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The Economic Implications of Natural Gas Pricing Adjustment in Indonesia

Aldi Martino Hutagalung*, Djoni Hartono[+, 1], Maarten J. Arentsen[#], and Jon C. Lovett[^]

Abstract – *International gas prices have increased rapidly in the last few years. However, the domestic gas price in Indonesia has not been adjusted accordingly, staying relatively low at almost one third of export prices. The low domestic gas price keeps gas producers from selling the gas to the domestic market, so price adjustments are necessary to provide an incentive for selling of gas to the domestic market. This paper explores the possible room for maneuver in making adjustments in gas price, and analyzes the consequences on the Indonesian economy. As in many other developing countries, Indonesian pricing policies have multiple objectives, including generation of government revenue, security of supply for the domestic market, and other social objectives. The present paper examines the macro- and microeconomic impacts of gas price adjustments in both the short and long term. The macro-analysis was conducted by applying the computable general equilibrium (CGE) model; while the micro-analysis was evaluated by utilizing the net back value. The present paper contributes to examination of constraints to setting gas prices for various economic sectors that are essential to both national economic development and which are major natural gas consumers. The modelling results show that it is possible to adjust the gas price in Indonesia without negatively affecting the economy.*

Keywords – *computable general equilibrium, energy, natural gas, net back, pricing policy.*

1. INTRODUCTION

Natural gas pricing mechanisms can have consequences on the development of gas markets, especially in Indonesia, whose domestic gas market is still in an early developmental stage [1].[2] There are several methods in gas pricing: regulation by the government, indexing to substitute fuel or products, or market mechanisms (spot price) [2]. Gas pricing policy in Indonesia is intended to fulfill multiple purposes such as generating government revenue, social objectives, and ensuring supply security, all of which are standard practices in developing countries [3],[4]. The principle of including multiple objectives within gas pricing has been applied in various countries, such as India which set the gas at a low price to keep the prices of final goods low [5], as has China [6].

The gas price must reflect economic efficiency, meaning that the production costs must be taken into account [4]. Meanwhile, the social objectives can be interpreted as serving the interests of all consumers, especially low-income groups in the country [4]. In contrast to the social objectives, gas pricing is also expected to make a major contribution to state revenue in order to support national development [7].

Natural gas pricing has been the subject of much research [8],[9]. However, few studies have been conducted on natural gas pricing reform. Orloy [10] examined the impact of natural gas price adjustment in Russia, while Zhang [11] analyzed the impact of gas prices in China. Although the papers mentioned above applied the computable general equilibrium (CGE) model as their methodology, as has been done in this study, a different approach was used in this paper. Firstly, this paper specifically studies price determination in the upstream side of the Indonesian gas market, since there were different pricing mechanisms for the downstream side, making price administration in the upstream essential because of its relation to the allocation policy (see Hutagalung *et al.* [12]). This policy package was implemented as government sovereignty over natural resources. Therefore, the application of the “market mechanism” was not applicable to upstream pricing. Secondly, apart from the macro impact of gas price adjustment, this study examines the cost structure of gas consumers to estimate their willingness to pay.

Currently, the average domestic Indonesian gas price is relatively low compared to the export price, which is almost one third higher. The government has set the domestic price at a significantly low level for equity and development reasons [13] following negotiation between producers and consumers. However, the low domestic price compared to the international prices, does not encourage gas producers to fulfill domestic needs, at a time when domestic gas demand is growing fast.

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[2] Indonesian gas liberalization started in 2001 with the Law of Oil and Gas was still in an ongoing process; where many new regulations were coming during a decade of its implementation to complement the statute.

The government is thus facing a dilemma. The gas price should reflect the demand shortage following the growth of the domestic market. However, the higher price would then conflict with social and development objectives. Yet, if no change is made, producers will prefer to export the gas to the detriment of domestic supply creating a threat to economic development as the gas is used by economic sectors to generate multiplier effects. Moreover, there is also a supply deficit in which gas supply for the domestic market cannot be fulfilled entirely, due to demand growth [12].

In the meantime, adjustments to the price level are needed to stimulate investors to commit to the costs of exploring new oil and gas blocks. Most of the new gas fields are situated in remote locations, they are scattered, relatively small in size, and some have high levels of CO_2 [7]. Hence, new exploration will require large investments. If all the costs are not reflected in the price, it will be uncertain whether or not gas from these new fields will be available, since no one will be interested in such an investment.

Indonesia urgently needs to revise its pricing policy, leading to the following research question: to what extent can the gas price level can be adjusted without weakening economic development? Changing the natural gas price is an acute political-economic problem. Oil and gas represent the pivotal Indonesian assets since most of the consumers come from sectors supporting the economic development, and raising the prices (close to the export price level) will negatively affect the economy. A subsidy is not a suitable option as gas price is already at the economic level to encourage domestic development. However, there is a lost opportunity as it will still be below the international market price. Unlike oil, which has a single market price as a benchmark for subsidy calculation, the economic value of gas varies across the area, adding complexity to the process, since subsidy needs approval from other ministries (besides the ministry of energy).

The expected contributions of the present paper are as follows: (i) it focuses on exercising economic shocks in the short and long term due to the changes in the pricing policy in those three mentioned sectors based on the macro and microanalysis. Most of the literature on energy price-focused solely on the macro impacts of the price, and there was no analysis dealing with how the price could impact the cost structure of the consumers; and (ii) it will contribute to the range examination in setting gas prices in various economic sectors essential for both the economic development and the primary consumers of natural gas. Those sectors include the metal industry, paper industry, electricity production, and petrochemical industry. This price-setting aims to determine the floor and ceiling prices of natural gas serving as a benchmark for gas price approval by the government. It is something that has not been done in previous studies on natural gas.

2. INDONESIAN GAS PRICING POLICY

The energy price policy in Indonesia is an amalgamation of regulated prices and the market mechanism. The gas price is determined by the government as mandated in the Oil and Gas Law No .22 year 2001, based on proposed prices from the negotiation between producers and consumers. The government holds veto power on accepting or rejecting the price whenever it is considered violating its objectives; for instance; in case of extremely high prices. The general formula of the Indonesian gas price is as follows:

$$GP = H_{Go}\, x\, (1 + \alpha)^t + b \text{ crude price} + c \text{ price of commodity} \quad (1)$$

where GP is the determined gas price; H_{Go} represents the baseline price at years 0; α is the escalation factor to accommodate changes in economic growth (inflation) or oil prices as well as production decline; b is the linked coefficient to the price of crude oil; and c represents the linked coefficient of gas prices to consumers' commodity price, *i.e.*, carbamide or azane.

The Indonesian gas price was developed to serve both producers and consumers' interest. However, its implementation is quite problematic since the producers and consumers have different expectations. The producers will use the export price as their reference point to set the price; while consumers will do the opposite. If both parties are willing to adjust their price levels in such a way to meet at a point where both interests can be satisfied, then the deal is sealed. If otherwise, the government has the last word. The consumers' request for a low price is often supported by the government to protect the domestic market.

There are two different criteria used by the government to assess the business negotiation. First, the regulators ensure that the price degree will generate adequate state revenue to support economic development; which favor export options due to the higher prices. Second, the price should protect both producers' and consumers' interests [7]. In other words, the gas price must provide maximum income for the state and also be reasonable for local consumers. Predominantly, the government approves the modest gas price, which is set significantly lower than the liquefied natural gas (LNG) export price based on the international price benchmark. For instance, when the price at the spot market is USD 11/MMBTU, then the approved price by the government is determined somewhat lower than USD 11/MMBTU. This "low gas price for domestic consumers" can be considered as the market price as it reckons the producers' cost plus a margin. However, there is an opportunity cost for producers to have the gas sold to an exporter. This condition has implications: producers prefer to export the gas which is not favorable for domestic market development. If the government requires that most of the gas should be sold to the domestic market at this "low gas price" in the long term, it does not encourage investors to do explorations to find new gas fields.

The recent update of this conflicting situation is President Regulation 40/2016 that regulates the gas price for the certain industry is maximum USD 6/MMBTU. The implementation is rather problematic because the government has to keep the producer return remains constant to avoid arbitration for violating the contract and the only way to do this is by sacrificing government take. If the government has to reduce its revenue then as an exchange the industry should generate multiplier effect for national economy and shows that effect of gas price is substantial in their cost structure.

This paper is contribute to partially analyze the case, as it takes more macro approach to analyze the impact of gas price, with data limitation it is impossible to scrutinize the cost structure of each consumer or industry, hence, fertilizer and power plant was chosen as sample of analysis due to their significant gas consumption

Data series on gas prices between 2010 and 2016 had the trend of low gas price for various consumers and discrepancies amidst the domestic and international prices (Figure 1). The highest price refers to the export price, while the lowest price refers to the domestic price in years. The average price is the weighted average (WA)[3] of all gas prices that are traded at different price and volume, including the export and domestic prices, while average fertilizer and electricity prices were calculated as a weighted price in each sector.

Taking the example of the year 2008, the fertilizer and electricity sectors bought gas at USD 3/MMBTU and USD 3.9/MMBTU, respectively. As a comparison, the LNG price was USD 15.67/MMBTU. As long as the producers are allowed to sell a significant amount of gas for export, it would not be a problem. However, in conjunction with the growth of domestic demand, if the price disparity between domestic market price and investment cost is too high, it is improbable that the producers will sell the gas to local consumers.

There were cases where local buyers gave a signal to accept higher prices but were still at a level far below the export price. Moreover, the state-owned gas company (PGN) planned to raise the price by 50%, which was then responded with a rally from consumers in the industrial sector, even though the price was much lower than the export price.

If Indonesia wants to develop its domestic market, a price adjustment is necessary by pushing the domestic price as close as possible to the export price. The current WA of the price is at USD 4.19/MMBTU, and the export price is at USD 11/MMBTU [14]. Thus, there is a wide range of price adjustments. It is showed that the methodology of price determination needs to be revised; but what are the principles that should be used by the government? It is suggested that the government analyze the two perspectives: (i) macroeconomic analysis: analyzing the wide economic impacts based on the performance of macro indicators caused by gas price adjustment. [1]; and (ii) microeconomics analysis: measuring the price level that consumers are willing to tolerate [1].

Various studies showed that sudden price changes could seriously impact economic performance [15]-[17]. Hence, the macroeconomic impact analysis is necessary. Furthermore, the main gas consumers are industrial and electricity sectors with high linkages to other sectors. The microeconomic analysis calculates the willingness to pay for different consumers by evaluating the cost structures and setting up the ceiling prices among sectors. This analysis is out of the macro analysis scope, which captures the wide economic impacts of price adjustment; while at the micro level, the different cost structures will have different impacts. As an illustration, when the calculated average price is USD 4.19/MMBTU, a certain consumer buys the gas at USD 2/MMBTU, while others might already purchase at USD 5-6/MMBTU or even more without harming their profit.

The following section discusses the macro impact of different price levels and how they individually affect each sector in Indonesia. It elaborates on the economic theories to be applied in designing the Indonesian gas pricing. The CGE model is employed to assess the macroeconomic impacts, while the netback value concept is applied to analyze the impacts at the microeconomic level.

3. METHODOLOGY

3.1 Computable General Equilibrium (CGE) for Macro Analysis

The general equilibrium model is a model that describes market linkages for all goods and services in the economy [18]. It applies the general equilibrium concept to analyze resources' allocation [19]. The CGE is built upon the microeconomic foundation that analyzes the behaviors of individual agents. Households maximize their utilities by choosing a composite of goods that are subject to budget constraints.

On the other hand, firms want to maximize profits by selecting certain intermediate input factors that are limited by technology [20]. The price and quantity will be set up at the equilibrium point formed by producers and consumers' supply and demand functions [20]. The backbone structure of the model in this paper is constructed based on the static Australian Orani-G model. The structure of the model is shown in Figure 2. The selection of the CGE model for the macro analysis was based on its ability to evaluate the broad impacts of the policy on the overall economic growth, sectoral growth, employment, and energy consumption. The model was extensively used in policy studies in developing countries as it does not require substantial time-series data, which is mostly not available. CGE was applied in several studies on subjects such as energy, particularly energy pricing (see Aydin and Acar [21]; Lin and Jiang [22]; He *et al.* [20]; and Aydin and Acar [32]) as well as natural gas impact [11], [10]. To the best of the authors' knowledge, there is little or no research regarding the Indonesian energy policy, especially natural gas. Hutagalung *et al.* [12] and Hutagalung *et al.* [23] evaluated the effects of both natural gas allocation and infrastructure development policy on the Indonesia macro-economy with the CGE model. This paper covers an area of natural gas policy

[3] Weighted average is the sum of multiplying the gas price by its calorific value divided by the total calorific value of gas. For example, if there are two contracts, A with price USD 3/MMBTU and volume 10 MMBTU, and B with price USD 5/MMBTU and volume 2 MMBTU, then the weighted average is calculated by (3x10+5x2)/12 = USD 3.33/MMBTU.

that has not been analyzed, *i.e.,* pricing policy, aiming to fill the literature gap.

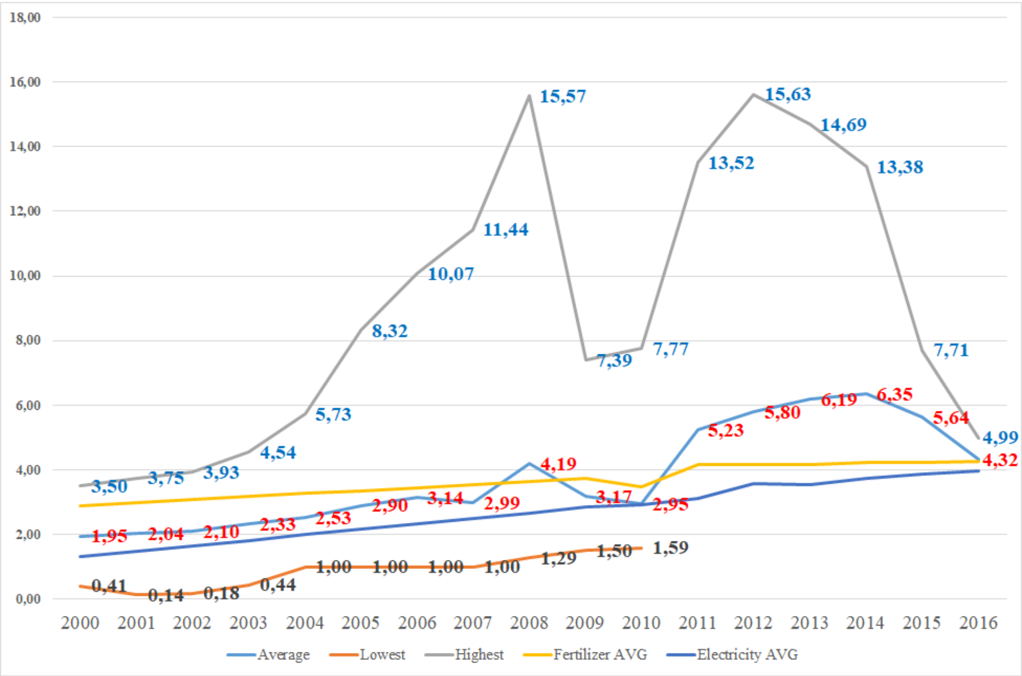


Fig. 1. Indonesian Natural Gas Price 2000-2016 (in USD/MMBTU).
Source: Ditjen Migas [14].

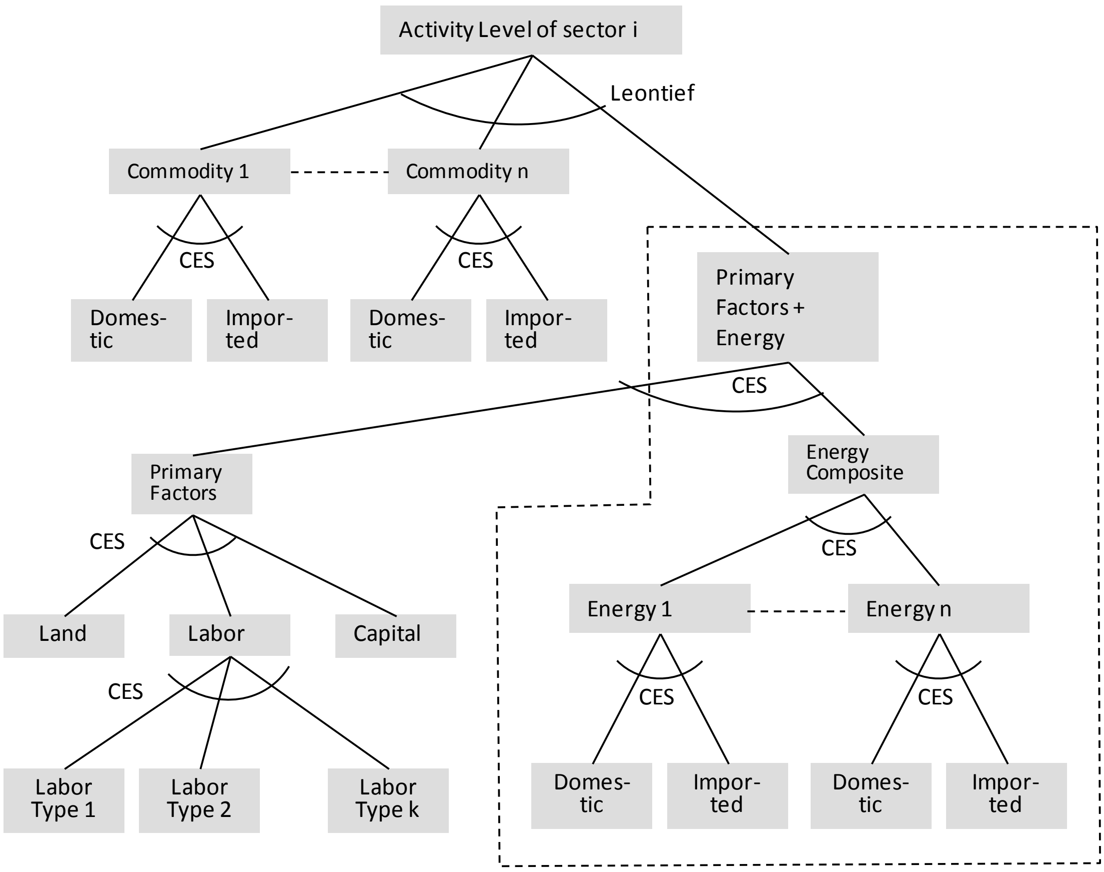


Fig. 2. The Structure of CGE Model.
Source: Yusuf and Resosudarmo. [24].

Closure

The CGE model needs some exogenous variables to close it (closure) because it commonly has fewer variables than the equation. Two closures are set in this paper, a short run closure and long-run closure based on capital mobility. In the short run, there is no capital movement or labor across the industry; while in the long term closure, an aggregate of employment and capital are set as exogenous and mobile across sectors.

Database of CGE Model: Social Accounting Matrix

The CGE model uses a Social Accounting Matrix (SAM) as its database. The SAM is a wide data framework of the economy, representing the economic structure of a nation. This paper adopts the 2008 Indonesia's SAM, which is the most updated table published by the National Bureau of Statistics. Previous studies used the earliest version of the Indonesian SAM and discussed both its validity and reliability [25]-[29].

Table 1 groups sectors in the Indonesian SAM used as a database for the CGE model.

The original SAM needs to be modified to fit the purpose of the study's simulation, energy-intensive sectors. Therefore, the energy nest, *i.e.*, coal, natural gas, crude oil, geothermal and mining, needs to be disaggregated; as well as petrochemical from refinery and electricity from public water and gas sectoral clusters, resulting in 44 economic sectors. The household types are also modified by aggregating them into a single type of household.

Parameters of the Model

This model uses the elasticity parameter called ''the Armington number'' that defines the degree of substitution across goods. Other parameters in the model are elasticity of value-added that determines the level of capital and labor substitutions, and the elasticity of export demand that expresses how to export commodities will respond to the changes in the international market. The values of the parameter in this study are taken from the GTAP database.

Table 1. Classification of the production sectors.

No.	Classification	Sector	Classification
1.	Food Crops	26.	Subsidized LPG
2.	Estate Crops	27.	Non-Subsidized LPG
3.	Livestock	28.	Liquefied Natural Gas
4.	Forestry and Hunting	29.	Subsidized Electricity (Electricity)
5.	Fishery	30.	Non-Subsidized Electricity
6.	Metal (Ore)	31.	Hydro
7.	Coal Mining	32.	Urban Gas
8.	Crude Oil (Crude)	33.	Clean Water
9.	Natural Gas (Gas)	34.	Construction
10.	Geothermal	35.	Trade and Storage
11.	Other Mining	36.	Restaurant and Hotel
12.	Food Processing (Food)	37.	Train
13.	Textile and Leather (Textile)	38.	Land Transportation
14.	Wood Processing	39.	Air-Water Transportation and Communication
15.	Paper, Metal and Other Industries (PMI)	40.	Supporting Services
16.	Petrochemical	41.	Bank and Insurance
17.	Bio-Ethanol	42.	Real Estate
18.	Biodiesel	43.	Public Services
19.	Other Refineries	44.	Personal Services
20.	Gasoline		
21.	Bio-Gasoline		
22.	Kerosene		
23.	High-Speed Diesel Oil (HSDO)		
24.	Bio HSDO		
25.	Non-Subsidized Gasoline		

Source: *Biro Pusat Statistik*/Central Bureau of Statistic (BPS) [33].

Simulation Scenario

The macroeconomic impact of pricing policy was analyzed with the static CGE model, through short and long run closures. The wage of formal employment was set to be exogenous. Capital and employment aggregates were exogenous variables for lengthy run closures. Several scenarios of price changes were simulated, the baseline of the simulation was the price of natural gas in 2008 (USD 4.19/MMBTU), which was the year of SAM table used in this paper. Table 2 showed all price scenario compared to the baseline. It should be noted that there was no subsidy scenario imposed in any scenarios of the model. The terminology subsidy coming out in the result section was related to the product price of the consumer utilizing natural gas, which was something that existed beforehand and was not part of the scenarios of this paper.

Table 2. Simulation scenarios.

	SIM A1	SIM A2	SIM A3	SIM A4	SIM A5
Percentage	34%	43%	55%	67%	91%
Price level	5.6	6	6.5	7	8

Source: Author's calculation

3.2 *Net Back Value Concept for Microanalysis*

The netback concept was formulated to set the maximum price to be paid by consumers for substitute goods. In the present paper, it could be interpreted as the maximum bearable gas price for consumers before their switching to alternative fuel [30]. The analysis of netback value was assessed at the micro-level coupled with the energy price to natural gas prices at the level of the production process [31].

The value of the netback for electricity and fertilizer could be computed in two different procedures based on a study by Ditjen Migas [13]. Due to the data limitation, the method used a simplified formulation of the net back by excluding the time frame and covering only the type of project.

Net Back Value for Electricity

The netback value for electricity was computed by examining the electricity tariff generated by gas fire power plant for various gas price scenarios and comparing to the electricity tariff generated by diesel power. The tariff of electricity was calculated as:

$$NBV = Fuel\ Cost + O\ and\ M + Tax \qquad (2)$$

Fuel and operational costs and taxes were assumed to be fixed and measured in USD for every scenario.

Net Back Value for Fertilizer

Capital expenditure (CapEx) and operation expenditure (OpEx) were set to be fixed in all scenarios of fertilizer netback calculation and measured in USD. The formula was as follows:

$$NBV = (Fertilizer\ Price - Capital\ Expenditure - Cost\ of\ Transportation)/Gas\ Utilization \qquad (3)$$

Capital expenditure referred to the capital investment of the fertilizer plant, while the cost of transportation was the cost to deliver the fertilizer to the consumer.

4. RESULT

The impact of price adjustment was simulated in various scenarios of price escalation relative to the price of natural gas in 2008. The highest price escalation was 91%, which was the closest to the export price. Macroeconomic indicators evaluated the short and long term impacts of different gas prices.

4.1 *Influences on Macro Indicators*

The effect of gas price escalation was recapitulated in Table 3. In the short run (SR), almost every macro indicator showed a downturn; while the impact was moderate in the long run (LR) due to the reallocation of capital and skilled laborers across sectors. However, the contractions in sectoral outputs declined the investment (see Figure 3 for details).

The household consumption decreased in every scenario and was consistent with the downturn in the employment level from which the household got income. The consumption refers to spending made by resident households to meet their everyday needs, such as food, clothing, housing (rent), energy, transport, durable goods (notably cars), health costs, leisure, and miscellaneous services. Nevertheless, all macro indicators showed a downturn below 1% due to the contribution of output expansion of the capital from intensive sectors such as oil and coal. It is worth noting that the terminology export in the macro indicator was the total exported commodity, not just natural gas.

Table 3. Macro indicators in the short run and long run (change in %).

Simulation/ Price Level	SIM A1 (34%) 5.6		SIM A2 (43%) 6		SIM A3 (55%) 6.5		SIM A4 (67%) 7		SIM A5 (91%) 8	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
Gross Domestic Product	-0.30	-0.13	-0.43	-0.22	-0.65	-0.41	-0.88	-0.61	-1.11	-0.81
Households Consumption	-0.23	-0.07	-0.34	-0.15	-0.56	-0.33	-0.79	-0.53	-1.02	-0.73
Government	-0.79	-0.66	-0.79	-0.78	-1.08	-0.90	-1.18	-0.96	-1.24	-1.01
Investment Demand	-0.23	-0.07	-0.23	-0.15	-0.56	-0.33	-0.79	-0.53	-1.02	-0.73
Export	0.77	0.67	1.05	0.92	1.52	1.34	1.97	1.76	3.28	3.59
Employment	-0.28	0	-0.34	0	-0.41	0	-0.46	0	-0.50	0

Source: Author's calculation.

The outputs of the intensive gas sector (electricity, petrochemical, PMI) declined by less than 2% because it was backed up by the subsidy policy (Figure 3). In the petrochemical sector, gas was used as feedstock, which was non-substitutable, explaining why it suffered the worst impact.

On the other hand, the high gas price had minimum impacts on the outputs of less gas-utilization consumers (*e.g.,* wood, textiles, and the food industry). The most non-gas intensive sectors, as presented in Figure 3b, suffered negative impacts caused by the gas price changes as consequences of the indirect effects induced by the gas-intensive industry. Overall, the impacts were better in the long term compared to the short term; as it enabled the movement of capital, leading to the transformation of the production structure.

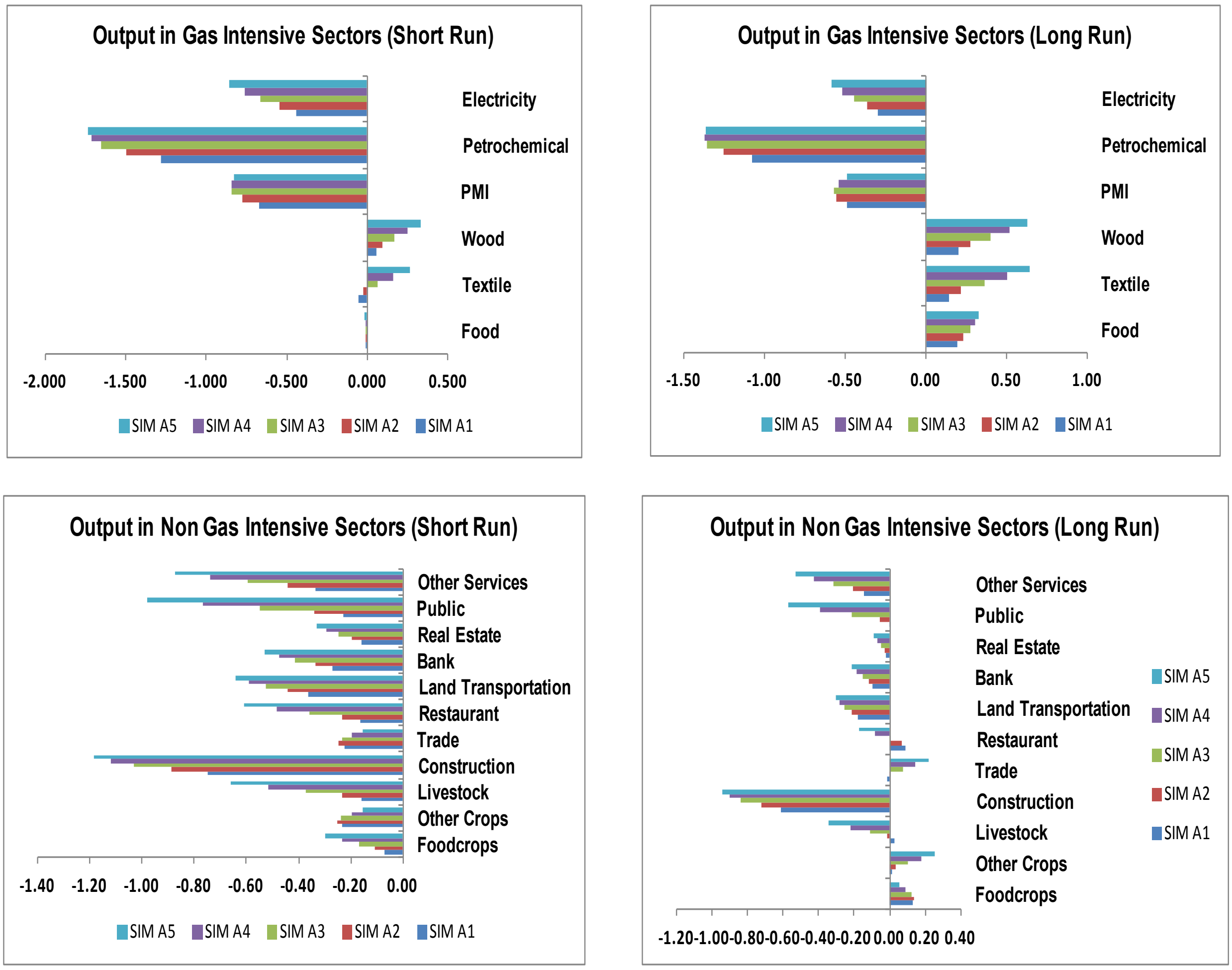


Fig. 3. Short-run and long-run outputs.
Source: Author's calculation

Surprisingly, the effects on employment were different from the sectoral outputs, as shown in Figure 4. Intuitively, the impacts were expected to be similar, where output shrinkage was followed by a cutback in employment. The simulation result revealed that the mentioned scenario did not occur in electricity, petrochemical, PMI, and other industries because of the subsidy effect (government subsidizes electricity tariff and fertilizer prices). Thus, the demand for these products is relatively unaffected by price adjustment. On the contrary, in the non-gas using sectors (regardless of the level of labor intensity), a downturn in outputs was followed by the employment cutback.

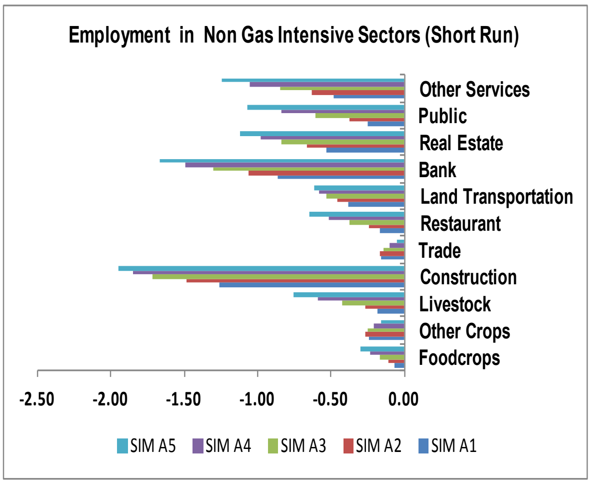
4.3 Net Back Value

The netback value aimed to find a reasonable price level for different consumer sectors by considering the cost structure. This method was used to calculate the fairest gas price for both the electricity and fertilizer sectors. It was assumed that producers sell gas directly to consumers, meaning that the gas price was net by excluding additional costs such as transportation and taxation.

Gas Price for Electricity/Power Plants

The electricity generation costs from the gas-fired station and diesel-fueled power plant need to be compared to estimate the value of the netback for power generation. Basic data costs such as operational and maintenance costs, and taxes, were taken from a study conducted by Ditjen Migas [13] applied for various gas prices. Assuming that all other costs were fixed, the cost to produce electricity with gas price ranging from USD 4/MMBTU to USD 9/MMBTU could be estimated. In each scenario, operation and maintenance, and tax were set as constant while the fuel cost (gas price) was raised by USD 1/MMBTU up to USD 9/MMBTU

Table 4 showed that when the gas price was USD 9/MMBTU, the cost of electricity generation was 12.2 cents/kWh. Producing electricity with the same cost from diesel-fueled power plant will need a high-speed diesel oil (HSDO) for USD 15.24/MMBTU [34].



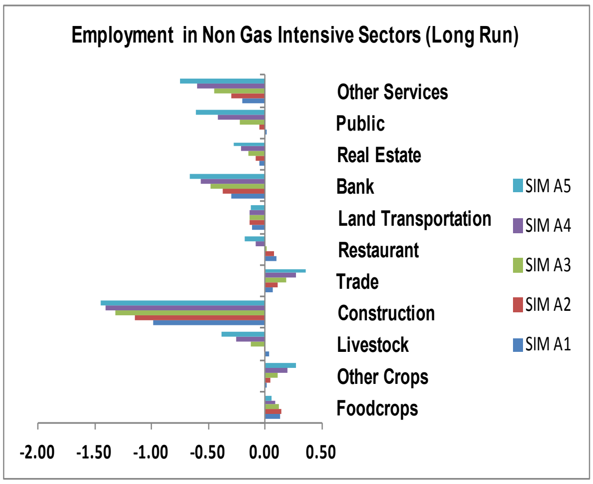


Fig. 4. Short-run and long-run employments.
Source: Author's calculation.

Table 4. Electricity costs of gas-fired power plant for different gas prices ($ cent/kWh).

Cost Comp.	Scen 1	Scen 2	Scen 3	Scen 4	Scen 5	Scen 6
Plant	1.8	1.8	1.8	1.8	1.8	1.8
Fuel (Gas)	4	5	6	7	8	9
O and M	0.8	0.8	0.8	0.8	0.8	0.8
Tax	0.6	0.6	0.6	0.6	0.6	0.6
Total Cost	7.2	8.2	9.2	10.2	11.2	12.2

Source: Ditjen Migas [7] (compiled by author).

Table 5. The net back value of gas in the fertilizer industry.

Cost Component	Scen. 1	Scen. 2	Scen. 3
Fertilizer price, $/ton	178	178	178
MMBTU gas/ton	25	21.4	14.87
CapEx and OpEx, $/ton	22	22	22
Transportation, $/ton	22.5	22.5	22.5
Net back	5.34	6.24	8.98

Source: Ditjen Migas [13] (modified by author).

This result indicated that USD 9/MMBTU was a tolerable gas price for the electricity sector, which was much higher than the current average gas price for electricity at USD 3.9/MMBTU.

Gas Price for Fertilizer Plant

The same approach could be used to calculate the net back price for the fertilizer industry. There were three scenarios, each of which simulated different gas consumptions through the fixing of all other costs (The same CapEx/OpEx and transportation cost). Next, the netback was computed based on consumption. A different method of calculation was used since fertilizer consumed natural gas as a feedstock and not as fuel. Therefore, there would be no comparison between fuel substitution prices as in the electricity case.

The input variable for netback calculation was gas per ton to produce fertilizer. It was assumed that an efficient fertilizer plant would consume gas ranging from 14 to 25 MMBTU/ton. A computation illustration of the net back value was as follows:

Gas utilization x Gas price + Capital expenditure + Transportation = Fertilizer price

25 MMBTU x Gas Price + USD22+USD22.5 = USD178

Gas price = (USD178-USD22-USD22.5)/25 = USD 5.34/MMBTU

As summarized in Table 5, the net back value for different gas intakes (21, 21.4 MMBTU/ton and of 14.87 MMBTU/ton) could be estimated through a similar formula. This approach showed that the more efficient the fertilizer production process, the higher the gas price could be with the same level of output. In each scenario, while holding the fertilizer price constant, the price of the gas will vary depends on the efficiency of the fertilizer plant. The more efficient the plant the less gas consumed that lead to higher gas price affordability for the same level or fertilizer price.

This analysis revealed that the netback value of fertilizer fell within USD 5.34/MMBTU to USD 8.98/MMBTU. As a comparison, on average, the gas was sold to fertilizer industry at 4.16/MMBTU, which could be considered too low and adjusted to USD 8.98/MMBTU without affecting the cost structure.

4.4 *Energy Consumption*

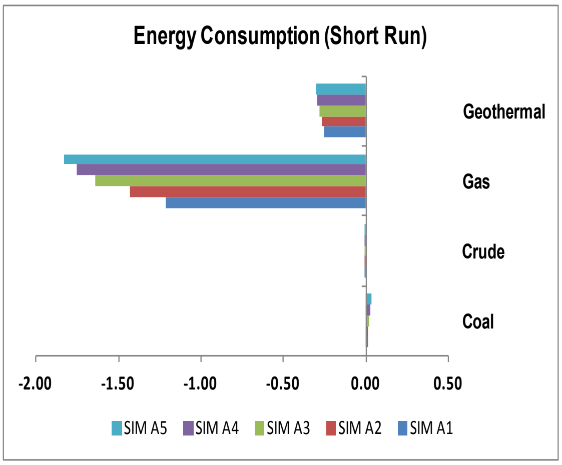
Energy consumption was interchangeable so that changing the price in one energy commodity could affect the consumption of other energy commodities depending on the elasticity of the substitutions among energy commodities. The result showed that both energy consumption and energy intensity declined less than 1% (Table 6 and Figure 5) in both the short and long runs, indicating that gas utilization was substitutable or at least limited substitution to other energy sources.

Gas suffered the most as the impact of price hike with a 2% decline in consumption (Figure 5). Coal consumption increased due to the spillover effect from gas, but none of it shifted to geothermal, indicating that this sector was not competitive for gas. Geothermal was used as the primary energy for power plants. This result showed that even with the price hike, gas was still more favorable for electricity production

Table 6. Energy consumption and energy intensity.

Simulation	SIM A1 (34%)		SIM A2 (43%)		SIM A3 (55%)		SIM A4 (67%)		SIM A5 (91%)	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
Energy Consumption	-0.30	-0.13	-0.43	-0.22	-0.65	-0.41	-0.88	-0.61	-1.11	-0.81
Energy Intensity	-0.23	-0.07	-0.34	-0.15	-0.56	-0.33	-0.79	-0.53	-1.02	-0.73

Source: Author's calculation.



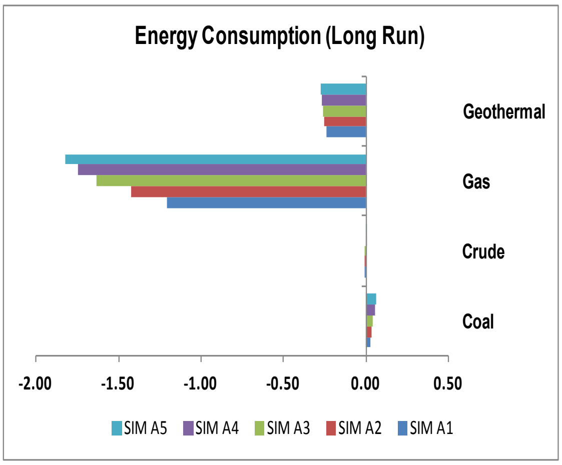


Fig. 5. Short- and Long-Run Energy Consumptions.
Source: Author's calculation.

5. DISCUSSION

In the previous section, it was suggested that gas price should be adjusted approximately from USD 4.19 to USD 11/MMBTU, representing the average domestic price and export price, respectively. The macroeconomic analysis indicated that a price increase was possible without harming the economy or the outputs of the industrial sectors; even if the price was adjusted up to 91% of the current price or equivalent to USD 8/MMBTU. This study selected a moderate scenario where 55% price adjustment (USD 6.5/MMBTU) was set as the floor price or the lowest gas price in every negotiation contract.

Apart from the wide impact analysis, the microanalysis was carried with the netback value. Putting the results together, the structure of the Indonesian gas price could be modified, as shown in Figure 6. With the LNG price at USD 11/MMBTU and an average domestic price at USD 4.19/MMBTU, the macro-analysis had room for price maneuver up to USD 8/MMBTU. Taking into account the cost structure analysis (netback) for fertilizer and electricity, it was possible to determine the gas prices, even at the highest level, being USD 8.98/MMBTU and USD 9/MMBTU, respectively.

Each consumer had a different type of cost structure; hence, different ceiling price should be applied. The ceiling price was not the maximum price that could be imposed, which was an indication of the maximum price that consumers were willing to pay. Referring to the electricity case with the netback value at USD 9/MMBTU and the current price (average of all sectors) at USD 4.19/MMBTU, it was still reasonable for the power generation sector to purchase the gas up to USD 9/MMBTU. In addition to the result of the macro analysis that set the floor price at USD 6,5/MMBTU, there was still a wide range of price from USD 6,5 to USD 9 to adjust the price for particular consumers.

Natural gas pricing framework with floor and ceiling price rule alongside with price differentiation for a segmented consumer is not uncommon. The government of Nigeria divided the consumer into three groups, strategic domestic sector, strategic industrial sector, and the strategic commercial sector where this segmentation is based on the different demand sectors have different strategic benefits to the country and different pricing considerations, thus require different pricing considerations [35].

Furthermore Omisakin *et al.* [35] also elaborate that consumer group corresponding to three different approaches for determining the floor price that is determined based on the cost of supply basis (regulated pricing regime), product netback price basis and (pseudo-regulated pricing regime), alternative fuels basis (market-led regime). Another study on the natural gas price by Aolin and Qing [36] proposed reform on the China gas pricing regime by introducing price structure for different consumer and the price is linked to the price of alternative energy (netback).

The aforementioned study uses a similar approach with Indonesia in terms of developing the conceptual pricing framework. The proposed concept about ceiling and floor price in Indonesian gas price is derived from LNG pricing formula, where it serves as protection for both producer and consumer [37]. The floor price will protect the producer to be guaranteed a certain minimum price, while the consumer is guaranteed a maximum price of gas. However, the essence of this paper is how this price setting is taking into account the wide impact on the national economy instead of focusing only on the particular consumers.

The issue of energy price is quite sensitive in Indonesia [1], hence the decision to increase the price should be considered carefully, not only the nominal of the price but also the implementation of the policy; whether or not the price is adjusted gradually or swiftly; whether or not it is politically feasible to impose a high price to certain sectors. However, these concerns are out of the scope of the paper.

The concepts and approaches proposed in this paper are expected to be used as theoretical guidelines for the regulators in deciding the gas price. However, there were few constraints such as a simplified methodology for the netback value; and also, the reliability and validity could be improved with better data. It is worth noting that other factors, such as the impacts of pricing subsidies and state revenue, need to be taken into consideration in the Indonesian gas pricing policies. Implementation of scientific and reasonable pricing mechanism of natural gas is not easy and need step by step improvement [36].

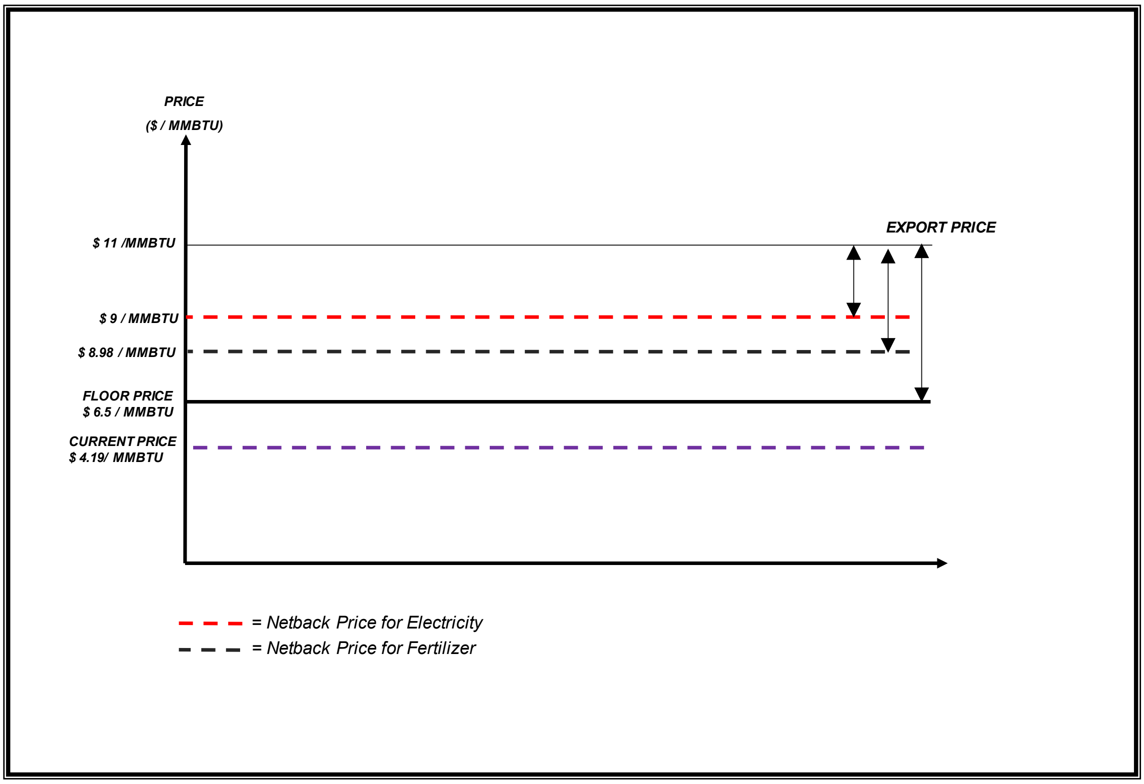


Fig. 6. The proposed price structure based on macro- and micro-level analysis.
Source: Ditjen Migas [18] (modified by author).

6. CONCLUSION

The oil and gas law mandates the government to regulate the price. However, there are some challenges. On the one hand, the government must ensure the availability and affordability of energy; but on the other hand, there are potential drawbacks such as the disincentive of gas producers, and a contra-productive condition in promoting energy efficiency. A clear gas pricing policy is needed; more precisely, a guideline in the pricing mechanism. The fundamental problem was to accommodate both producers' and consumers' interest, which was then reflected in the determined price.

This paper proposed macro and micro analyses of price decisions. The CGE model was applied to asses the aggregate impact on the optimal domestic gas price at the macro level as well as the sectoral impacts of a gas price increment. Meanwhile, the netback value was analyzed at the consumer level. Combining these two approaches enabled this paper to quantitatively set the range of prices that served multiple objectives based on several parameters used as an indicator for acceptable results. The main results are summarized as follows:

a. The macro analysis result revealed that macroeconomic indicators such as gross domestic product (GDP) growth, employment level or household consumption shrinkage were within the acceptable range (less than 1%), while the sectoral output of intensive gas sectors declined less than 2% and for less gas consumer it was even lower, especially in the long term. Based on this result, the gas price could be adjusted to USD 8/MMBTU, setting the floor price or the lowest acceptable level of gas price.
b. The netback value with the cost structure analysis provides the ceiling price, which varies for a particular gas consumer, which depends on how significant gas price in their cost structure. For electricity, the ceiling price is USD 9 /MMBTU while it is USD 8.98/MMBTU for a fertilizer plant. This ceiling price was an indication of the consumers' willingness to pay the maximum price considering their cost of production.
c. Energy consumption analysis indicated that there was a spillover effect from gas that increased coal consumption. However, the number was not significant due to the inelastic use of natural gas as the electricity sector is the only sector that could easily change to other energy sources.

In conclusion, it is possible to adjust the gas price in Indonesia without negatively affecting the economy. There were limitations to this study. For instance, the static model was used, not taking into account the dynamic efficiency effects. This paper only focused on the upstream gas price. Further study can be expanded to cover the analysis of the impact and downstream segment of the gas market.

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