POLICY ANALYSIS OF PETROLEUM INDUSTRY IN INDONESIA

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Abstract.

The role of oil has been traditionally dominating the economic development in Indonesia since the country launched its first national development program in 1969. Now with the increasing domestic oil demand and the dwindling oil reserve in the country, the future prospect of oil supply is quite alarming. Natural gas which emerges to take part of oil role has not gained substantial market in the domestic market, although export shows a promising figures. This paper is endeavoured to analyze the policies in oil and gas sector to help decision maker formulate his policy to get the most achievement of his objectives.

1. Petroleum Industry in Indonesia.

Oil industry is an old industry in Indonesia, dated back to 1871, 12 years after Colonel Drakes spudded his wildcat in Pennsylvania. The first oil well was drilled in Sumatera, and commercial oil production started in 1885. Following the Indonesia's independence in 1945, nationalization of foreign companies was underway. Now there is only a single state oil company, i.e. Pertamina, on behalf of government, running the whole oil and gas industry in the country. In the upstream part (exploration and production), Pertamina employs private companies, mostly foreign companies, to carry out the activities under production sharing agreement.

Natural gas gained recognition for its commercial use when the fertilizer plant was put on stream in 1963. Prior to that, gas wells were abandoned and the associated gas which comes out accompanying oil production was used for field operation in a very small amount, and the rest was wastefully flared. The role of natural gas got its real impetus in 1977 when the first tanker was shipped to Japan carrying LNG of 28 TBtu. Since then the volume of LNG shipment abroad was increasing under long term contract, usually around 20 years, with wider market : South Korea, Taiwan, and, in this near future, Singapore.

Oil has long been playing three roles in Indonesia's economy, i.e. (i) as main energy supplier for domestic use (ii) as potential source of government revenue, and (iii) as major foreign exchange earner. As a new emerging non-oil energy alternative, natural gas production has been increasing very rapidly and is expected to become a partner to oil in sharing the roles.

The Problems.

Indonesia traditionally depends on oil for its energy supply, accounting abaut 66% of the commercial primary energy in 1985. The increasing demand caused by the economic development and need for export earning have created problems of multi facet. First, the high production, which at present the country produces at full capacity, will lead to rapid reserve depletion. Second, the conflicting objective of providing energy to the domestic users and export to collect foreign exchange needs to be reconciled. Meanwhile there are coal and natural gas and other energy alternatives that have not been fully utilized. If coal and gas, the strong candidates for oil substitutes, can be brought into domestic market then most of the problem can be solved. Other alternative solution is to boost the hydrocarbon exploration to strengthen the oil supply side. Utilization of the opportunities needs a comprehensive and clear policy set up. This study is an effort in helping the decision maker (i.e. government) formulate the policies which can appropriately manage the oil and gas industry in line with his or her objectives. A model representing the oil and gas sector is developed as a tool for the policy analysis.

2. Policy Formulation.

First step in formulating the policy is to identify the objectives of the decision maker (i.e. government), and select the indicators to assess the achievement of the objectives. Policy instruments are then selected as a base for the formulation of policy alternatives. Followings are the brief framework of the policy formulation.

The Objectives.

This paper identifies and sets the followings as the main objectives of government in managing the oil and gas sector :

- To provide energy for the domestic use for the short-run as well as for the long-run demands.
- To provide a reliable income generator to the government from both domestic sources and foreign sources (export).

Performance Indicators.

The indicators used in this study to evaluate the policy performance include :

a. Production to domestic consumption ratio (PCR).
   PCR indicates the capability of the supply side in meeting the demand. Oil PCR higher than one tells that the oil production is in access for export after meeting the domestic demand. Oil PCR lower than one indicates that oil import is carried out to fill the deficit oil consumption in the domestic market.
b. Government revenue.
c. Trade Balance.
   The national trade balance is very much determined by the oil and gas trade balance. The traditional role of oil and gas export is to compensate the poorly deficit non-petroleum trade balance in the country. Higher net export value of oil and gas indicates better performance.

Policy Instruments.

To implement its policy, government needs tools that can be used to control the performance of oil and gas sector so that it will behave according to its interest. The policy instruments held by the government in managing the oil and gas sector as examined in this study include :

a. Setting the profit sharing.
   Production sharing, the splitting of oil and gas profit between government

and the operating companies, is negotiated before the companies start exploration or when the contract will expire and is to be extended. Government has full authority to set the production sharing, while the contractors converts the production sharing figure into ROI (return on investment) based on expected future hydrocarbon price. This ROI determines the companies commitment in exploration and production expenditure. Investment on exploration is very risky so the companies tend to minimize it. Lower ROI leads to less spending on exploration that companies will commit, and vice versa. Through this instrument (of determining the production sharing), government has an access to manage the exploration activities. Exploration is of course needed to discover new hydrocarbon fields to replenish the extraction of proven reserves.

b. Control on production.
Government directly controls the oil production; it can curtail production at the expense of export, for example, if future supply for the domestic use is deemed to be endangered by current production level. Similar exercise can also be applied to gas production, but the chance of curtailing gas production is unlikely. Instead government tries to increase production by opening wider market for gas.

c. Control on domestic oil and gas pricing.
This is basically a demand management for oil and gas since demand responds directly to the price. Government can set the domestic price lower than international price by providing subsidy to boost the domestic demand, or press the demand by cutting the subsidy. In this study, subsidy is calculated from crude oil or gas purchased by the processing plants at export price minus the crude oil or gas purchased at the prevailing prices. Cheap oil from "domestic obligation" (a certain amount of oil production which must be allocated for domestic use by the oil producing companies, and is compensated with US$ 0.20 per barrel by the government) is considered as subsidy. In the case of oil, government plans to curb the subsidy due to the rapid growth of demand and worsening oil reserve, while for gas, the subsidy is still given to boost the domestic market. To some extent, this subsidy instrument can be used to penetrate gas into oil market to ease the pressure on oil demand. Price alone is not sufficient to influence the market. For goods like oil and gas, infrastructure is needed to access the market. In transport sector, for example, lowering CNG (compressed natural gas) price will not effectively increase the CNG sale nor decrease the gasoline sale if the number of CNG-filling station is not increased and car production does not switch to CNG-consuming cars. Thus, government can use the instrument of apportioning the energy use among the consumer to manage the demand by providing the market access. By providing more CNG-filling stations and passing the law which discourages the production of gasoline-run cars and encourages the production of CNG-run cars, growth of oil demand can be eased and gas market will widen.

Formulating the policies.

To identify the influence of the policy parameters upon the system behaviour, a certain combination of policy and strategy is picked up as a base policy package and an experimentation is carried out. The behavioral pattern produced through model simulation becomes a reference. The other policy packages are formulated by copying the base policy package and changing only one parameter, and experimentations are then carried out. The results are compared to the output of the base policy package which is used as a reference, and the differences of the behavioral patterns show how the change of policy can

affect the system's behaviour.

Coyle (1985) defines policy as a process of linking the policy instrument to other parameter(s) in the model, while the quantitative measure of the linkage is defined as a strategy. An indicative parameter (indicator) of the future supply capability is reserve to production ratio (RPR, unit in year). This parameter which is addressed in many papers, such as : Banks (1977), Moeseke (1988), and Parhizgari (1987), will be employed in policy formulation. A "safe" oil-/gas RPR is introduced as a mark point of the strategy set-up which indicates how long the country is given time to switch to other energy alternatives, or to accumulate (through exploration) the oil-/gas to the desired level. For example, the "safe" RPR which is taken 18 years for both oil and gas cases in this study, implies that the country needs 18 years to accumulate energy stock at desired level to replace the current oil/gas which supply is anticipated to cease 18 years later.

Experimentation on the following policy options are conducted in this study. The terms of policy package will be used interchangibly with policy in the next discussion.

Policy 1 (Base Policy).

a. The oil and gas profit sharings are set fixed at 15% and 40% respectively in favour of government.
b. Oil and gas production is to meet the demand.
c. Subsidy on crude oil is given fixed 20% of the international price.
d. Gas subsidy is discriminated by consumer type as follows :
   - fertilizer plants 70%
   - non-fertilizer petrochemical industry
   - other industry industry 30%
   - LPG plant (for domestic use) 20%
   - power utility 20%
   - household sector 20%

   Gas subsidy in this case is defined as the fractional reduction of gas price charged to the consumer as compared to the gas export price.

Policy 2.

As the Base Policy, except oil and gas profit sharings are allowed to vary with oil and gas RPR respectively. Company's share on oil profit varies from 15% up to 40% corresponding to oil RPR of 30 and 15 years respectively. On gas profit, company's share varies from 40% up to 60% corresponding to gas RPR of 50 and 10 years respectively.

Policy 3.

As the Base Policy, except oil and gas production is limited by the "safe" production rate. This "safe" production rate corresponds to the "safe" RPR of 18 years. This implies the maximum oil and gas productions of 5.6% of their proven reserves.

Policy 4.

As the Base Policy, except oil subsidy is linked to the oil RPR. Subsidy starts at oil RPR of 20 years and increases up to 60% at oil RPR of 10 years. As a mark point, subsidy of 30% corresponds to the oil RPR of 15 years.

Policy 5.

As the Base Policy, except gas subsidies to non-fertilizer plant vary with the gas RPR. Subsidy starts at gas RPR of 20 years and increases up to 60% at gas RPR of 10 years. As a mark point, subsidy of 30% corresponds to the gas RPR of 15 years.

Exogenous to the model are the economic (GDP) growth, and oil price. GDP growth is set at 7%, a slightly higher than government's plan (6.5%). Oil price is scenarioed at US$ 25 per barrel. The planning horizon for the simulation-run covers period of 25 years, from 1985 to 2010, but the switches from the Base Policy to other policy alternatives starts in 1988.

3. The Model.

Studies on dynamic modeling of oil and gas supply have been done by some scolars. See, for examples, Naill,R.F. 1979, Behrens III,W.W. 1979, Elmaghraby, A.S. 1982, and Choucry,N. 1989. While they adress in single commodity, i.e. oil or gas only in the model, this paper identifies the strong interaction between the two. Since for Indonesian case gas is becoming more important as oil substitute in both supplying energy and as export commodity, the model is developed to cover both oil and gas.

Figure 1 shows the causal-loop diagram of the model. The dashed lines indicate the embeddiment of policy in the model. A single negative loop is identified from the figure (loop 1) which indicates an equilibrium seeking system. Since the undiscovered HC (hydrocarbon, i.e. oil and gas) resources are depletable, the system tends to perform a declining activity.

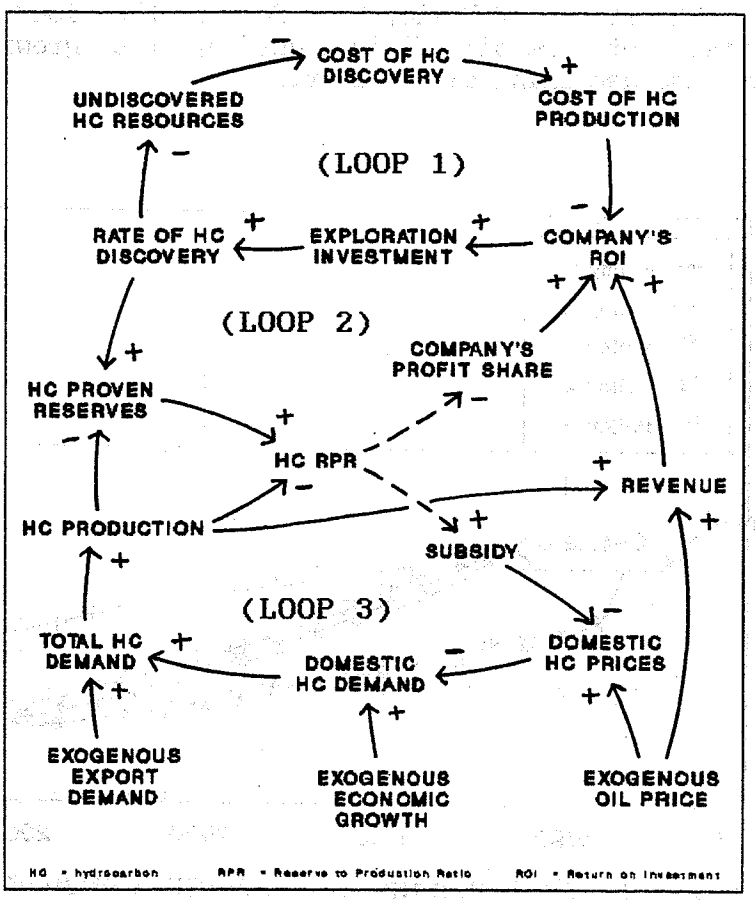

Figure 1. Causal-loop Diagram of The Oil and Gas Sector

The exogenous factors working on the system will greatly affect the system's performance. Employing policies on profit sharing determination as linked to the HC reserve to production ratio, a second negative loop (loop 2) is generated. This policy is intended to mitigate the long-run effect of dwindling undiscovered HC reserves, and to absorb the destabilizing effect of the exogenous parameters. Policy of subsidy as linked to the HC reserve to production ratio also creates another loop (loop 3) which checks the demand side.

4. Results and Analyses.

Oil production to domestic consumption ratio.

Figure 2 shows the oil PCR performances. Under the Base Policy, the country will cease oil export in 2001 as indicated by oil PCR (production to domestic consumption ratio) which drops down to one, and begins as a net oil importer since then. Other policies give somewhat similar pattern, except Policy 2 and Policy 3. Under Policy 2 which links the oil profit share to the oil RPR, the oil reserve can be successfully maintained. The country can still export the oil albeit with declining volume till the end of planning horizon. Policy 3 performs the worst condition as compared to the other policies since it leads the country into early oil import in 1997. To maintain the oil reserve, the policy curtails oil production and takes consequence of importing oil to fill the oil shortage in domestic market. It is noticable in the figure that in the short-run the implementation of Policy 3 directly affects the oil export, while the effect of Policy 2 is felt in the long-run. The overall declining pattern of the oil PCR is caused by the growing domeestic oil consumption and the declining oil production.

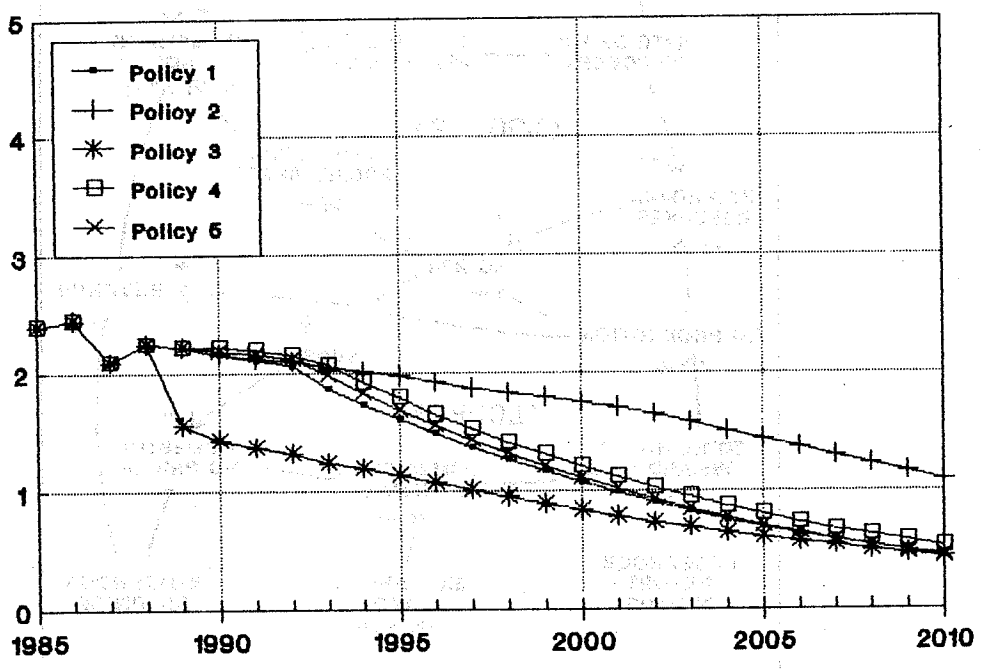

Figure 2. Oil Production to Domestic Consumption Ratio

Gas production to domestic consumption ratio.

There is no substantial effect imposed by the implementation of different policy alternatives on the gas PCR as shown in Figure 3. Policy 5 which links the gas subsidy to the gas RPR, shows a small deviation from the base policy performance due to the higher gas consumption in the domestic market as a result of subsidy provision on gas usage. All gas PCR curves are far above one, indicating that production can easily meet the domestic demand, while gas export is still carried out. The declining pattern of gas PCR is caused by the increasing gas domestic consumption and constant export volume.

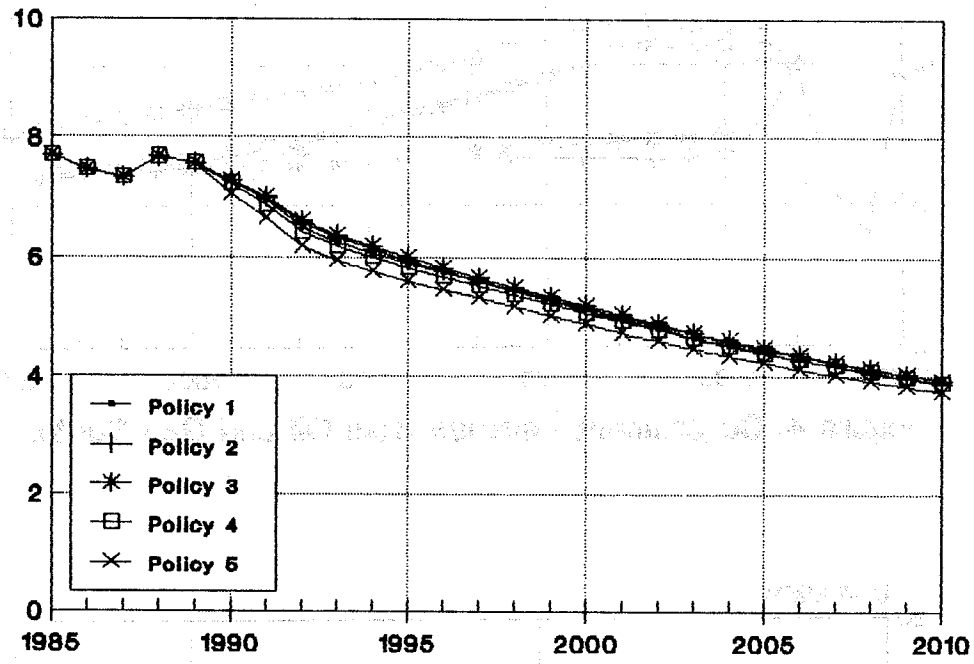

Figure 3. Gas Production to Domestic Consumption Ratio

Government Receipt from Petroleum Industry.

Figure 4 depict the government receipt from oil and gas sector for different policies implementation. The revenue squeeze in 1986 was caused by the fall of oil price down to US$ 14 per barrel. Under the Base Policy the government revenue increases and peaks in 1992, and then declines for the rest of the period. The peak point of the revenue also reflects the peak of oil production. Policy 2 which links the oil profit share to oil RPR, shows a poor performance in collecting revenue to the government due to higher oil profit share is given in to the companies. Government revenue from oil is mavh higher than from gas, therefore the pattern is much influence by the government revenue from oil. Comparable to Policy 2 is the Policy 3 which limits oil production at the safe oil production. The drop of oil production after the implementation of this policy leads to drop of government revenue. Policy 4 which links the oil subsidy to oil RPR, practically abolishes the subsidy due to the condition of already low oil RPR. Higher oil price does not necessery reduce the domestic consumption since domestic demand is insensitive to the

price. The subsidy squeeeze will of course increase government revenue.

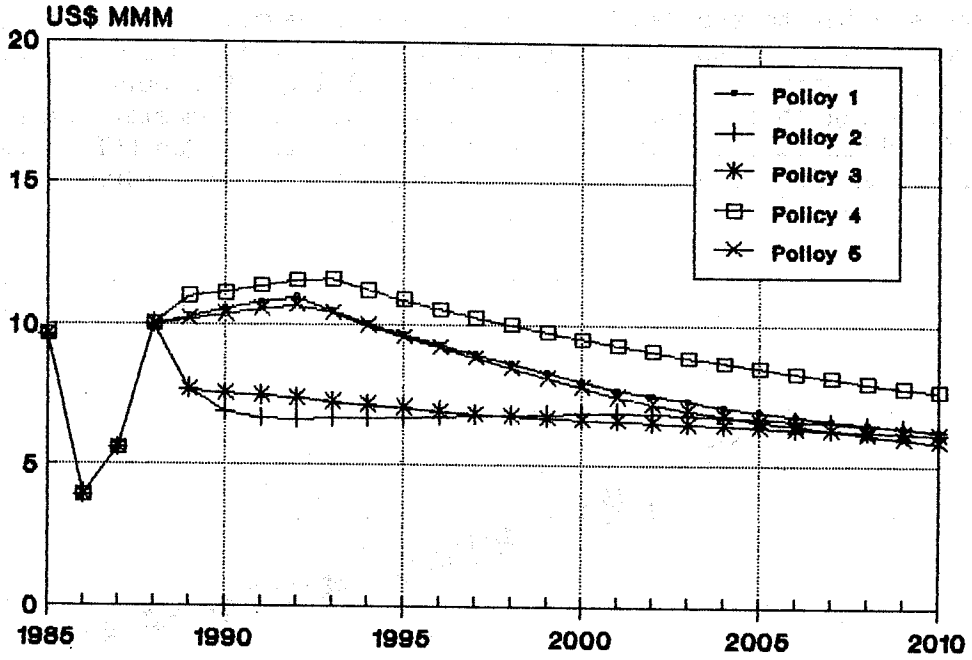

Figure 4. Government Revenue from Oil and Gas Sector

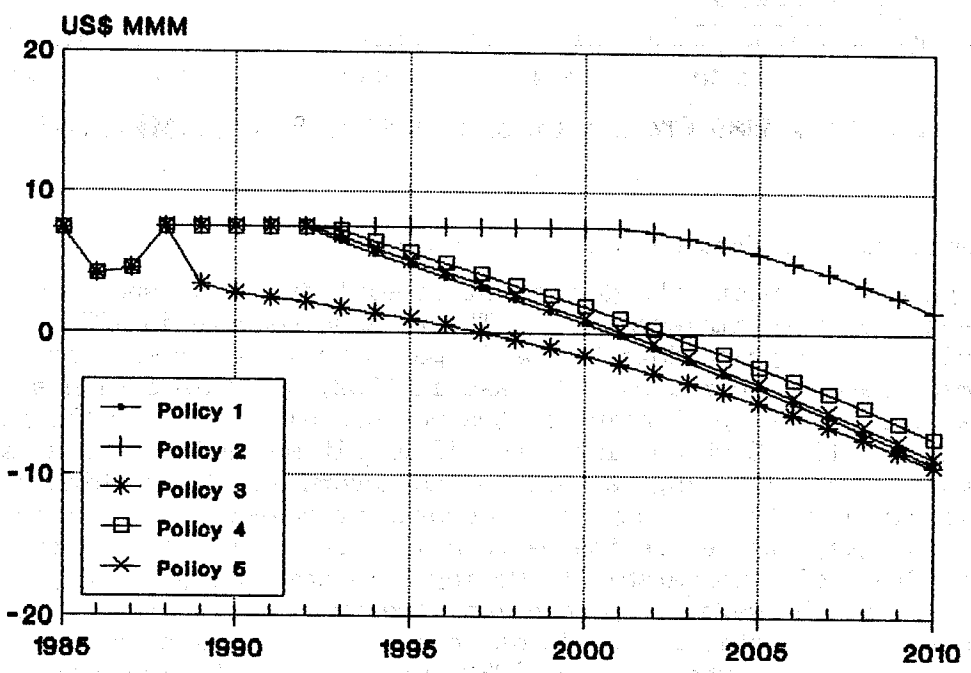

Figure 5. Oil and Gas Trade Balance

Oil and Gas Trade Balance.

The oil and gas trade balance performance is depicted in Figure 5. Although under the Base Policy the country becomes a net oil importer in 1995, the oil and gas trade balance dips to negative figure later in 2001, due to natural gas export. Policy 2 shows the best performance due to its superioroity in maintaining the oil reserve; the trade balance is still positive at the end of simulation. Other policies are somewhat similar to the Base Policy, but Policy 3 shows the worst performance. For the sake of oil stock maintainance, production is curtailed leading to premature oil import to meet the domestic demand.

5. Conclusion and Remarks.

Based on the objective of maintaining the domestic oil supply reliability, Policy 2 shows superiority among the other policies. In the case of gas which stock is relatively abundant, all policies give indifferent performances. Policy 2 also performs the best balance of trade. However in regard to the government revenue, Policy 2 together with Policy 5 give a frustrating figures. Linking the oil subsidy to the oil RPR as adapted under Policy 4, would give the most contribution to the government vault.

From the results of the policy experimentation above, it is concluded that the selection of policy instrument depends on the objectives to be pursued. One policy may produces the best performance in one attribute, while in other attribute different policy gives better results. Combination of policy instruments should be employed in formulating the policy so that a desired performance can be approximated, although compromizing different and, sometimes, conflicting objectives is not an easy task.

Sensitivity analysis to observe the oil price effect on the behavioral pattern under the implementation of the policy alternatives can also done using the model by changing the oil price scenario. Due to time and space limitation, that can not be covered in this presentation.

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