The Role of Natural Gas Sector in the Indonesian Economy: Input-Output Table Analysis

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Abstract. The natural gas sector has an important role in the Indonesian economy and sustainability. The decrease in natural gas production and reserves impacts sectors that require natural gas as input and support for production activities. This study analyzes the relationship between the natural gas sector and other sectors in Indonesia and the multiplier impact. The method used in this research is Input-Output table analysis using IOW. The data used is the 2016 Input-Output Table and workforce according to business field. The results show that the natural gas sector has high forward linkages and low backward linkages. However, Natural gas has an important role in supporting other important sectors in the economy. This study provides several strategic recommendations related to the development of the natural gas sector and aims to optimize the role of natural gas in Indonesian economy.

Keywords: Energy; Input-Output Table Analysis; Multiplier; Natural Gas; Sector Linkages

1   Introduction

Issues related to energy, global warming, and climate change are complex problems. One of the steps that the Indonesian government has taken is to ratify the Paris Agreement into Law Number 16 of 2016, which states that it is serious about ensuring that the earth's temperature rises below the threshold of 2 degrees Celsius and is committed to working to limit the temperature increase to 1.5 degrees Celsius, above the earth's temperature in the pre-industrial period. This shows that the government is committed to mitigating climate change.

Government Regulation Number 79 of 2014 Article 1 Section 2 Point C states that "To realize energy economics, national energy development priorities are based on the principle of optimizing the use of natural gas and new energy." On the other hand, natural gas is fossil energy. Natural gas is the cleanest and most environmentally friendly fossil energy [3]. Rahardjo [8] stated that natural gas is a clean energy source and can be used as an alternative to fossil energy because burning natural gas produces 50 percent lower carbon dioxide (CO2) pollution than coal and 30 percent lower than petroleum. This was also confirmed by Tampubolon & Kiono [11], who

stated that natural gas is the cleanest fossil energy because it produces lower CO2 than other fossil energies, which can be used as a link for the transition of fossil energy toNew Renewable Energy (NRE).

Over the last few years, natural gas has been one of the government's priorities. This is proven by a government program, namely constructing a gas network to be distributed to households and small customers. Apart from that, the government has also stipulated Government Regulation Number 121 of 2020 Article 3 Section 1 on the Price of Certain Natural Gas (HGBT) with the highest price being US$6/MMBTU. This policy aims to encourage accelerated economic growth and increase the competitiveness of national industry [6]. This shows that natural gas is vital in encouraging industrial productivity, ultimately leading to national economic growth.

If analyzed from a utilization perspective, most natural gas over the last few years has been used to meet domestic needs rather than exports. This can be seen in Figure 1. where since 2016- 2021, domestic use of natural gas has consistently exceeded 50 percent of the total use of naturalgas and has a trend that is constantly increasing every year to secure the national natural gas supply by enforcing regulations in the form of larger allocations, for domestic needs. Tampubolon & Kiono [11] also stated that the government limits natural gas exports to make energy capital for national development.
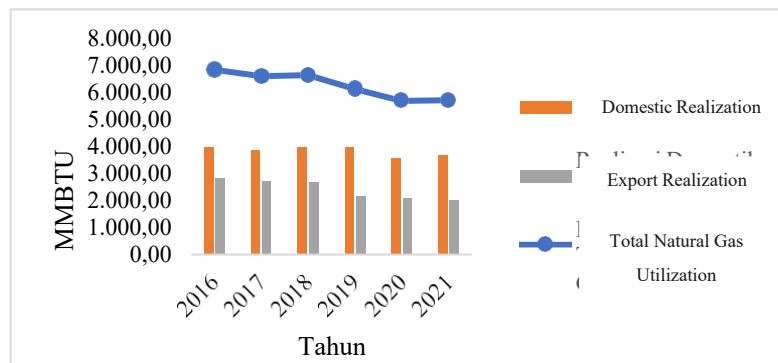

Figure 1. Realization of Natural Gas Utilization in 2016-2021

(MMBTU)

Source: Kementerian ESDM (2022)

The natural gas sector can also be used as input and supporting material for other sectors [9]. Even though the majority of natural gas is used to meet domestic needs rather than export, if we look at the use of natural gas per sector in 2021, the majority of use is actually for LNG exports amounting to 1,294.12 Billion British Thermal Units per Day (BBTUD), where BBTUD is a unit of volume Natural gas is an important measure in assessing natural gas consumption and production. Apart from that, natural gas was also used for the industrial sector amounting to 1,578.28 BBTUD, piped gas exports amounting to 752.70 BBTUD, fertilizer amounting to 681.97 BBTUD, electricity amounting to 679.90 BBTUD, domestic LNG amounting to 479.27 BBTUD, lifting amounting to 167.78 BBTUD, domestic LPG 88.05

BBTUD, city gas 8.42 BBTUD, and BBG 3.92 BBTUD [6]. This shows that natural gasplays an important role in the economy because it is used to meet domestic needs.

Many studies have examined inter-sector linkages using input-output analysis. However, the sectors used by previous researchers are different. Kim et al. [4] analyzed the interrelationships of the mining sector, which in this study did not specifically separate the natural gas sector. Apart from that, Kountul [7] also conducted research discussing the interrelationships and output of the oil, gas and geothermal sectors. In this research, Kountul (2023) did not specifically separate the natural gas sector. Wibowo [12] also studied the relationship between the natural gas sector and other sectors in Indonesia. However, the data used comes from the 2000 Input-Output table.

Based on this, research focusing on the natural gas sector is still limited and tends not to specifically study natural gas, so further research needs to be carried out. Therefore, this studyaim to see the relationship between the natural gas sector and other sectors in Indonesia. The results of this study can enrich academic literature related to natural gas and policy referencesrelated to the natural gas sector in Indonesia.

2 Research Method

In this research, the method used is Input-Output Table analysis. Input-Output analysis can show sectoral dependence, where the production results of one sector can be used as input and support for other sectors and vice versa [10]. According to Daryanto & Hafizrianda [2], Input-Output analysis can show how big the relationship between sectors in the economy is, which bases its analysis on balance. According to Cristóbal & Biezma [1] Input-Output analysis can be a tool in economic planning which not only provides an overview of the financial impactsrelated to changes in a particular policy, but can explain the impact on the economy in general.

This research analyzes the relationship between the natural gas sector in Indonesia using datafrom the 2016 Indonesian Input-Output Table and sectoral workforce sourced from the Central Statistics Agency. In this research, the Input-Output Table which initially consisted of 185 sectors was then aggregated into 35 sectors by referring to the classification made by the Central Statistics Agency and research conducted by C-BEPES, Pertamina University. This aggregation is carried out by considering the sector's relevance to the context of the research being conducted, where sectors that are not related to natural gas are aggregated and sectors that are related to natural gas are not aggregated.

3 Results and Discussion

3.1 Analysis of the Linkages of All Sectors in the Economy

This research presents transactions between sectors in the economy, both in providing input for production and distributing production output, obtained through analysis of the Input- Output Table. Table 1 shows the linkages between sectors based on the

classification of 35 sectors.

Table 1. Forward and Backward Linkages Classification of 35 Sectors

Number	Sector	Forward Linkages		Backward Linkages	
		Direct	Direct and Non Direct	Direct	Direct and Non Direct
1	Agriculture, Farm, and Fisheries	0.45	2.25	0.20	1.33
2	Processing Industry	2.20	4.82	0.52	1.85
3	Provision and Accommodation	1.47	3.61	0.42	1.71
4	Transportation Services	1.13	2.82	0.49	1.81
5	Other Services	2.09	4.79	0.33	1.56
6	Coal	0.45	1.61	0.49	1.82
7	Petroleum	0.88	2.22	0.23	1.36
8	**Natural Gas**	**1.16**	**2.55**	**0.25**	**1.39**
9	Geothermal	0.13	1.17	0.25	1.39
10	Iron Sand and Iron Ore	0.02	1.02	0.21	1.34
11	Tin Ore	0.04	1.04	0.30	1.49
12	Bauxite Ore	0.003	1.00	0.28	1.45
13	Copper Ore	0.01	1.02	0.29	1.48
14	Nickel Ore	0.03	1.03	0.40	1.65
15	Other Metal Mining Goods	0.01	1.02	0.29	1.50
16	Gold Ore	0.02	1.04	0.31	1.52
17	Silver Ore	0.01	1.01	0.32	1.53
18	Non-Metal Mineral Mining Goods	0.10	1.14	0.20	1.33
19	Other Mineral Mining Goods	1.09	2.42	0.27	1.46
20	Fuel Oil	0.49	1.79	0.35	1.50
21	LPG	0.02	1.03	0.38	1.55

Number	Sector	Forward Linkages		Backward Linkages	
		Direct	Direct and Non Direct	Direct	Direct and Non Direct
22	Biodiesel	0.28	1.45	0.34	1.49
23	LNG	0.04	1.07	0.37	1.53
24	Petrochemical	0.58	1.75	0.47	1.74
25	Fertilizer	0.08	1.12	0.51	1.79
26	Chemical Goods	0.04	1.07	0.46	1.78
27	Oleochemical	0.11	1.15	0.43	1.69
28	Tire	0.02	1.04	0.64	2.15
29	Rubber Gloves	0.01	1.02	0.63	2.12
30	Flat Glass	0.04	1.07	0.48	1.78
31	Ceramic Clay	0.02	1.04	0.54	1.88
32	Cement	0.08	1.12	0.51	1.89
33	Steel	0.04	1.06	0.49	1.82
34	Electricity	0.32	1.52	0.63	2.00
35	City Gas	0.17	1.23	0.34	1.48

Based on Table 1, it can be seen that the natural gas sector has a direct forward linkage of 1.16.The interpretation is that for every 1 million rupiah of output from the natural gas sector, the distribution of output to other sectors and the natural gas sector itself is directly 1.16 million rupiah. Meanwhile, if we look at the direct and indirect forward linkages. The natural gas sectorhas a direct and indirect forward linkage of 2.55, which means that for 1 million rupiah of outputfrom the natural gas sector, the distribution of output to other sectors and natural gas itself directand indirect is 2.55 million rupiah. This shows that the natural gas sector has relatively large direct and indirect linkages with other sectors.

Apart from forward linkages, in Table 1 you can also see backward linkages for natural gas. Thenatural gas sector has a direct backward linkage of 0.25, which means that for every increase in final demand in the natural gas sector of 1 million rupiah, it can increase demand for inputs originating from other sectors and natural gas by 0.25 million rupiah. Furthermore, natural gas has a direct and indirect backward linkage of 1.39, the interpretation of which is that for every increase in final demand in the natural gas sector of 1 million rupiah, it can increase input demand directly or indirectly from other sectors and natural gas itself by 1.39 million rupiah. This value is relatively small when compared with other sectors. Based on this, the natural gas sector has relatively small direct and indirect backward linkages with other sectors.

Based on an analysis of the linkages of all economic sectors, the natural gas sector has a significant future linkage because it has a value above one and is greater than the average value of all sectors. The implication is that the natural gas sector can increase the output of other sectors through the provision of inputs produced from the natural gas sector. This shows that the natural gas sector plays a vital role in

encouraging the growth of existing economic sectors .Apart from that, if we look at backward linkages, the natural gas sector has low backward linkages because it has a value below one and is lower than the average value of all sectors. Thisshows that the natural gas sector has not been able to increase production growth in the upstream natural gas sector. Therefore, what needs to be done is intervention from the government to increase growth in the upstream natural gas sector because the natural gas sector itself has not been able to increase the growth of its upstream sector.

3.2 Analysis of the Relationship between the Natural Gas Sector andOther Sectors

After analyzing the linkages of all economic sectors, Table 2 will explain in detail the linkagesof the natural gas sector with other forward and backward sectors.

Table 2. Forward and Backward Linkages of the Natural Gas Sector with Other Sectors

Number	Sector	Forward Linkages		Backward Linkages	
		Direct	Direct and Non Direct	Direct	Direct and Non Direct
1	Agriculture, Farm, and Fisheries	0.0000	0.0083	0.0000	0.0088
2	Processing Industry	0.0009	0.0082	0.0127	0.0383
3	Provision and Accommodation	0.0000	0.0070	0.0326	0.0534
4	Transportation Services	0.0000	0.0170	0.0193	0.0313
5	Other Services	0.0000	0.0058	0.0475	0.0798
6	Coal	0.0000	0.0078	0.0000	0.0023
7	Petroleum	0.0138	0.0186	0.0050	0.0085
8	**Natural Gas**	**0.0584**	**1.0658**	**0.0584**	**1.0658**
9	Geothermal	0.0584	0.0657	0.0065	0.0073
10	Iron Sand and Iron Ore	0.0000	0.0051	0.0000	0.0000
11	Tin Ore	0.0000	0.0047	0.0000	0.0001
12	Bauxite Ore	0.0000	0.0037	0.0000	0.0000
13	Copper Ore	0.0000	0.0046	0.0000	0.0001
14	Nickel Ore	0.0000	0.0070	0.0000	0.0001
15	Other Metal Mining Goods	0.0000	0.0050	0.0000	0.0000
16	Gold Ore	0.0000	0.0056	0.0000	0.0003

Number	Sector	Forward Linkages		Backward Linkages	
		Direct	Direct and Non Direct	Direct	Direct and Non Direct
17	Silver Ore	0.0000	0.0059	0.0000	0.0000
18	Non-Metal Mineral Mining Goods	0.0000	0.0037	0.0000	0.0005
19	Other Mineral Mining Goods	0.0000	0.0047	0.0511	0.0580
20	Fuel Oil	0.0703	0.0827	0.0021	0.0070
21	LPG	0.0756	0.0889	0.0001	0.0003
22	Biodiesel	0.0692	0.0814	0.0012	0.0039
23	LNG	0.0755	0.0888	0.0002	0.0006
24	Petrochemical	0.0252	0.0421	0.0064	0.0084
25	Fertilizer	0.1707	0.1969	0.0000	0.0003
26	Chemical Goods	0.0002	0.0099	0.0000	0.0006
27	Oleochemical	0.0001	0.0110	0.0000	0.0008
28	Tire	0.0000	0.0080	0.0001	0.0004
29	Rubber Gloves	0.0000	0.0103	0.0001	0.0002
30	Flat Glass	0.0646	0.0822	0.0001	0.0004
31	Ceramic Clay	0.0494	0.0747	0.0000	0.0006
32	Cement	0.0098	0.0265	0.0000	0.0007
33	Steel	0.0348	0.0595	0.0000	0.0004
34	Electricity	0.1477	0.1818	0.0066	0.0100
35	City Gas	0.2315	0.2522	0.0002	0.0012

In Table 2, information is obtained that the sector with the most significant direct future link to natural gas is city gas, with a value of 0.2315. The interpretation is that for every increase in final demand in the natural gas sector of 1 million rupiahs, the output allocation that will be channeled directly to the city gas sector is 0.2315 million rupiahs. Apart from that, the natural gas sector also has a large direct forward linkage with the fertilizer and electricity sectors, with values of 0.1707 and 0.1477, respectively. This shows that natural gas output makes the largest contribution as input to the city gas, fertilizer, and electricity sectors. However, if we look at it based on direct and indirect links to the future, the natural gas sector has a relatively strong influence on the natural gas sector itself, amounting to 1.06.

If we look at the direct relationship with natural gas, the largest is the natural gas sector itself, with a value of 0.058. The interpretation is that for every 1 million rupiah increase in final demand for the natural gas sector, input from the natural gas sector itself requires 0.058 million rupiah. The natural gas sector also has a large direct backward linkage with the other mineral mining goods and other services sectors, with values of 0.051 and 0.047, respectively. This shows that the natural gas sector requires input from the natural gas sector itself, the other

mineral mining goods, and other services sector. If we look at the direct and indirect linkages, the sector that has the largest direct and indirect linkage is the natural gas sector itself.

Apart from that, if we analyze the sectors that receive HGBT adjustments, namely the fertilizer, petrochemical, oleochemical, steel, ceramic clay, glass, and rubber glove sectors, the results show that of these seven sectors that have a large direct future connection with gas earth, namely the fertilizer, steel, ceramic clay and flat glass sectors. This shows that the value of fertilizer, steel, ceramic clay, and flat glass is greater than the average value of the linkage of all sectors. However, petrochemical, oleochemical, and rubber gloves sectors have little direct forward linkage with natural gas because their value is smaller than the average value of linkages for allsectors.

4   Conclusion

The results of this research answer the hypothesis that has been built. First, the natural gas sectorhas large forward linkages and small backward linkages. This can be seen from the value of direct linkage to the front of natural gas of 1.16 and direct linkage to the back of 0.25. The implication is that the natural gas sector has an important role in the Indonesian economy because the output produced from the natural gas sector is needed and can be used as input for other sectors of the economy.

The linkage analysis that has been carried out shows that the natural gas sector has the greatestfuture linkages with city gas, fertilizer, and electricity. However, if we look at backward linkages, the natural gas sector has the greatest linkages with the natural gas sector, other mineralmining goods, and other services sector. Meanwhile, in the other mineral mining goods sector,petroleum and natural gas mining services are used, as well as other mining and excavation services. On the other hand, in other service sectors, there are professional, scientific, and technical services.

Based on the research that has been carried out, suggestions that can be given to the government,especially the Ministry of Energy and Mineral Resources, are optimizing the development of the natural gas sector. Steps to be taken are to develop technology and infrastructure, especiallyfor gas distribution. The development of technology and infrastructure can support supply chain efficiency and avoid the non-confluence of demand and supply of natural gas. Apart from that,the government needs to develop technology and infrastructure in upstream natural gas activities, considering that a sectoral approach is not appropriate because the natural gas sector has a relatively small backward linkage value.

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