogenously). Total backward linkage, which include the effects of direct and indirect effects of backward linkages is indicated by the inverse matrix of Leontief (Nazara, 2005).

Table3. Five Economic Sectors with Total Backward Linkage to Cement Industry in Indonesia

No.	Code	Sector	Coefficient	%
1	113	Cement Industry	1,00228	59.1
2	35	Coal	0,19289	11.4
3	142	Electricity and Gas	0,10068	5.9
4	37	Natural gas and Geothermal	0,09112	5.4
5	104	Oil Refining Goods	0,06939	4.1
Total Backward Linkage to Cement Industry			1,69517	

Source: Central Bureau of Statistics Indonesia (2008a).

Based on input-output table Indonesia in 2005, there are 43 economic sectors that have total backward linkage with cement industry. From these sectors, 5 sectors that have the highest total backward linkage are: cement, coal, electricity and gas, natural gas and geothermal and oil refining goods industry.

From Table 3, it can be seen that cement industry has the highest coefficient of 1,00228 indicating if there is 1 million rupiah increase in demand in cement industry, it will induce the output growth of cement industry of 1,00228 million rupiah. Furthermore, cement indsutry also induce its own output of 59.1%.

6.2.2. Total Forward Linkage

Forward linkage does not only have direct effect but also indirect effect from additional output (exogenously). Total forward linkage, which include the effects of direct and indirect effects of forward linkages is indicated by the inverse matrix of Leontief (Nazara, 2005).

Table 4. Five Economic Sectors with Total Forward Linkage to Cement Industry in Indonesia

No.	Code	Sector	Coefficient	%
1	113	Cement	1,00228	82.3
2	145	Agricultural Infrasturcture	0,06777	5.6
3	146	Roads, Bridges and Ports	0,04824	4.0
4	114	Other goods from non-metallic materials	0,04271	3.5
5	144	Residental and non-residental buildings	0,02297	1.9
Total Forward Linkage of Cement Industry			1,21811	

Source: Central Bureau of Statistics Indonesia (2008a).

Based on input-output table Indonesia in 2005, there are 43 economic sectors that have total backward linkage with cement industry. From these sectors, 5 sectors that have the highest total forward linkage are: cement industry, agricultural infrastructure, roead, bridges and ports, other goods from non-metallic materials, residential and non-residental buildings.

From Table 4, it can be seen that cement industry has the highest coefficient of 1,00228 indicating if there is 1 million rupiah increase in demand in cement industry, it will induce the output growth of cement industry of 1.00228 million rupiah.

6.3. Cement Industry Linkage Relations, 2005-Present: Rationale

Based on the backward linkage analusis of cement industry by using input-output table in 2005, it can be concluded that coal sector has the biggest backward linkage, this shows that in 2005 the main heat source of energy in cement industry in Indonesia is coal which later followed by electricity and gas, natural gas and geothermal, oil refining goods such as fuel as alternative source of heat energy to produce cement. Whereas, all types of excavation products, such as limestone, clas and sand iron which are the main materials in cement production placed fourth in the sectors with highest backward linkage after electricity and gas as well as natural gas and geothermal sector.

The current condition of direct backward linkage of cement industry in 2014 is similar with its condition in 2005, in which, coal sector, electricity and gas, natural gas and geothermal sector, excavation goods and oil refining goods are still the sectors with the biggest direct backward linkage with cement industry. This is due to the fact that the output from these sectors are being used as inputs in cement production process indicating with the increase in output produced by cement industry, there is also an increase in output from other sectors that provide inputs so, the growth in cement industry will induce the growth in other industry.

Based on the backward linkage analysis of cement industry by using input-output table in 2005, it is shown that agricultural infrastructure sector has the biggest forward linkage with cement industry compared to other industries. This indicates that in 2005, there were more development in agricultural infrastructure such as irrigation and dams compared to other infrasturctures such as roads, bridges, ports as well as residental and non-residental buildings, namely, houses and offices.

These relations of linkages in cement industry happened in 2005 which is different compared to the current condition. This can be seen in Table 5 in which from 2005 to 2014, the output growth in each sectors with forward linkage to cement industry has changed.

Table5. Growth of Food Crops Sector,Building Sector andOther Goods in Indonesia in 2005-2014

Year	Food Crops		Buildings		Other Goods	
	Billion Rupiah	%	Billion Rupiah	%	Billion Rupiah	%
2005	125.802	2.6	103.598	7.5	3,779	2.6
2006	129.548	3.0	112.233	8.3	3,916	3.6
2007	133.888	3.4	121.809	8.5	3,806	-2.8
2008	142.000	6.1	131.009	7.6	3,770	-1.0
2009	149.058	5.0	140.268	7.1	3,890	3.2
2010	151.501	1.6	150.022	7.0	4,007	3.0
2011	154.154	1.8	159.123	6.1	4,080	1.8
2012	158.910	3.1	170.885	7.4	4,034	-1.1
2013	161.925	1.9	182.118	6.6	4,005	-0.7
2014	164.082	1.3	194.093	6.6	4,362	8.9
$\overline{X}$	147.087	3.0	146.516	7.3	3.965	1.8

Source: Central Bureau of Statistics Indonesia (2008b, 2010, 2015).

Large magnitude of increase in output of the buildings sector compared to other sectors from 2005 to 2010 shows, there is a bigger development in building sector such as the development of roads, bridges, ports, residental and non-residental buildings compared to agricultural infrastructure sector such as the development of irrigation and dams. Therefore, this indicates that in 2014 there was a shift in forward linkage in cement industry from agricultural infrasturcture in 2005 to buildings sector in 2014.

7. Conclusions

Based on the linkage analysis on cement industry on input-output table Indonesia in 2005 with 175 sectors classification, it can be concluded that cement industry has backward linkage to 43 economic sectors (5 sectors with the biggest backward linkage: coal, electricity and gas, natural gas and geothermal, excavation goods, and oil refining goods) and forward linkage to 15 economic sectors (5 sectors with the biggest forward linkage: agricultural infrastructure, roads, birdges and ports, other goods from non-metallic materials, residental and non-residental buildings, buildings and electricity, gas, water installation as well as communication).In direct linkage, cement industry is still classified as low linkage with the coefficient of direct linkage less than one. However, in direct linkage, cement industry has stronger backward linkaged compared to forward linkage. In total linkage, cement industry has stronger linkage to upstream compared to downstream, therefore, the growth of cement industry will have larger effect on upstream sectors.

The current condition of direct backward linkage of cement industry in 2014 is similar with its condition in 2005, in which, coal sector, electricity and gas, natural gas and geothermal sector, excavation goods and oil refining goods are still the sectors with the biggest direct backward linkage with cement industry. However, in forward linkage, it is believed there is a shift in cement industry from agricultural infrasturcture in 2005 to buildings sector in 2014.

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