DEVELOPMENT OF PETROCHEMICAL INDUSTRY IN INDONESIA : A POLICY EXPERIMENTATION

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Abstract.

This paper analyses the roles of key policy measures for the development of petrochemical industry in Indonesia based on indigenous oil and gas resources. Policy experimentation for the petrochemical industry development is carried out through a simulation model of the industry. The results show that a combination of policy instruments is needed for achieving the various objectives and that the performances of policies can vary widely between the short-run and the long-run.

1. Introduction.

The development of petrochemical industry in Indonesia is receiving an increasing attention in the overall industrial development strategy of the country in the recent years. Indigenous petrochemical industry development is considered important in improving the trade balance of the country and to accelerate economic growth. In 1987, the imported petrochemicals was accounted for about 4% of merchandise imports (BPS,Statistics of Indonesia 1987)

Along the chain of petrochemical industry (PI), the downstream PI such as plastics, synthetic rubber, and fiber industries are already well established, while the upstream PI are not yet sufficiently developed. As a result, a large amount of petrochemical feedstocks are still imported despite the fact that the country has a number of favorable conditions (e.g. availability of oil and natural gas, a large domestic market for petrochemical products, and having experiences in operating hydrocarbon industry) to build an integrated petrochemical industry.

The development of PI, however, is faced with the shortage of domestic capital. The inflow of foreign capital, thus becomes a key determinant for the development of the industry. The level of foreign investment and collaboration, however, depends on the government policies relevant to the industry in general and the incentive schemes in particular.

This paper analyzes the implications for PI development of major policy instruments, that consist of subsidy on naphtha and gas feedstocks, and tariff on imported products. A simulation model is developed for the purpose of policy experimentation.

2. Policy Formulation.

Major objectives in the design and analyses of policies for development of PI in Indonesia are related to (1) market development for petrochemicals, (2) integration of the industry from upstream to downstream, (3) reducing import dependence and improving trade balance in petrochemicals, and (4) PI's contribution to government revenue.

The evaluation of alternative policies in relation to these objectives requires a set of performance indicators. The effect of a policy set on market development is evaluated in terms of total supply value of petrochemicals which is expressed as the total value of imported-, and domestically produced petrochemicals at international market prices (International market prices are used here to eliminate the effects of import tariff and other taxes on total supply value).

The level of PI integration that can be achieved under a policy is assessed in terms of the capacity of olefin plants that could develop under the policy. The import share in total supply value of petrochemicals is used to measure the level of import dependence while the collection of sales tax, corporate taxes, and import tariff measures the total contribution of the industry to government revenue.

Three policy instruments that are considered in the present study are : (i) import tariff on petrochemical products, (2) subsidy on gas feedstock, and (iii) subsidy on naphtha feedstock. The feedstock subsidy is defined as the amount by which the export price of the feedstock exceeds the domestic price.

Policy Alternatives.

In this study, the Base Policy is mostly based on the current practice of the government in managing the industry. The corresponding behavioral pattern simulated by the model is treated as the reference for analysis of alternative policies. Other policy packages are formulated similar to the Base Policy, except that one policy is changed at a time. The behavioral pattern corresponding to each policy package is then compared to the reference pattern to see how a particular change in policy could affect the system's behavior. The following alternative policy packages are considered in the present study.

Policy 1 (Base Policy).

a. Normal tariff of 20% is imposed to all chemical product imports. This was the average chemical import tariff prevailing in the country in 1988 (BPS,Financial Statistics,1988).

b. No naphtha subsidy to olefin plants.

c. A natural gas subsidy of 30% to olefin and methanol plants. This is also the current rate of subsidy for methanol plant. Fertilizer industry in the country is totally protected in that no import of fertilizer is allowed to the extent that the domestic plants can meet the demand. In the model, a very high tariff on imported fertilizer is imposed if domestic plants are capable to supply, and there is no tariff in the event an import becomes unavoidable due to insufficient domestic production.

Policy 2.
It is the same as Policy 1, except that the naphtha subsidy to petrochemical sector varies with the share of aggregate import value. A subsidy is given if the aggregate import share is 10% or above. The rate of subsidy increases with the aggregate import share of chemicals. The maximum rate of subsidy is 60% for the aggregate import share of 80% or above.

Policy 3.
It is the same as Policy 1, except that the gas subsidy to petrochemical sector varies with the share of aggregate import value. The subsidy varies from a minimum of 30% to a maximum of 80%. The maximum level of subsidy is given when the aggregate import share of petrochemical product is 80% and above.

Policy 4.
It is the same as Policy 1, except that tariff on individual chemical import varies with the share of individual chemical import value. Tariff varies from 20% to 200% of gas export price. The maximum tariff of 200% is applicable when import share is 80% or above.

There are several exogenous parameters in the model, i.e. : chemical export demand, economic (i.e. GDP) growth, and oil price. GDP growth is set at 7% per annum, a slightly higher than government's plan which is 6.5% (Kompas. 1989). Oil price is set at US$ 25 per barrel. The period for simulation-run is 25 years, from 1985 to 2010. Policy-switches from the Base Policy to other policy alternatives are set to take place in 1988 in this study.

3. The Model.

Figure 1 shows the causal-loop diagram of the model. The dashed lines indicate the policies of how the import tariff and subsidy on feedstocks (naphtha and gas) are determined, i.e. by linking them to the aggregate chemical import share. Import tariff is determined in response to the level of individual chemical import share which in turn affects the domestic chemical prices. The aggregate chemical import share is used to determine the level of subsidy on feedstock. Lower feedstock price will encourage domestic production and attract investment in this industry.

Figure 1. Causal-loop Diagram of Petrochemical
Industry Development Model.

In the absence of relevant policies, feedback loops are unidentified, and the performance of the model is solely determined by the exogenous parameters. Governmental policy interventions create feedback-loops as depicted in the figure (Loops 1 and 2). Policies on tariff and feedstock subsidy are used to reduce the sensitivity of model behavior to the exogenous parameters (mainly oil price here), and to regulate the development of PI in line with the objectives discussed earlier.

Plant expansion- and petrochemical production decisions are based on mixed integer programming cost minimization model which is employed to determine the plant types, plant size, and number of plants to be built. The model is similar to that developed by Rudd et Al (Rudd,1981; Trevino,1980; Jeminez,1986) for the petrochemical technology assessment in United States and Mexico.

4. Results and Analyses.

Market Development.

The development of petrochemical markets is indicated by the supply value of the industry. Figure 2 depicts the supply values of the industry for different policies. Policies 2 and 3 which provide subsidies to naphtha and gas feedstocks respectively, match well with the Base Policy in the short-run, and show deviation starting from year 2005. This is because under Policies 2 and 3 the olefin plants can be established to capture export opportunity as well as to substitute the import.
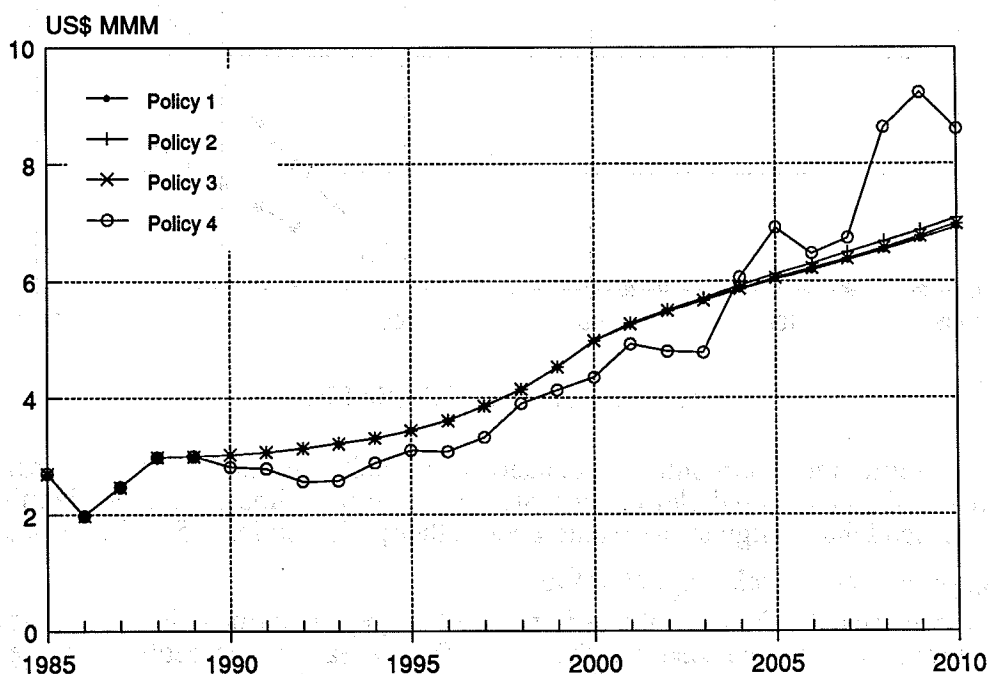
Figure 2. Petrochemicals Supply Values.

In Policy 4, tariff policy surprisingly yields more pronounced effect as depicted in the figure. The initial high aggregate import share of 76% in 1988 sets the high tariff on chemical import which in turn more than offsets the increase in demand due to economic growth. High domestic prices make investment more attractive and more plants are constructed. When the plants are on stream, import shares of petrochemicals decline resulting in tariff reductions since tariffs are linked to the import shares under this policy. This further adds to the increase in demand for petrochemicals due to economic growth. The fluctuating pattern of the supply value under Policy 4 indicates an equilibrium seeking mechanism embedded in this policy (When the chemical import shares are high, tariffs are increased, while during low chemical import shares tariffs are lowered. This indicates that tariffs are stable at certain levels of chemical import shares). It suggests that with the policy of linking tariff to import share the supply level will grow at higher pace in the long-run despite the decline of supply in the short-run.

Development of Olefin Plants.

Under the Base Policy, the construction of olefin plant is not feasible along the planning horizon as depicted by Figure 3. Under Policies 2 and 3, construction of olefin plants have to wait until 1995 when the demand reaches a sufficient level of economical size plant with a capacity of 450 kTon/year (JCI,1987).
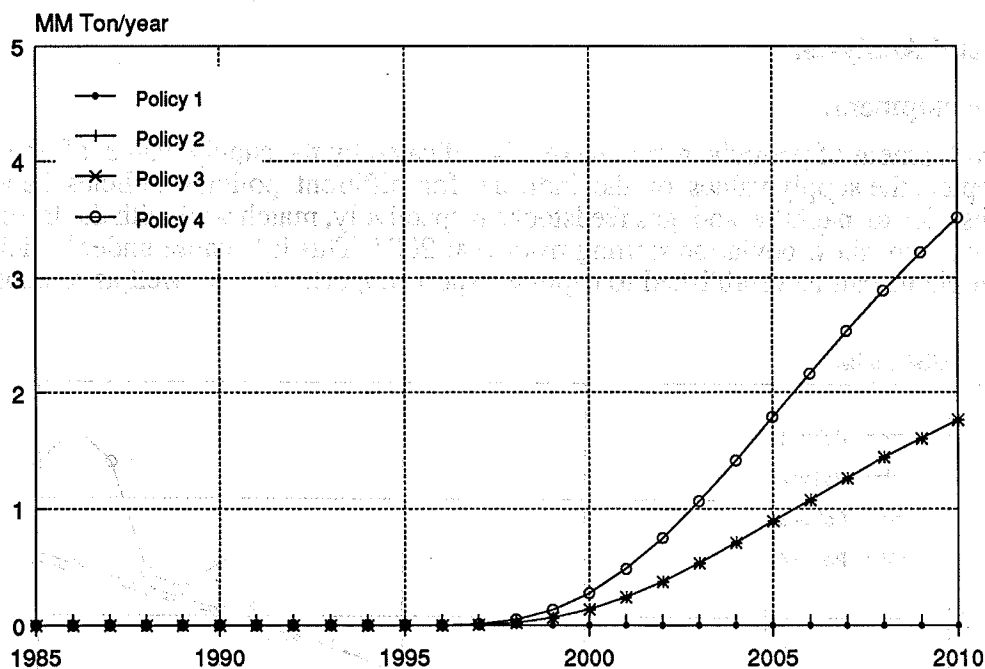
MM Ton/year

Figure 3. Capacity of Olefin Plants.

Policy 4 shows more pronounced expansion of capacity in this basic chemical industry : Both naphtha- and ethane-based olefin plants are on stream over time during the planning horizon to meet the demand that is higher than that under other policy options (See Figure 2).

Share of aggregate chemicals import value.

The performances of different policies in terms of aggregate petrochemicals import shares are depicted in Figure 4. It can be seen that the Base Policy leads to the declining share of import down to the minimum level of 38% in 2001. This is due to the absence of olefin plants in the country as a result of which dependence on the imported products could not be reduced further.

Policy 2 enables naphtha-based olefin plant to be on stream by 2000, while Policy 3 establishes ethane-based olefin plant prior to 2000. Policy 2 is superior than Policy 3 in substituting the import due to the wider variety of products yielded from the naphtha feedstocks compared to ethane feedstock.

Policy 4 shows a jump in import share, because the reduction in supply value is larger than the reduction in imports. Then it shows a declining trend prior to 2003 which shows another big jump due to the drop of chemical supply. The rest of the period is characterized by the declining trend of import share.
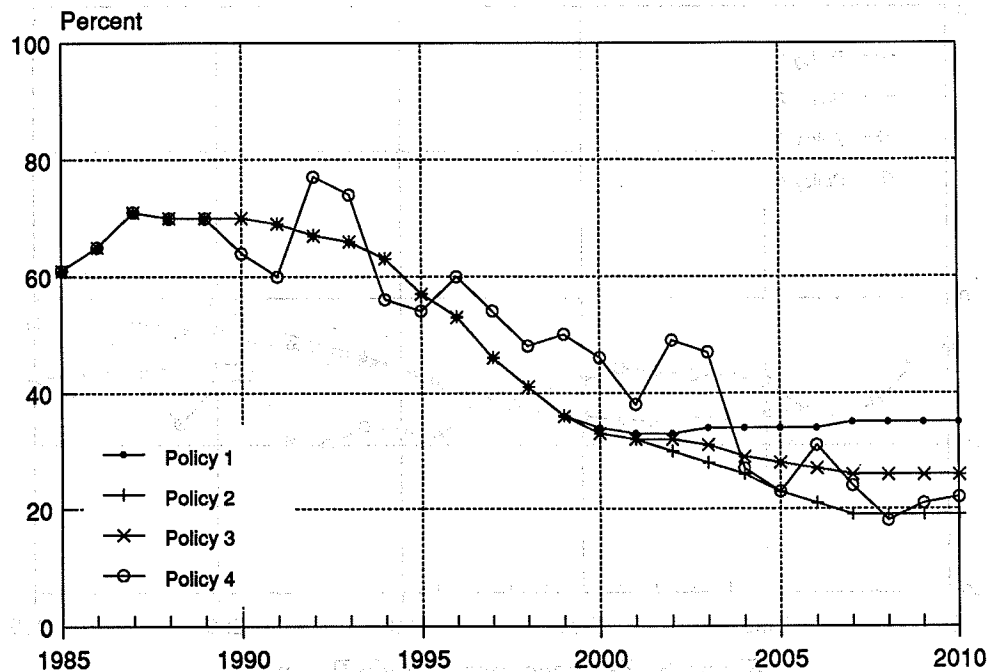
Figure 4. Petrochemicals Aggregate Import Shares.

Trade Balance.

The trade balance of chemical sector shows a deficit throughout the planning horizon under all policy packages except Policy 2 as depicted in Figure 5. However, the trade deficits, overall, show a declining trend over time.

Under the Base Policy, trade deficit is almost constant initially, and starts to improve in 1995 up to 2001. This improving phase occurs during the proliferation of the downstream petrochemicals plants in the country. Since there is no olefin construction in the planning horizon, pthe country has still to import feedstocks for the downstream industry, so the trade deficit experiences a slight increase near the end of the simulation period.

Policies 2 and 3 show an improvement over the Base Policy in this respect. There is even a trade surplus taking place after 2006 under Policy 2. The construction of olefin plant does substantially help substitute the imported feedstock. Policy 2 which promotes naphtha-based olefin plant construction shows a better performance on trade balance than Policy 3 which promotes ethane-based olefin, since naphtha has superiority in giving wider variety of co-products than ethane feedstocks.

In the case of Policy 4, higher petrochemical prices due to higher tariffs act towards restraining the imports and improving the petrochemical trade balance. However the growing demand in the later years increases the import leading to worsening balance. After 2002 chemical imports decline as domestic olefin plants are on stream by then. However, due to the counter-promotional-effect of Policy 4 on domestic production during the periods with low import shares, (i.e. it reduces the tariff when the import share is low), the improvement cannot be carried out smoothly. It therefore shows that the policy does not consider the plant capacity. Even when the domestic capacity is capable to meet the domestic demand, import tariff might be lowered to make the imports more competitive, if the import share is low.
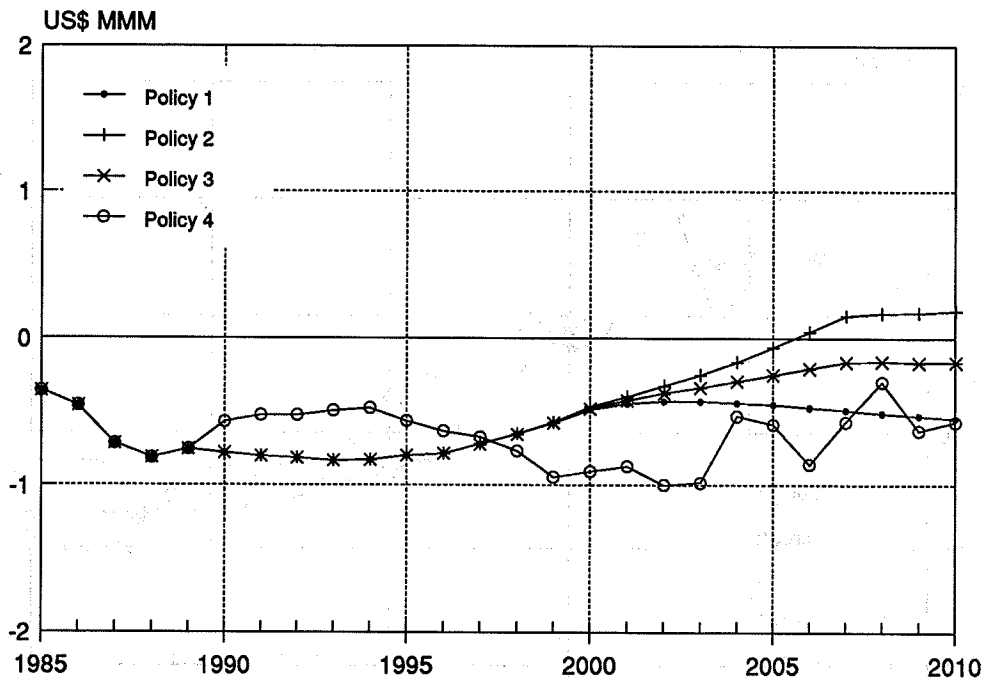
Figure 5. Petrochemicals Trade Balances.

Government revenue.

Figure 6.6 shows government revenues under various policies. The Base Policy results in a pattern of revenue that grows in the supply.

Policies 2 and 3 which provide subsidy on naphtha and gas feedstocks respectively do not show any significant effect on the government revenue, because the subsidy is given by the government through the oil and gas sector.

Under Policy 4 which imposes higher tariff than other policies, the government can collect more revenue. Right after the switch from Base Policy to Policy 4 in 1988, the revenue shoots up by more than 12 times that of the Base Policy. But with the higher price of petrochemicals in domestic market under this policy due to higher tariff, demand for petrochemicals declines. As a result, import volume declines and so does the government revenue. With the growing chemical supply value in the later years (Figure 1), import of chemicals grows as well, yielding more revenue to the government. The fluctuating pattern of government revenue is due to the changing import tariff that is linked to the import share.
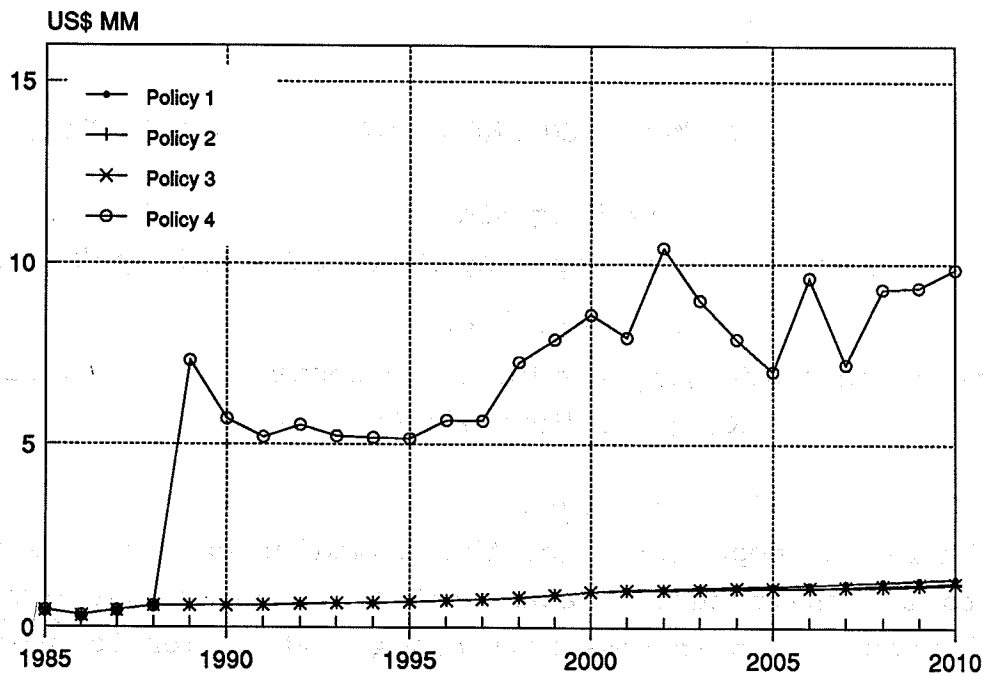
US$ MM

Figure 6. Government Revenues from Petrochemical Sector.

5. Conclusion and Final Remarks.

The results of policy simulation suggest that the policy performances can vary widely between the short-run and the long-run and that no particular policy set analyzed shows a distinct superiority to the rest of the policies. A careful combination of all policy instruments is thus needed to achieve the objectives.

We wish to note here that oil price fluctuation can very much influence the model performance. The model developed in this study is in fact capable to perform the sensitivity analysis on the effect of oil price fluctuations. These issues are, however, being considered in Arsegianto (1991).

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