Industrial Policy Design Based on Supply and Demand Sides
Case: Indonesia's Manufacture of Products of Plastic (ISIC 356)

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Abstract

The objective of this study is to develop a system dynamic model that can be used as a tool for industrial policy design. The model developed consists of eight sectors a – production sector, capital sector, labor sector, raw material sector, financial sector, house hold sector, government sector, and international trade sector which are categorized into supply and demand sides. The simulation results suggest that integration of supply and demand sides' factors into the design of industrial policy enables the industrial sector to maintain production growth. On one side, the demand side policy tends to be effective in short-term maintaining market demand. On the other side, the supply side policy is needed to strengthen the industrial capabilities to keep industrial competitiveness in the long run. Strengthening the supporting industries to ensure supply of materials to the main industry demands a serious attention from the government. Otherwise, high growth of the industry may drive high increase in import of materials that may result in negative trade balance.

Key Word: National Industry, Policy, Supply side, Demand side, Model

1. Introduction

The role of industrial sector is significant to the economy of Indonesia. During 1980 - 1990, the national gross domestic product (GDP) of Indonesia increased by 6.1% annually, and in the following five years it grew at about 7.6% per year. The contribution of the industrial sector in the Indonesian economy accounts for about 42%, with an annual growth rate of 6.9% in 1980-1990 and 10.1% in 1990-1995 (World Bank, 1997).

To support high growth of the economy, Indonesian government has been long relying on demand side policies to improve the economic distortions. The policies include increasing government spending, encouraging investment, controlling foreign trade, subsidizing domestic consumption and controlling factor prices. Implementation of the policies has created some short run surges in the economy (Arif and Saeed, 1989). On the other hand, the supply side (real sector) which is supposed to be the main sector in strengthening the industrial competences to enable the economy to face the free trade era has been neglected. The unbalance policies has impaired the structure of national industry. High growth of industry, dominated by down stream sectors, drove high increase in imports, in particular processed materials, resulted in negative trade balance (excluding oil and gas exports). Figure 1 shows exports and imports of Indonesia between 1981 - 1996. Import of processed raw materials for industry accounts for about 41 - 55% of the imported raw materials, or for about 31 - 42% of the total import (Central Bureau of Statistics of Indonesia, 1998).

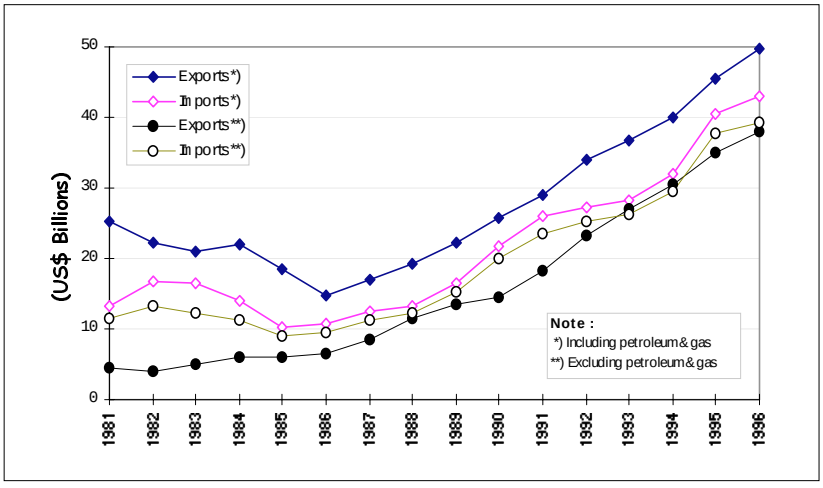

Figure 1. Exports and imports of Indonesia between 1981 - 1996 (*Source:* Central Bureau of Statistics of Indonesia, 1997.

The high reliance on import of processed raw materials has weakened the structure of Indonesian industry. It is proved in the current monetary crisis that hits a number of Asian countries. Large depreciation of Indonesian Rupiah, up to 400%, againts US dollars has created high inflation in the first quarter of 1998 leaded the nation to the worst economic crisis in the new order era, obstructed daily production activites, and seriously challenged

further development of Indonesian economy. The crisis has shown that the industrial structure of Indonesia is critically vulnerable, the development in real sector therefore needs a serious attention. In addition, to cope with the short-term problems that require immediate solution, and at the same time the long-term problems, Indonesian government today is faced by a number of challenges to integrate the demand side and supply side (real sector) in the comprehensive design of industrial policy.

The main purpose of this research is to develop a model that can be used as a tool to support the design process of comprehensive industrial policy. The model includes the supply and demand sides to enable the creation of favorable conditions that can support high growth rate of industry. Manufacture of products of plastic, one of the industrial sectors of Indonesia that have high priority to be developed, is chosen as a case to provide practical considerations in the development of model and the design of policy.

2. Model Structure

The model developed consists of eight sectors, i.e., production sector, capital goods sector, labor sector, raw material sector, financial sector, household sector, government sector, and international trade sector. This structure is similar to *The National Model* developed by Forrester (1989). The main sector in this model is production sector, while the others are grouped into two categories. One is the *supply side sector*, consists of labor sector, raw material sector, capital goods sector, financial sector, and government sector. All of these supply side sectors provide input of production factors to the production sector. The second one is *demand side sector*, or sales distribution channels of production sector, composed by household sector, international trade sector, and government sector. The interactions between the sectors are described in Figure 2.

Production Sector

Production sector is a collection of manufacturers of products of plastics in the country providing all plastic products purchased by household and government in domestic market. In this market the national industry competes with imported products to fulfill the need of domestic market. The market clearing mechanism is built into this sector in form of interaction between price and product availability of domestic products and those of the imported products in the domestic market.

The production sector consists of four loops. The first three loops compose the market clearing mechanism in the domestic market, and the fourth loop demonstrates the mechanism of industrial investment process. The market clearing mechanism is initialized by unfilled demand of domestic market. The unfilled demand defines potential production rate that the industry needs to run. Despite the potential production rate, the industry operates at actual production rate, which usually is lower than the potential production rate, due to limitation in actual production capacity. The actual production rate induces product inventory level, which controls shipment rate from the industry to the market. The comparative position of shipment rate against the unfilled demand defines price and delivery delay of the products. The competitive position of the industry, reflected by the product price and delivery delay in comparison with those of the imported products, accordingly defines the market share of the industry in the domestic market. For simplicity, the price and delivery delay of the imported products of plastics are set at constant values during simulation.

In the last loop, the potential production rate determines the production capacity that should be provided by the industry to meet the market demand. There are three categories of production capacity used in the model: (1) *installed capacity* or *maximum capacity* represents the maximum outputs the industry may produce utilizing the installed capital equipment, (2) e*ffective capacity* determined by the availability of skilled labor required to operate the capital equipment during the production process --the higher the number of skilled labor available for production, the smaller the gap between the installed and the effective capacities, and (3) *actual capacity* defined by the availability of raw materials. The availability of raw materials in appropriate amount and time brings the actual capacity close to the effective capacity. The requirement for additional production capacity increases the gap between the required and the installed capacities which in turn drives the investment in the industry. Realization of the investment will increase the production capacity, and subsequently the actual production rate.

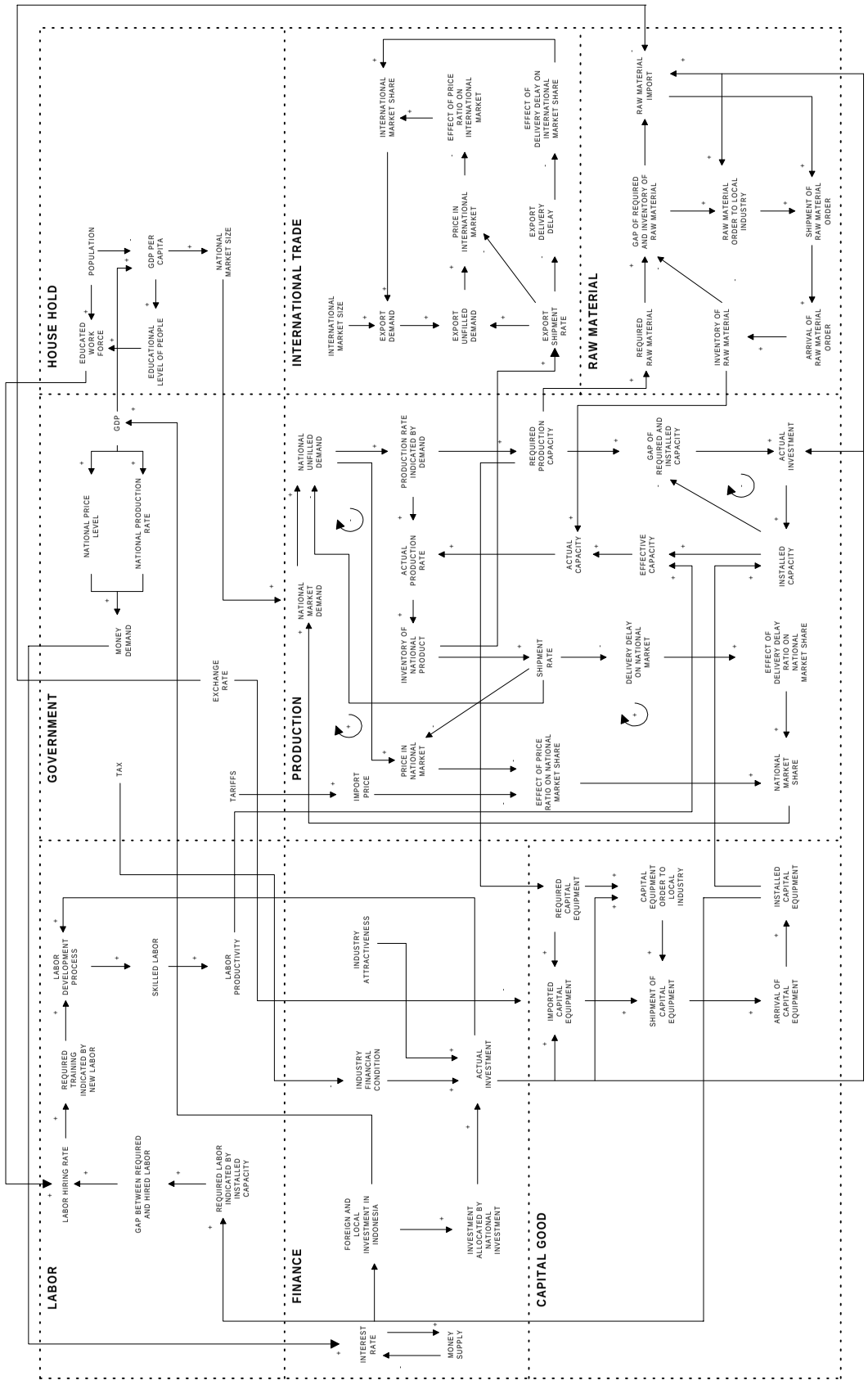

Figure 2. Causal loop of industrial model

Capital Sector

The capital sector fulfills the needs of the industry for capital equipment. The need for production capacity induces the requirement for capital equipment. If the requirement is greater than the installed capital equipment, the industry will order new capital equipment to the domestic industry or import it from overseas. The installed capacity of the industry rises after the arrival and installment of capital equipment order.

The Labor Sector

The labor sector absorbs workforce from the household sector. The installed capital equipment induces the required labor force in the industry and this condition will increase the gap between the required and the hired labor. If the number of the required labor is lower than the labor force available in the industry, it will increase the labor-firing rate. With the same logic, if the required labor is greater than the total labor force then the industry will hire new labor to optimize the utilization of capital equipment and train them to become skilled labor. Increase in number of skilled labor will in turn increase labor productivity of the industry and finally the effective production capacity.

Raw Material Sector

This sector supplies the raw materials of products of plastic to the production sector. Demand of the production sector for the raw materials demand is governed by the gap between the required amount and the available amount of raw material in the inventory of the industry. The production sector will then be ordering the materials to domestic industries or to overseas suppliers of the raw materials. The inventory level and the actual production capacity rise when the order of the materials arrives.

Financial Sector

Financial sector provides funds needed by the industry. The financial requirement of the industry include (1) investment of capital equipment, (2) investment in human resource development, and (3) working capital necessary for labor hiring/firing and raw material ordering. Fund for investment in plastic industry is derived from the total foreign and domestic investment in Indonesia and affected by industrial attractiveness and financial condition of the industry.

Government Sector

The government sector provides the endogenous mechanism of national GDP determined by consumption, government expenditure, investment export and import. Increase in GDP induces the market size, and the aggregate production and price level. This condition will increase the demand for money. Interaction between money supply and money demand determines the interest rate, which subsequently governs the investment.

The Household Sector

The household sector supplies the workforce to the labor sector and becomes the main customer of the industrial outputs in the domestic market. The size and the average income of population determine the domestic market size of plastic products. The average income also controls the birth rate, mortality rate and educational level of the population.

International Trade Sector

The mechanism of international market product in this sector is similar to the market clearing mechanism in the production sector. Export demand is determined by international market size for national product and Indonesia's share in this market. Growth in market demand increases the potential production rate. After the production process is accomplished the products are shipped to the destinated export countries to reduce the unfilled export demand and export delivery delay. Decrease in unfilled export demand is lowering the price of export product in the destinated countries. The market share of national product in international market is determined by the comparison between national product price and delivery delay and those of the foreign competitors.

3. Model Behavior

Supply Side

Behaviors of the model created from the supply side sector represents the capability of the national industry to fulfill the market demand. The availability of the required production factors – capital goods, raw materials, labor, and fund – governs the capability of the industry reflected by the production capacity. The development of the industrial capacity available for serving the market is given in Figure 3.

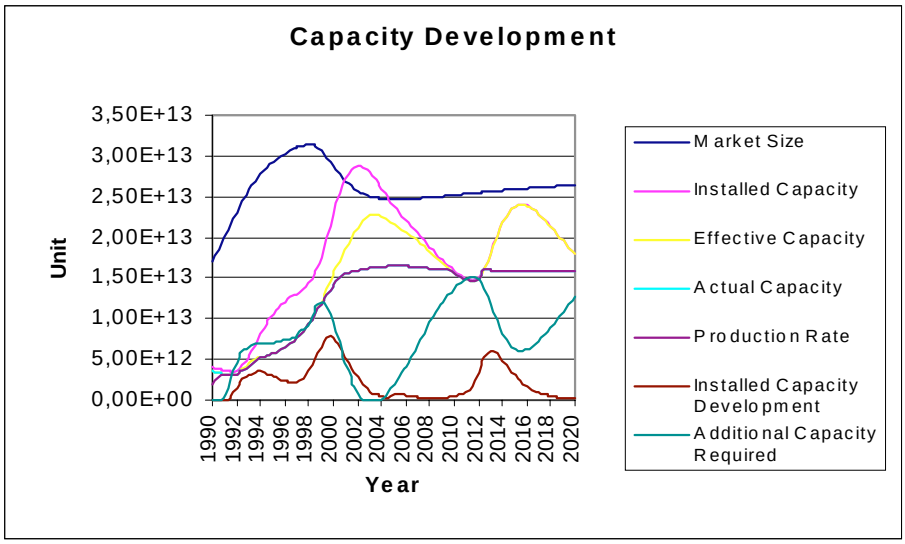

Figure 3. Industrial capacity growth

During 1990-1998 the growth of the market size influences the market demand for plastic products which yields requirement for additional capacity of the industry. In general, the development of the installed capacity cannot meet the required additional installed capacity, due to financial condition of the industry which limits the available investment resources allocated to the industrial sector of plastic products. The development of the installed capacity also is dictated by delay of shipment and installation process of the capital goods. Futher, delay in labor development process and limited training capacity result in the effective capacity which in most cases is lower than the installed capacity.

The monetary crisis that currently hits Indonesia has reduced the market size of plastic products and capability of the industry to expand its capacity. The crisis decreases the investment rate in the country and restrains capacity expansion. This situation explains why the industry is incapable of increasing its capacity although additional capacity is required. After 2003 the installed capacity and the effective capacity continuously decline until 2112. After 2112 the installed capacity equals to the effective capacity, since the development of the installed capacity is hindered by the unfavorable financial condition during 2003-2112. The condition gives an opportunity to the industry to develop labor capability to meet the requirement specified by the installed production facilities. Rupiah depreciation against US Dollar in 1998 brings about implausible increase in imported raw material prices. The condition causes a shortage in supply of raw materials until the end of simulation period. As a result, the production rate is constrained by the availability of raw materials.

Demand Side

Market shares of the national industry in domestic and international markets, described in Figure 4, are determined by the price and delivery delay of the products, in comparison with those of the competitors in the related market. In general, when the market demand is higher than the actual production capacity, the unfilled demand will increase. Since the production rate is limited, this situation will lengthen the delivery delay of the products. As a result of market clearing mechanism, the high market demand raises the product price. High price and long delivery delay will lower product competitiveness in market and consequently reduce the market share. Low market share provides the opportunity to the industry to serve the unfilled demand, which then shortens the delivery time. The market clearing mechanism also brings the product price to the lower level. This condition makes the product become more competitive in market and ultimately increase the market share again.

In 1998 when the monetary crisis unfolds, the national GDP of Indonesia goes down and the market size shrinks, the market share of the national industry rises taking advantage from lower product price relative to the imported one. Figure 5 exhibits the development of market demand and production rate, and the industrial outputs allocated to domestic and international markets. Rupiah depreciation against dollar unintentionally creates protection to the domestic market from imported products. As the dollar value increases, the price of imported products goes up and becomes less competitive in the domestic market. This condition leads to the significant increase in domestic market demand in 1998 though only in a very short term. On the contrary, despite the lower product price, the market share in the international market does not improve, due to longer delivery delay.

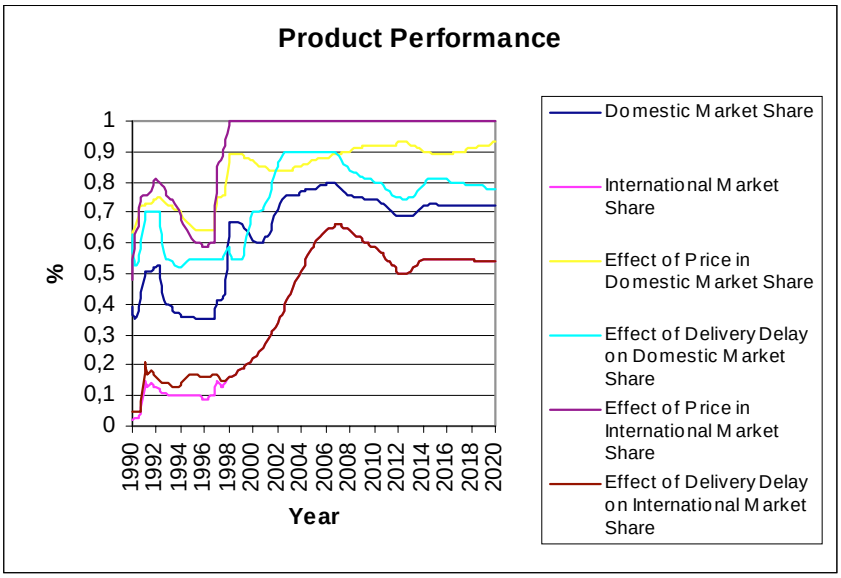

Figure 4. Product performance in domestic and international markets

After 1998 the export market plays a more important role in the development of plastic industry. High domestic market demand in 1998 cannot be sustained due to large increase in unfilled demand, which then lengthens product delivery delay. The monetary crisis makes capacity expansion become economically infeasible, despite requirement for additional production capacity. Moreover, the crisis also leads the domestic market size to decline in 1998-2003 and to grow at a very slow rate in 2004-2020. Under this situation, after 1998, the market demand continuously declines until the end of simulation period.

In the export market, the competitive price leads to growth in market demand until 2007 and exceeds the domestic market demand. After this period, as the production capacity is constrained by the availability of raw materials, the production rate cannot increase. This situation makes the delivery delay become longer and the market demand slightly decrease in 2008-2112. In 2113-2020 the market demand increases even in a slow rate as a result of improved delivery delay.

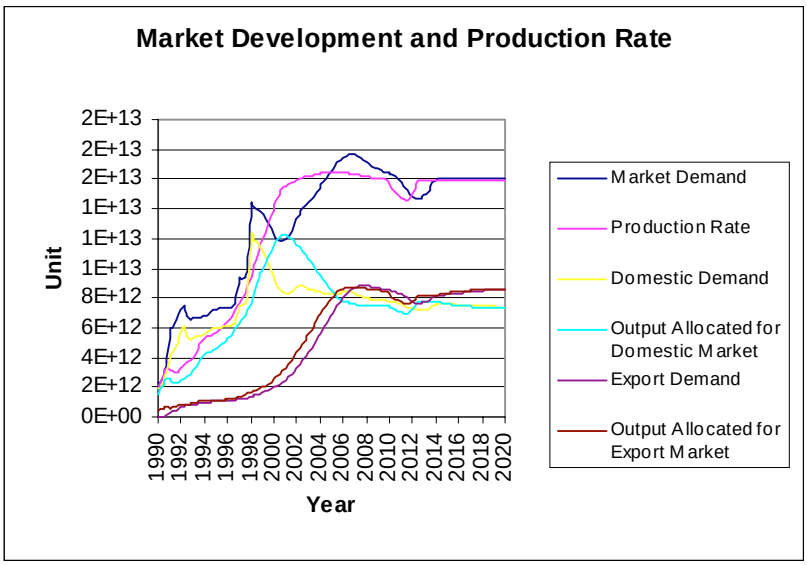

Figure 5. Market development and production rate

4. Policy Design

Derived from the vision and mission of the national industrial policy, there are four major objectives of the industrial policies of Indonesia: (1) high industrial growth rate, (2) high competitiveness in domestic and international markets, (3) market development, and (4) contribution to national trade balance (Cakravastia et al., 1997).

Several measures apply to evaluate the performance of the policies. The industrial growth is measured by total production value whose increasing rate indicates the expansion of production activities in the industry. The industrial competitiveness levels in domestic and international markets are evaluated through the market shares

gained by the industry in the both markets. High market share implies high capability of the industry to cope with competition in the related market. Further, the expansion rates of domestic and international market demands apply to measure the market development of the industry, while discrepancy between import and export values provides a measure of industrial contribution to the national trade balance.

Two policy instruments from the demand side are considered in the current study, e.g. (1) encouraging investment in the country, and (2) encouraging export market. Further, three policy instruments from the supply side are (1) reducing ICOR *(Incremental Capital Output Ratio)*, (2) reducing imported raw materials, and (3) reducing length of labor development process which implies requirement for better education and training systems. Based on these policy instruments four policy packages are developed: (1) base policy, (2) supply side policy, (3) demand side policy, and (4) both side policy. *Base policy* is representing current practices of Indonesian government in governing the industry. The behavioral patterns corresponding to each of the policy packages are comparatively analyzed to identify particular changes in the policies that may affect the system behaviors. Table 1 itemizes the instrument components of the policy packages used in the study. The simulation is run for 30 years, from 1990 to 2020, to gain comprehensive behavior pattern of the model. Switch of the policy, from *base policy* to other policy packages, takes place in year 2000.

Table 1. Components of policy packages

Policy Packages	Supply Side			Demand Side	
	ICOR	Proportion of imported raw materials (%)	Delay in labor development process (years)	National investment coefficient	Export market share (%)
Base Policy	3	35	3	1	10
Supply Side Policy	2	20	2	1	10
Demand Side Policy	3	35	3	1.5	20
Both Side Policy	2	20	2	1.5	20

5. Results and Analyses

Industrial Competitiveness

The development of market share in each market applies to represent the competitiveness of national industry of plastic products. Figure 6 and Figure 7 exhibit the development of market share of the industry in domestic and international market respectively, with regards to different policy packages.

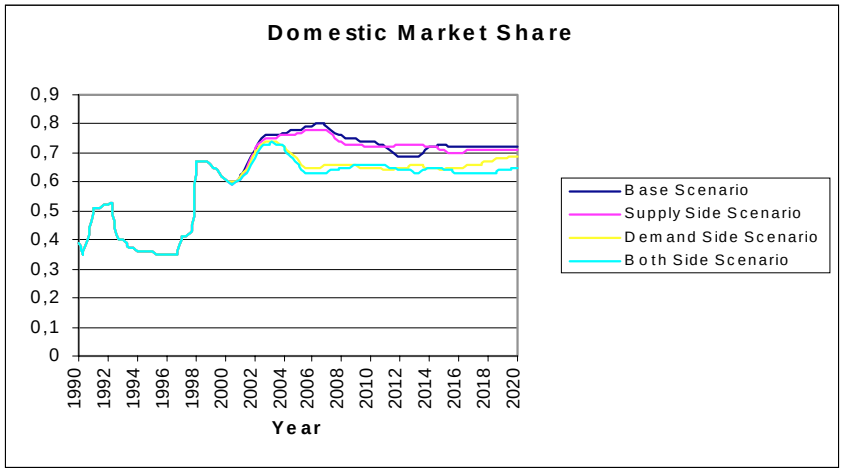

Figure 6. Domestic market shares

In domestic market, all policy packages yield similar behaviors until 2003. After 2003, *base policy* and *supply side policies* are superior to others. Despite higher investment, by 50%, than *base policy* and *supply side policy*, *demand side policy* and *both side policy* result decline in domestic market demand, due to the development of production capacity which is slower than the growth of market demand. Under *both side policy*, the development of the installed and effective capacities is more accelerated, compared to those under other policies. However, unfavorable financial condition has retrained the expansion of the actual capacity during 2003-2020, despite increase by 15% in local supply of required raw materials. This condition leads to longer delivery delay and increases product price which subsequently brings about decline in market share in either *demand side policy* or *both side policy*

In international market, between 1998-2002 under *both side policy* and *demand side policy*, production capacity cannot support the growth of market demand which results in market share decline. Production capacity development improves the capability of the industry to satisfy the market demand in 2003-2020. This condition makes the delivery delay become shorter and strengthen the market share of the national industry.

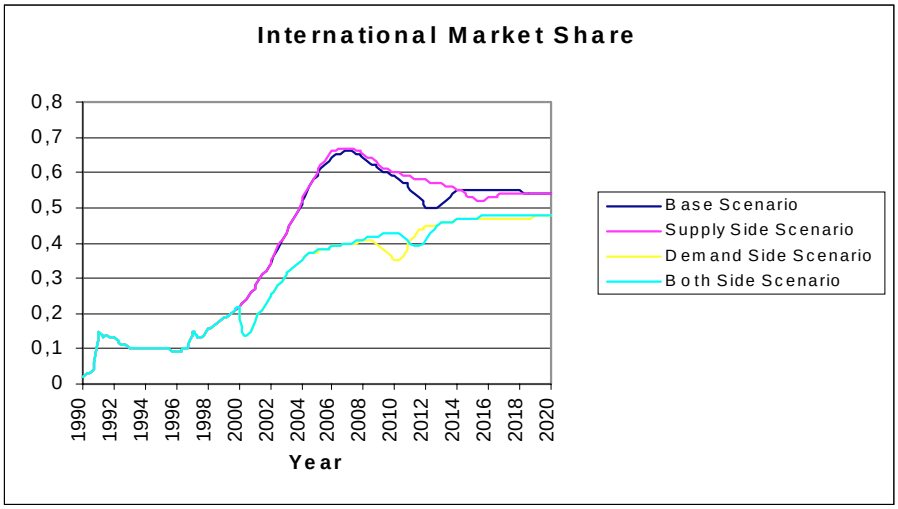

Figure 7. International market share

Under *supply side policy*, despite higher installed capacity, limited supply of raw materials retards the development of actual production rate, results in lower industrial capability in satisfying market demand and in maintaining the competitive position. The condition leads to decline in international market share between 1998 and 2014. After 2016 the international market share remains constant until the end of simulation period.

Market Development

The development of plastic product market is indicated by the total market demand of the industry (see Figure 8). The *demand side policy* and *both side policy* creates higher market demand than two other scenarios. The 50% higher in national investment rate give a rapid growth of GDP after monetary crisis in 1998 and increase the domestic market demand. In the international market increase in product market size induces the export demand.

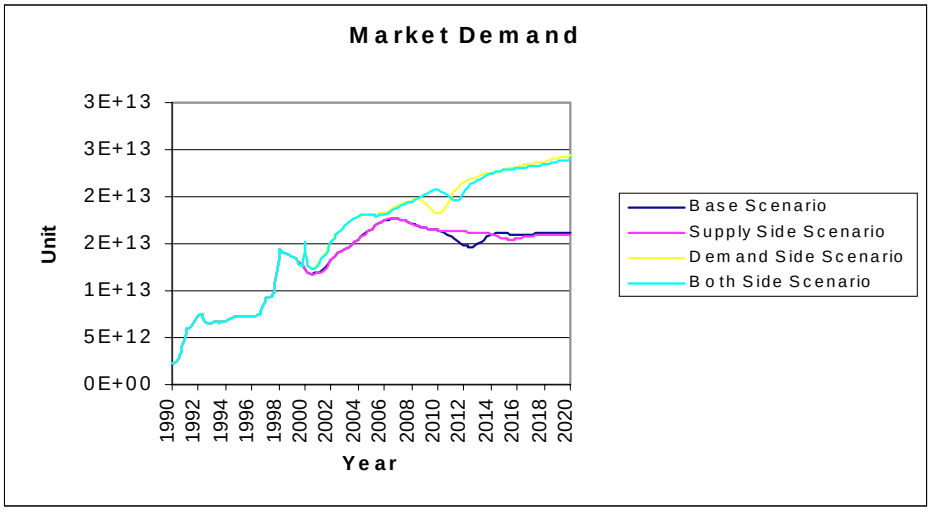

Figure 8. Development of market demand

Both side policy potentially increases the market demand. Under this policy the development of installed capacity and effective capacity is better than *demand side policy*. However, the availability of raw materials restrain the development of the actual capacity. If the constraint in supply of raw materials may be released, the policy will serve the market better than other policy packages may do.

Industrial Growth

The industrial growth is indicated by the production rate of the industry (Figure 9). The production rate under each policy shows similar behavior until 2006. After this period *demand side policy* and *both side policy* show better performance resulted from better market development that increases the production rate of the industry.

The results of *supply side policy* and *both side policy* demonstrate the important role of upper stream industries to assure a stable supply of raw materials. Under these two policies, high reliance on imported raw materials restrains the industry from operating at its maximum capacity, in particular between 2014-2020.\

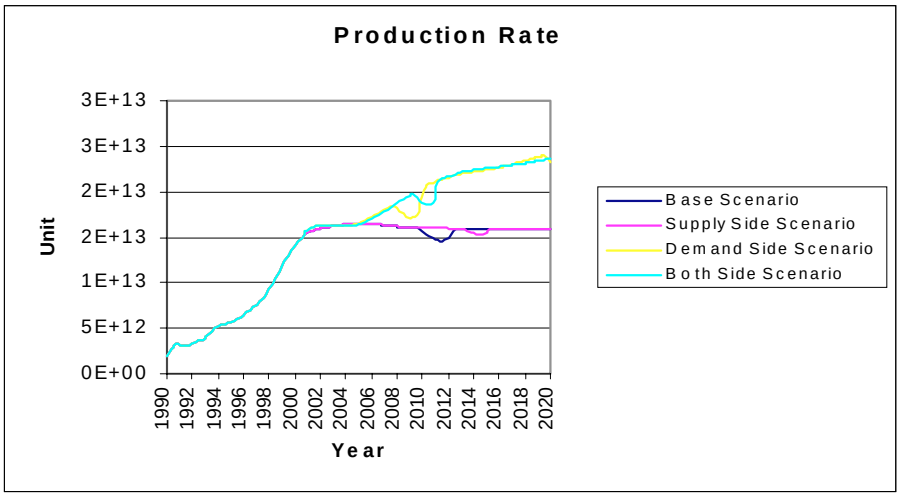

Figure 9. Development of production rate

Trade Balance

The trade balance of plastic product industrial sector shows a deficit until 2002 (see Figure 10). It is consistent with the actual data of chemical sector trade balance in period 1992-1996 causing a negative annual growth rate of -3.3 % (Central Bureau of Statistic of Indonesia, 1997). After 2002 the trade balance of the industry tends to improve and fluctuate until the end of simulation period. Several factors influence the fluctuation of trade balance, such as market share, production rate, and local supply of raw materials. High production rate may trigger increase in imported raw materials reducing national foreign exchange reserves. With higher production rate, and with higher supply of local raw materials, *both side policy* produces a better position of trade balance compared to other policies in the last period of simulation.

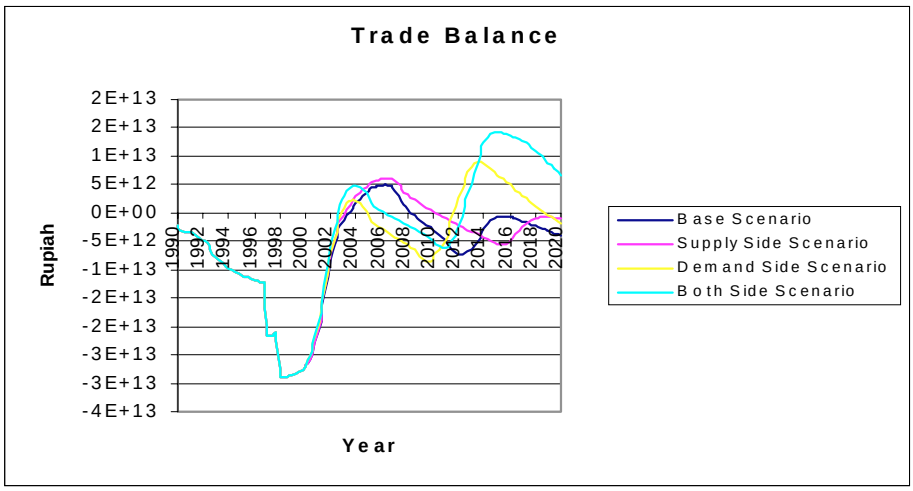

Figure 10. Development of trade balance

7. Conclusion

The results of simulation indicate that the monetary crisis unfolds in 1998 may seriously influence the development of plastic product industry in Indonesia. On one side, the crisis may reduce the gross domestic product and accordingly hinder the development of domestic market of plastic products of Indonesia. On the other side, the crisis may contingently provide protection to domestic market from imported products. It creates market for the national industries to substitute for the imported plastic products or for the imported raw materials. The study reveals that *demand side policy* is capable of maintaining the growth of market demand for stimulating the development of the industry. However, the policy is only effective in a short run. As a complementary, *supply side policy* is necessary to strengthen the industrial capabilities to keep the industrial competitiveness in the long run. Further, the development of the upper stream industrial sector demands a serious attention to provide a stable supply of raw materials for the national industry. The simulation results strongly indicate that high reliance on imported raw materials may critically hinder further development of the national industry.

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