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A Medium-term Macroeconometric Model for Economic Planning in Indonesia*

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I Introduction

The five-year development plan which the Indonesian Government works out every five years is indicative by nature, setting policy guidelines for government development policies. Three development plans have already been formulated and carried out since 1969, and implementation of the Fourth Five-year Development Plan (Repelita IV) began in April, 1983. In Repelita IV, macroeconomic models were employed in order to obtain consistency in macroeconomic aggregates in the economic framework of the plan. The plan states: "Repelita IV has attempted to employ macroeconomic models as guidance for its broad quantitative estimates. This has enabled the plan to take a better account of the existing interdependencies and interrelations among variables as well as among sectors, with a view to obtaining a better consistency in the planned macroeconomic aggregates. In this respect the present plan constitutes a step forward from the past practice."

The macroeconomic models consist of a macroeconometric model, an interindustry model and two submodels, agriculture and energy, as described in Fig. 1. The macroeconometric model comprises a core model, a fiscal submodel, a monetary submodel and a balance-of-payments submodel. The core model and each submodel were constructed and tested independently at the first stage, then at the later stage attempts were made to integrate them. The monetary submodel, however, was not connected with other models because of our shortage of computer capacity.[1] Consequently, the macroeconometric model, which consists of the core model, the fiscal submodel and the balance-of-payments submodel, was used for the purpose of conducting simulations for Repelita IV. The balance of payments submodel, however, was not completely

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1) The monetary submodel was successfully connected with the core model, but when we tried to integrate the core model with the monetary submodel as well as the fiscal submodel, we encountered difficulties with the computer capacity. For the monetary submodel, see Ezaki [1982] and Odano [1983a].

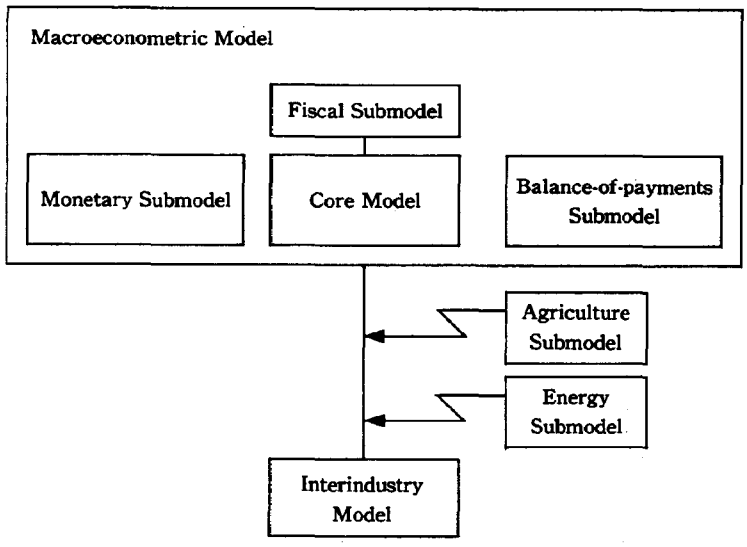

Fig. 1 Macroeconomic Model for Economic Planning in Indonesia

integrated with the core model and the fiscal submodel, but rather used for checking purposes, for it did not have feedback loop to influence the other models, and exchange rate treated as an exogenous variable in the macroeconometric model.

The core model was estimated several times with data for different sample periods. It was first estimated with the data for the sample period 1969 to 1980. Then data for 1981 were added, and it was re-estimated and revised to give Core Model-81. Core Model-81 was used for planning together with other submodels. It was then re-estimated with the data from 1969 to 1983 to give Core Model-83. Other submodels were treated similarly, and numerical suffixes are added to distinguish the different versions and revisions with different sample periods.

This paper aims mainly to describe the structure of the core model and to explain its structural equations. Section 2 describes the historical development of the Indonesian economy in the 1970s and 1980s in terms of macroeconomic aggregates. Section 3 explains the structure of the core model.[2] In section 4 multiplier analysis is briefly presented.

II Economic Development in Indonesia

1. Economic Development since 1969

It goes without saying that a necessary condition for model builders is to have a good grip of the characteristics of economic development in the past and of problems and issues of the present and future. First, therefore, a brief description is given of the economic development of Indonesia since 1969 in terms of macroeconomic aggregates.

Indonesia's per capita gross domestic product (GDP) was less than 100 dollars in 1970, about 200 dollars in 1974 and hit the 300 dollar mark in 1977. Indonesia became one of the lower middle-income economies in the World Bank's classification, attaining a per capita GDP of about 490 dollars in 1980.[3] GDP increased at an annual rate of about 20 percent in the 11 years from 1970 through

2) For detailed explanation of the fiscal submodel and the balance-of-payments submodel, see Bappenas and Ministry of Finance [1982] and Odano [1983b].

3) The dividing line between low-income and middle-income economies is 410 dollars at 1982 prices based on the World Bank's classification.

Table 1 Comparison with ASEAN Countries

	GNP per capita (dollars) (1982)	Population (millions) (mid-1982)	Average Annual Rate of Growth (%) (1970–1982)	Average Annual Rate of Inflation (%) (1970–1982)	Percentage of Labor Force in: (1980)		
					Primary Industry	Secondry Industry[2]	Tertiary Industry
Indonesia	580	152.6	7.7	19.9	58	12	30
Thailand	790	48.5	7.1	9.7	76	9	15
Philippines	820	50.7	6.0	12.8	46	17	37
Malaysia	1,860	14.5	7.7	7.2	50	16	34
Singapore	5,910	2.5	8.5	5.4	2	39	59
Korea, Rep. of	1,910	39.3	8.6	19.3	34	29	37
Hong Kong	5,340	5.2	9.9	8.6	3	57	40
Industrial Market Economies	11,070	722.9[1]	2.8	9.9	6	38	56
Japan	10,080	118.4	4.6	6.9	12	39	49
United States	13,160	231.5	2.7	7.3	2	32	66

Sources: World Bank, *World Development Report 1984.*
Notes: 1) This figure shows total population of industrial market economies. The average population is 38.0.
2) Secondary industry comprises mining, manufacturing, construction and electricity, water, and gas.

1981, due to a large extent to big increases in the price of the crude oil that Indonesia exported.

In comparison with ASEAN countries other than Brunei, Indonesia had the largest population and the lowest GDP per capita in 1982 (Table 1). In the World Bank's classification, Indonesia, Thailand and the Philippines belong to the lower middle-income economies, while Malaysia and Singapore belong to the upper middle-income economies. Indonesia performed as well as other ASEAN countries in terms of the rate of growth of real GDP between 1970 and

Table 2 Percentage Distribution of Real GDP by Industrial Origin

	1970	1975	1980	1983
1. Primary Industries	45.5	36.8	30.7	29.9
2. Mining and Quarrying	10.1	10.9	9.3	7.4
3. Manufacturing	8.4	11.1	15.3	15.6
4. Electricity, Gas, and Water Supply	0.4	0.5	0.7	0.9
5. Construction	2.8	4.8	5.7	6.3
6. Wholesale and Retail Trade	16.3	17.0	16.6	17.4
7. Transport and Communication	3.2	4.0	5.5	5.9
8. Banking and Other Financial Intermediaries	0.9	1.3	1.9	2.2
9. Ownership of Dwelling	1.7	2.6	3.0	3.1
10. Public Administration and Defence	6.0	7.4	8.7	9.2
11. Services	4.7	3.6	2.8	2.6
12. Gross Domestic Product	100.0	100.0	100.0	100.0

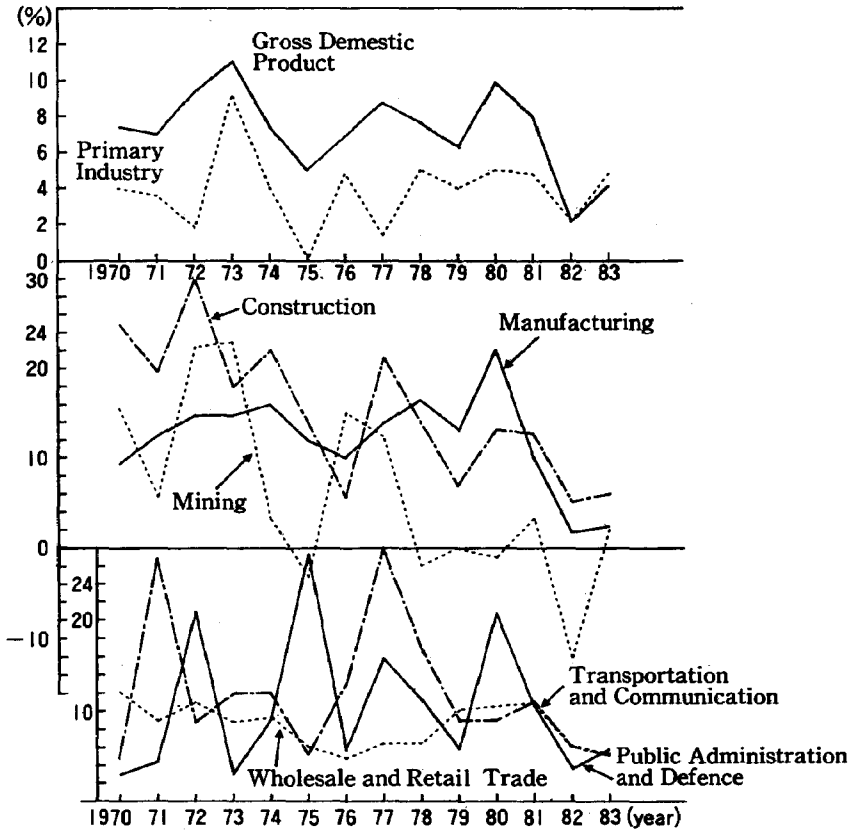

Fig. 2 Growth Rate of GDP by Industrial Origin

1982, but had the highest rate of inflation, 19.9 percent. In the industrial structure of employment, Indonesia has high percentage distribution in primary industry and low one in secondary industry.

Table 2 shows changes in the percentage distribution of real GDP by industrial origin. It is clear that the percentage of primary industry (mainly agriculture) decreased rapidly while those of manufacturing, construction, transportation and communication, and public administration and defence increased. Mining, and wholesale and retail trade maintained roughly a constant percentage distribution throughout the decade. Fig. 2, which depicts changes in annual growth rates of real GDP by industrial origin, reveals certain interesting features. First, real GDP follows a conspicuous growth-rate cycle with two-year up-swing and two-year down-swing. Second, as can be guessed from Table 2, growth rates of GDP and primary industry change almost in parallel except for 1977. Up to about 1976, in particular, the growth patterns of mainly agriculture and mining were reflected in GDP. Third, the influences on GDP of manufacturing, construction, and public administration and defence have increased since 1977, though agriculture and mining were still dominant. Fourth, the real growth rate of all industries dropped sharply in 1982, and most industries except agriculture recorded the lowest rate of growth since 1969. Their rates of growth were also very low in 1983. In building a macroeconometric model, it is extremely important to assess whether this sharp reduction in the rate of growth of real GDP is of a temporary nature or more permanent.

To find out why the growth rate of real GDP dropped suddenly at the beginning of the 1980s, we also have to examine GDP by expenditure. Fig. 3, which depicts growth rates of real GDP by expenditure, also reveals a few important facts. First,

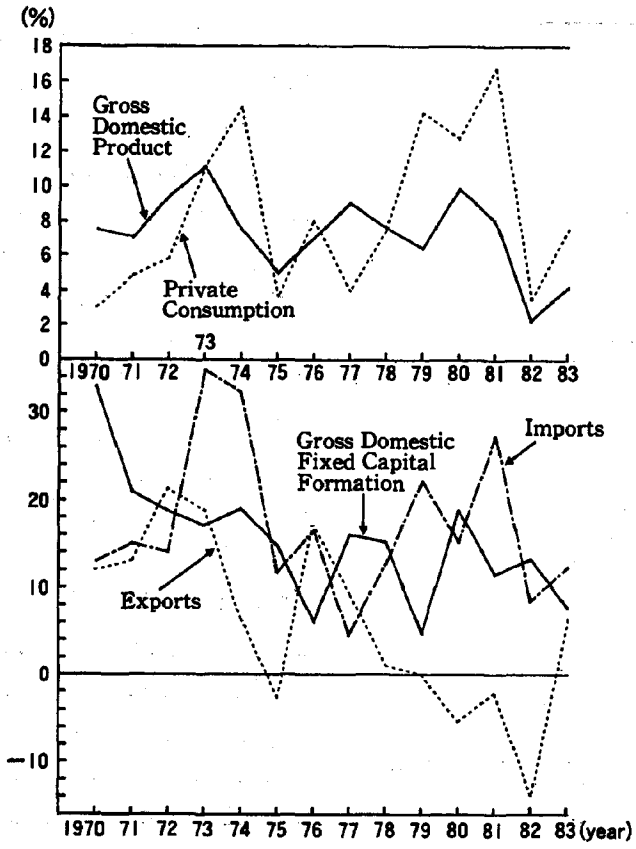

Fig. 3 Growth Rate of GDP by Expenditure

the rate of increase in private final consumption fluctuates almost in parallel with the growth rate of real GDP, but the former far exceeds the latter in 1974 and in the period 1979 to 1981. This phenomenon may only be observed in oil-exporting countries. This is attributable to two big increases in the price of exported crude oil. As Indonesia is an oil-exporting country, the so-called "oil shock" for oil importing countries turned out to be an "oil bonanza" for Indonesia. Income was transferred from oil importing countries to Indonesia and enabled private consumption to increase at a much higher rate than GDP. This is shown more clearly in Fig. 4, which shows annual movement of the terms of trade of Indonesia. The terms of trade substantially improved in 1974 and in the period 1979 to 1981.[4] That is to say, Indonesia became able to import three or four times as many goods and services as before the increases in the crude oil price with the same amount of exports in those years. We can also notice that imports increased substantially in the same years. At the same time, imports fluctuated almost in parallel with private consumption. Second, the rate of increase in exports decreased after 1976 and real exports even decreased after 1979. It was due to sharp increases in the export price of crude oil that the Indonesian economy was able to maintain a high growth rate in the late 1970s, despite the deceleration of real exports.

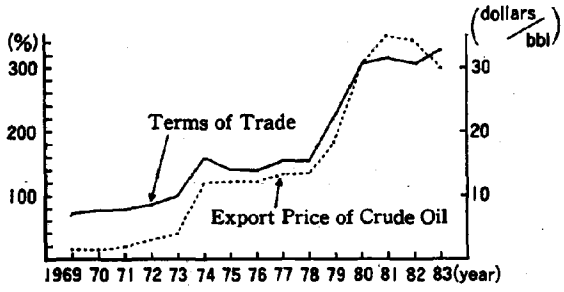

Fig. 4 Terms of Trade and Export Price of Crude Oil

The sharp drop in the growth rate of real GDP in 1982 was caused mainly by a steep decrease in exports, which was ascribed to the long-lasting severe world recession triggered by the second "oil shock."

4) Though the export price of crude oil decreased by five dollars per barrel, the terms of trade in 1983 improved. This is due to increases in export prices of primary goods because of recovery in the world market for those goods.

In 1983 non-oil exports of Indonesia increased due to the increase in world trade that accompanied the recovery of the world economy, especially the economy of the United States. The growth rate of real GDP, however, remained low, though it exceeded the rate in the previous year. This was caused by the reduction in both government consumption and investment. The export price of crude oil was reduced by five dollars per barrel in March, 1983. This affected government revenue adversely and aggravated the balance of payments. In the face of this economic difficulty, the

Table 3 Annual Growth Rate of Real GDP by Expenditure

	1969-1981	1982	1983	1970-1973	1974-1978	1979-1983
1. Private Consumption	8.5	3.4	7.5	6.1	7.5	10.9
2. Government Consumption	12.3	8.2	−1.0	15.0	12.3	7.5
3. Total Investment	14.9	13.0	7.8	22.6	14.2	11.1
3.1 Private Investment	9.8	24.0	26.2	18.4	8.9	13.1
3.2 Government Investment	22.6	4.7	−8.5	39.8	23.5	10.1
4. Exports	7.5	−13.9	6.3	16.2	6.3	−3.2
(Non-oil/gas Exports)	(4.4)	(−)	(−)	(−)	(−)	(−)
5. Imports	17.0	8.2	12.3	19.1	15.5	17.0
6. Gross Domestic Product	7.9	2.2	4.2	8.8	7.2	6.1
				(5.0*)	(6.7*)	(6.5*)

Note: *The target growth rate in each five-year plan.

Table 4 Annual Growth Rate of Real GDP by Industrial Origin

	1969-1981	1982	1983	1970-1973	1974-1978	1979-1983
1. Primary Industries	3.8	2.1	4.8	4.6	3.0	4.2
1.1 Agriculture	3.9	3.6	4.8	3.1	3.4	5.5
1.2 Forestry	3.1	−24.1	3.5	20.8	0.4	−10.7
1.3 Fishery	3.6	5.5	6.2	1.1	4.3	5.6
2. Mining and Quarrying	7.5	−12.1	1.8	16.7	5.0	−1.7
3. Manufacturing Industries	14.0	1.2	2.2	13.0	13.7	9.7
4. Electricity, Gas, and Water Supply	13.4	17.4	6.9	11.7	13.5	14.8
5. Construction	16.1	5.2	6.2	23.1	15.2	8.8
6. Wholesale and Retail Trade	8.0	5.7	3.8	10.3	6.5	8.0
7. Transport and Communication	13.4	5.9	5.0	13.3	15.1	7.9
8. Banking and Other Financial Intermediaries	15.4	11.7	7.0	22.2	14.9	11.0
9. Ownership of Dwelling	14.3	5.2	6.1	15.4	15.1	6.9
10. Public Administration and Defence	11.8	3.6	5.5	7.9	13.9	9.1
11. Services	2.5	2.3	2.5	2.6	2.4	2.4
12. Gross Domestic Product	7.9	2.2	4.2	8.8	7.2	6.1

Government restrained its expenditure severely and devalued foreign exchange. In this connection, real government consumption decreased by 1.0 percent and real government investment by 8.5 percent (Table 3).

It is crucial to recognize that Indonesia's external economic environment became much less favorable in the early 1980s than in the 1970s. The five-dollar reduction in the oil export price was literally a "reverse oil shock" to Indonesia. This is one of key elements of our model building.

Tables 3 and 4 show respectively the trends of real GDP by expenditure and by industrial origin. Both tables are based on the assumption that growth trends changed in the early 1980s. The last three columns in both tables show annual average growth rates for the past three five-year development plans. Observed growth rates of real GDP exceeded the targeted growth rates for Repelita I and Repelita II, but fell short of those for Repelita III because of the low growth rates in 1982 and 1983. Compared with the previous two planning periods, the average annual rates of increase in 1979-1983 decreased for most items in both tables. This may mean that as the scale of the Indonesian economy increased, the economic domestic frontiers were reduced and economic development decelerated. The rates of increase in real value added of forestry and mining dropped sharply, as did the rate of increase in construction, although this still remained relatively high. On the other hand, fishery, agriculture, and electricity, gas, and water supply attained accelerating growth rates through the three periods, though the acceleration was not large.

On the expenditure side, the rate of increase in exports dropped sharply, while private consumption increased at an accelerating rate. This was attributed to the "oil bonanza."

Indonesia has given priority to agricultural development to attain self-sufficiency in food and to developing and fostering import substitution industries mainly in the field of consumption goods. One problem is that the development of import substitution industries did not necessarily lead to export promotion and Indonesia lagged far behind in developing export industries. Exports, therefore, consist mainly of crude oil and primary products. In the 1970s crude oil export brought in enough foreign currency for Indonesia to import both consumer goods and capital goods needed to pursue its development policies. After 1982, however, Indonesia encountered difficulties in earning foreign currency and had to employ austerity policies. Another important feature of the Indonesian economy is that government expenditure, both consumption and investment, increased at the highest rate in the 1970s and led the economy. This is a common feature of almost all developing countries. Since Indonesia depends on crude oil export——about 60 percent of total export is crude oil and about 70 percent of government domestic revenues is related to oil production and export——decreases in the export price of crude oil and the quantity of crude oil

export compelled the Government to reassess its economic policies and development strategies in the early 1980s.

2. Economic Problems in the 1980s

We have seen that Indonesia was confronted with several economic problems in the early 1980s. These have to be taken into account in constructing a macroeconometric model. Some of them will be touched upon here.

2.1 Reduction of the Excessive Dependence on Petroleum and LNG

Indonesia depends on crude oil export in two aspects: to earn the foreign currency necessary for economic development, and to finance government expenditure, especially government development expenditure. Prospects for the quantity and price of crude oil export, therefore, are crucial factors in the future economic development of Indonesia. This means that the Indonesian economy is substantially influenced by the world economic conditions. Indonesia, therefore, has to reduce its excessive dependence on crude oil in order to attain a stable economic growth rate, by promoting non-oil exports on one hand and on the other by changing government revenue systems so as to increase tax revenue from sources other than oil companies and by reducing subsidies on refined petroleum products.

2.2 How to Finance the Economic Development

Needless to say, developing countries need foreign as well as domestic capital in order to achieve adequate economic development. It is usually difficult, if not impossible, for developing countries, especially low-income economies and lower middle-income economies, to finance their economic development with only domestic saving, for their saving rates are very low. Consequently, they have to earn foreign currency either by exports or by overseas financing such as foreign aid, borrowing or direct investment, or by both.

In the 1970s Indonesia earned enough foreign currency for her rather high economic development by exporting crude oil and gas. During the same period the Indonesian Govenment was able gradually to reduce the ratio of foreign aid to total government revenue, while increasing the share of development expenditure in total expenditure. Indonesia was, however, confronted with difficulties in increasing crude oil export in the face of "the reverse oil shock" of the early 1980s. High priority, therefore, needs to be given to the promotion of non-oil exports in place of crude oil and gas in Repelita IV. On the other hand, one way to save foreign currency is to foster and develop import-substitution industries so as to reduce imports and improve the balance of payments. Indonesia has adopted this development strategy for consumption goods industries and obtained good results. One problem is that the development of import substitution industries did not necessarily lead to the development and promotion of export industries. Another policy measure for increasing exports and reducing imports is devaluation of the exchange rate, which has been done several times in the past. In the past, however, devaluation of the

rupiah contributed to the reduction of imports but not to the promotion of exports.

Capital goods industries have not yet been developed in Indonesia, so that increases in public and private investment serve to increase imports and worsen the balance of payments, as will be shown later by multiplier analysis. It is a difficult and challenging task for policy-makers to decide what strategies should be adopted for developing capital goods industries. Different strategies from those adopted for consumption goods industries might be considered, for their impacts on others sectors will be more profound and far-reaching.

2.3 Creation of Employment Opportunity

It is estimated that 1.5 to 2.0 million mainly young people will enter the labor market every year in the coming years. An important task is to create jobs for this young labor force. According to the input-output table for 1980, the percentage distribution of employment among industries is as follows: primary industry, 54.1; manufacturing, 9.6; construction, 3.0; wholesale and retail trade, 12.4; transport and communication, 2.8; services and others, 16.3. It is also well known that most of the labor force is employed in small-scale or cottage industries, especially those using domestic resources. In the face of an decelerating economic growth rate, an economic and social system must be devised to make effective use of domestic resources and to absorb new entrants to the labor force.

2.4 Control of Inflation

Table 1 showed that the rate of inflation in Indonesia in the period 1970 to 1982 was very high compared with other countries. Indonesia has been trying to increase domestic savings by changing its financial systems. For this purpose, among others, it is crucial to control inflation in Repelita IV.

III Medium-term Macroeconometric Model for Economic Planning

1. Basic Framework of Macroeconometric Models

The major role played by macroeconometric models in economic development planning is that of tracing and estimating the relationship between economic policy objectives and policy measures in the light of past economic development, and of selecting optimal policy measures for achieving the policy targets set in order to solve the problems in the economy.

Our macroeconometric models were, therefore, designed to assess quantitatively the impact of government economic policies on a variety of macroeconomic aggregates, especially target variables. As mentioned, world economic conditions influence the Indonesian economy to a large extent, so that variables representing world economic conditions also have to be incorporated into the macroeconometric models to estimate their impact on the Indonesian economy. Fig. 5 shows major policy variables, data variables and target variables.

Main policy variables belong to the government sector and are closely connected with the fiscal submodel. As far

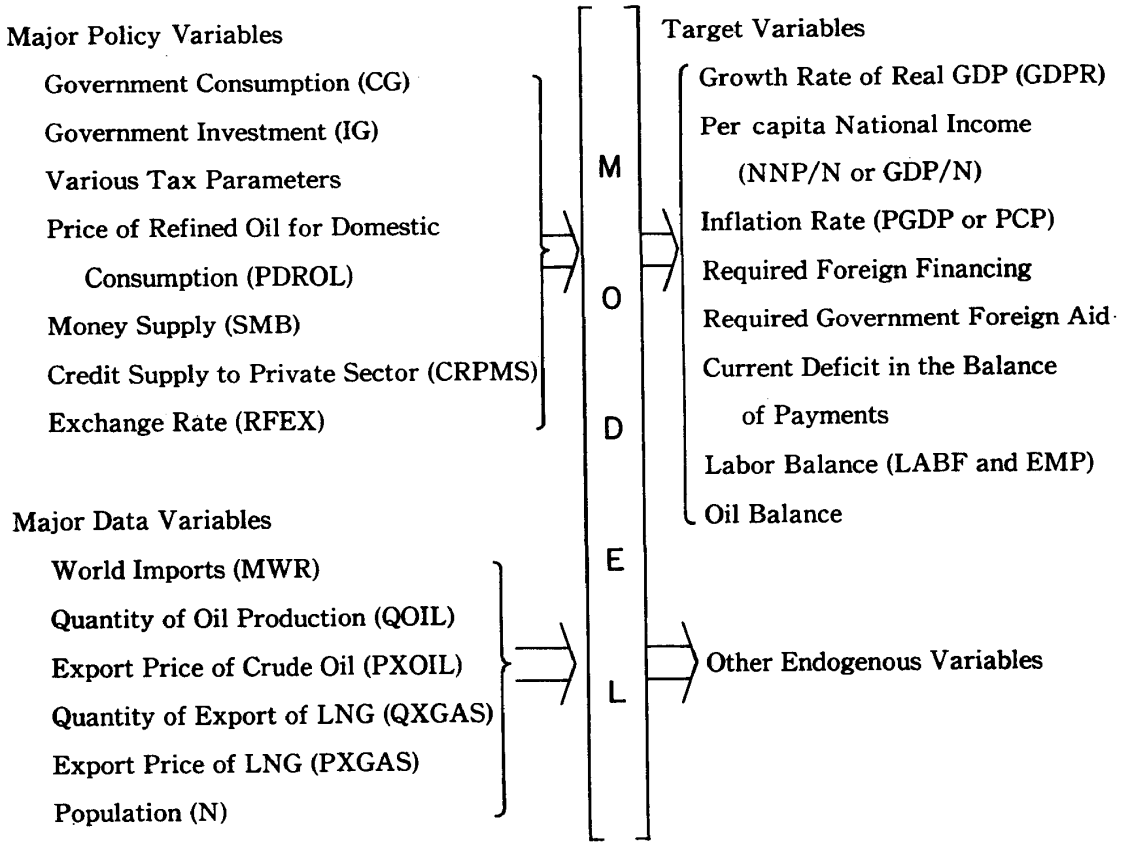

Fig. 5 Policy and Target Variables in the BAPPENAS Macroeconometric Models

as the government revenue is concerned, tax parameters are considered as policy parameters. Although various tax equations were estimated for the sample periods, the parameters of tax equations may be changed so as to estimate the impact of tax reform on government revenue and other economic aggregates during the planning period. Important policy variables in our models are government consumption, which roughly corresponds to the central government's routine expenditure, and government investment, which corresponds to the cental government's development expenditure less defence expenditure and subsidies on fertilizers. The Indonesian Government subsidized petroleum products in the 1970s to keep their domestic prices much lower than international market prices of their equivalents. Facing economic difficulties at the beginning of the 1980s, the Government introduced new policies to reduce the subsidies and to raise the prices to international levels during Repelita IV. To assess the government policy, the price of refined oil for domestic consumption was introduced into the core model as a policy variable. We also sought to introduce a government-regulated price index, made of prices of commodities such as rice and sugar, in order to assess the impact of government price policy on the rate of inflation and other

variables. But lack of data prevented us from making an adequate price index, which should be constructed in the future.

Money supply, which is the nominal supply of broad money in our model, and the loans to the private sector, which is the amount of credit supplied to the private sector by the monetary system, are introduced into our model as government monetary policy variables. As mentioned later, we had difficulty in incorporating these variables into the core model. Exchange rate is one of the most important policy variables.

The other exogenous variables which play an influential role in the macroeconometric model are called here "data variables." World imports, quantity of oil production, and export price of crude oil influence crucially the future course of the Indonesian economy as well as government development policies. Population is treated as a data variable, though it will be a target variable in the long run with the promotion of family planning.

The target variables listed in Fig. 5 are among those required for the economic indicators in the five-year development plan. Such endogenous variables as current balance, rate of inflation and the ratio of foreign aid to government revenue are considered as constraints to the government policies. The Government pursues optimal economic development policies subject to the constraints.

Once endogenous and exogenous variables are determined, structural equations have to be specified and estimated with data for a large enough sample. Broadly, there are two approaches often used in constructing macroeconomic models for developing countries. One emphasizes the supply side, based on the assumption that a shortage of the production capacity of goods and services puts a ceiling on the economic growth of developing countries. We call this "the supply-side approach." The other emphasizes the demand side, based on the assumption that a lack of demand restricts the economic growth of developing countries as well as developed countries. We call this "the demand-side approach." Ideally, both sides should be taken into account simultaneously, for in reality the production and demand sides interact. Emphasis, however, has to be laid on one side or the other in a small econometric model with less than one-hundred equations. A lack of data also compels us to select one approach. Both approaches were tried at the beginning of our model building.

First, the supply-side approach was pursued in the core model. A macro production function of the Cobb-Douglas type was introduced, and private consumption was to be estimated as a residual. But various difficulties were encountered in applying the supply-side approach. One was a lack of data on capital stock and employment. With this approach, sectoral production functions should be estimated. But this was impossible because no data on sectoral capital stock and employmetnt were available. Even on the macro basis, no data on gross capital stock were available. Another difficulty was that the core model based on this

approach could not predict the economic slowdowns which occurred in 1982 and 1983. This model also had difficulty predicting up-swings and down-swings within the sample period. For these reasons, the demand-side approach was adopted at the final stage.

Second, a private consumption function was introduced, and the production function was modified slightly and used in a different functional form for estimating employment. That is to say, the employment function was specified based on the assumption that employment was determined on the production function, given the volume of production and capital stock. The core model based on the demand-side approach showed much better performances in the interpolation and extrapolation tests and could trace the declines in growth rate in 1982 and 1983.

Third, the supply-side approach was also applied to the export functions. Exports were divided into three categories: crude oil, gas, and non-oil and non-gas (non-oil exports for short). In specifying each export function, export was essentially estimated as the difference between domestic production and domestic consumption. Good results, however, were not obtained for non-oil exports, so that a non-oil exports function was introduced. As far as crude oil export was concerned, the supply-side approach was adopted in the final version.

After scrutinizing the results of both approaches, the demand-side approach was selected for all functions except those related to crude oil.

2. *Structual Equations of the Core Model*

The core model consists of 59 equations: 21 structural equations and 38 identities. The fiscal submodel includes 12 tax-and-revenue-sharing equations and one identity. But only the system of equations for the core model is shown in the following "System of Equations." The structural equations of the core model will be explained here. Those of the fiscal submodel are explained in Bappenas and Ministry of Finance [1982]. Equation numbers in the following explanations refer to those in the system of equations.

2.1 Private Consumption Function (Equation 2)

The private consumption function includes real private national disposable income, real money supply and real private consumption with a one-year time-lag as explanatory variables. Since Indonesian national accounts do not include the income and outlay accounts of the household sector, data on household or personal disposable income are not available. The first explanatory variable, (NNP-TY)/PCP, is a proxy variable for real household disposable income. The second explanatory variable, SMB(−1)/PCP(−1), which is real money supply at the end of the previous year, is introduced to represent the real balance effect, through which money supply influences other endogenous variables. Although significant estimates of its coefficient were not always obtained, this explanatory variable was included because the inclusion of money supply in the core model would have become meaningless without money supply in the consumption

Rate of Increase in CPR	Rate of Increase in (NNP−TY) /PCP	Year
(%)	(%)	
3.0	7.6	1970
4.7	6.5	1971
5.8	12.8	1972
11.1	13.0	1973
14.5	18.3	1974
3.6	2.7	1975
8.0	10.6	1976
4.0	7.5	1977
7.5	5.2	1978
14.3	24.7	1979
12.7	14.7	1980
16.7	8.8	1981
3.4	−3.2	1982
7.5	7.9	1983

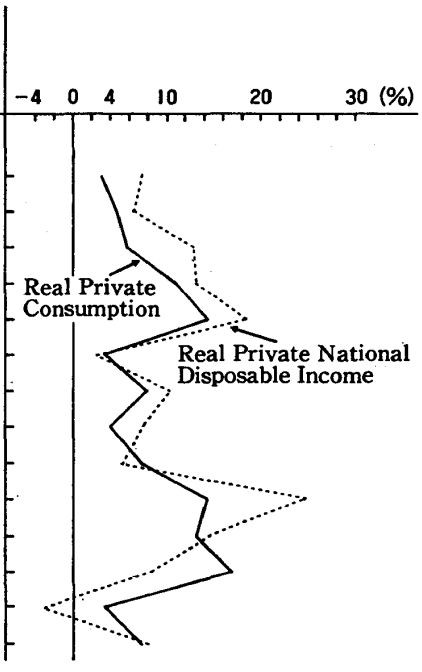

Fig. 6 Rates of Increase in Real Private Consumption and Real Private National Disposable Income

function. Real private consumption with one-year time-lag, CPR(−1), is included based on a distributed lag of the Koyck type.

When the private consumption function was reestimated with the data extended up to 1981, the opposite sign was obtained for the coefficient of real money supply. This seemed to be caused by an extremely high rate of increase in real private consumption relative to real private national disposable income in 1981. As Fig. 6 shows, the rate of increase in real private consumption is extremely high, 16.7 percent, despite the relatively low rate of increase, 8.8 percent, in real private national disposable income. This type of movement was not observed over the sample period 1969 to 1980, although the same phenomenon took place in 1982. A dummy variable was, therefore, introduced into the private consumption function in Core Model-81 in order to treat the private consumption observation for 1981 as an irregular movement.

This irregularity may be caused by the compilation method of private consumption in the national accounts of Indonesia. Private consumption, nominal and real, is compiled as a residual between the sum of gross domestic product and imports and the sum of final expenditures other than private consumption and increases in inventory.

According to our estimates, the long-term prospensity to consume with respect to private national disposable income was 0.613 in Core Model-81 and 0.655 in Core Model-81 and 0.655 in Core Model-83.

2.2 Real Gross Domestic Private Fixed Capital Formation (Equation 4)

The stock adjustment principle was employed mainly to provide explanatory variables for real gross domestic private fixed capital formation (IPR, real private investment for short). Real private investment was regressed on real gross domestic product with one-year lag (GDPR (−1)), net capital stock at the end of the previous year (KPR(−1)), and increase in real credit supply to private sector by monetary system (CRPMS/PI). Other investment theories such as the neoclassical type and Tobin's q could not be tried be-

cause of lack of data.

Bank loans to the private sector influence other endogenous variables through this equation, although a significant estimate of its coefficient was not obtained.

2.3 Exports Functions (Equations 6 through 13, 35 through 40)

Exports of goods and services are disaggregated into three components: oil, gas, and non-oil and non-gas exports. Exports of goods and services in the national accounts of Indonesia are not divided, and data on these components had to be sought from other sources. The sum of these components, therefore, is not necessarily equal to exports of goods and services in the national accounts, but includes statistical discrepancies. Consequently, the statistical equations 13 and 39 were estimated in order to complete the model.

2.3.1 Crude Oil Export and Quantity of Refined Oil for Domestic Use (Equations 6 through 10)

As mentioned, the quantity of crude oil export (QXOIL) is obtained as the difference between production and domestic use, as shown by equation 8.

(1) Crude Oil Export Identity (Equation 8)

QXOIL = QOIL# + QMOIL# − QDOIL + QXOSD#,

where QOIL denotes the quantity of crude oil production, QMOIL the quantity of crude oil import, QDOIL the quantity of crude oil for domestic consumption and QXOSD statistical discrepancy, and the symbol # indicates that the variables are exogenous.

The quantity of refined oil for domestic consumption QDROL is converted into the quantity of crude oil by equation 9, which follows the technical relation for conversion.

(2) Function of the Quantity of Refined Oil for Domestic Consumption (Equation 10)

The quantity of refined oil for domestic consumption (QDROL) is a log-linear function of real total consumption (CR), real total investment (IR) and the ratio of price of refined oil for domestic consumption to consumer price index (PDROL(−1)/PCPI(−1)). The first two explanatory variables represent income effect and the last one represents price effect. Though real GDP was tried as representative of income effect in place of CR and IR, better results were not obtained. The difference in elasticities with respect to consumption and investment are considered to be reasonable. A reasonable and more-or-less stable estimate of price elasticity was also obtained as shown in the system of equations.

It will be desirable in the future version to break down refined oil products into main petroleum products such as kerosene.

2.3.2 Real Gas Export (Equation 11)

Gas export (XGASR) is essentially determined exogenously. Almost all of gas export is LNG, and the quantity is determined by the long-term production and export contracts. The export price of gas (PXGAS) follows that of crude oil, which is an exogenous variable.

2.3.3 Real Non-oil and Non-gas Exports Function (Equation 12)

The real non-oil and non-gas exports (XNOSR) function was specified in accord-

ance with the typical theory of demand function. The explanatory variables consist mainly of real world imports (MWR) as the relevant income variable and the ratio of price of non-oil exports (PXNOS) to world export price (PWX) as the relative price variable. One important channel through which world economic conditions influence other endogenous variables is this equation. A dummy variable was introduced to explain unusually sharp declines in 1982 and 1983, without which the equation did not fit well. One reason for the sharp decline was that Indonesia banned the export of lumber and changed its policy for shrimp export. It should be noted that the estimated price elasticity is very low.

2.4 Import Functions (Equations 14 through 18, Identities 44 through 48)

Imports of goods and services are disaggregated into four components: consumption goods, investment goods, raw materials and intermediate goods, and services and statistical discrepancy. Like the function of non-oil exports, all imports were regressed on a variable representing income effect and a variable representing price effect.

2.4.1 Function of Imports of Consumption Goods (Equation 14)

Imports of consumption goods (MCR) are a function of real total consumption (CR) and the ratio of import deflator for consumption goods to consumption deflator (PMC/PC). A fairly high estimate of price elasticity of consumption-goods-imports demand was obtained. This means that the government policy toward foreign exchange can exert a strong influence on imports of consumption goods, as will be shown in the multiplier analysis.

2.4.2 Function of Imports of Investment Goods (Equation 15)

The long-term elasticity of imports of investment goods with respect to real investment in Core Model-81 is 0.945, much higher than that of imports of consumption goods. The difference between the elasticities is reflected in the difference between the multipliers of government consumption and investment, as will be shown later. In Core Model-83, the estimated long-term income elasticity is 1.014, slightly larger than 1.0, although it should be less than or equal to 1.0. These estimates of coefficients indicate that almost all investments have had to be imported because capital goods industries have not yet been developed in Indonesia.

2.4.3 Function of Imports of Raw Materials and Intermediate Goods (Equation 16)

Real imports of raw materials and intermediate goods were specified as a function of real GDP (GDPR) and the ratio of import deflator for raw materials and intermediate goods to GDP deflator (PMRM/PGDP). Fairly stable estimates of the coefficients were obtained. The fit also improved as more recent data were added to the sample.

2.4.4 Function of Imports of Services and Statistical Discrepancy (Equation 17)

Satisfactory results were not always obtained in terms of fit, although a stable coefficient was estimated for each version. This is due to a defect in the way the data

were compiled. The data on imports of services and statistical discrepancy (MSDR) were compiled as the difference between real imports of goods and services (MR) in the national accounts and the sum of MCR, MIR, and MRMR, which were obtained from other data sources. MSDR, therefore, includes not only imports of services but also statistical discrepancy. The problem is that MSDR accounts for more than half of MR.

2.5 Depreciation Function (Equation 19)

Depreciation is essentially related to capital stock. But in practice, firms accelerate depreciation when they earn better profits, and vice versa. GDP/capital ratio was introduced as a profitability variable in place of profit/capital ratio which was not available. There are two kinds of real depreciation introduced in Core Models-81 and 83. One is real total depreciation, which is needed to derive net national product from gross national product (see equations 54 and 55). The other is net private depreciation, which is used for deriving real private capital stock (see equation 20 (2)).

2.6 Employment Function

The employment function is, as mentioned, derived from the production function together with the adjustment principle. Desired labor demand is assumed to be determined by the production function, given capital stock and output. Let EMP* denote desired labor demand. Then we have,

$$\ln EMP^* = a_0 + a_1 \ln GDPR - a_2 \ln KR(-1),$$

where $a_1 > 0$, $a_2 > 0$.

But firms cannot adjust their employment to the desired level within one year due to various costs involved. So they are assumed to adjust their employment partially. This is formulated as follows,

$$(EMP/EMP(-1)) = \lambda (EMP^*/EMP(-1)),$$

where $0 < \lambda < 1$.

Substituting EMP* into this equation and taking logarithms of both sides gives the following labor demand function:

$$\ln EMP = a_0\lambda + a_1\lambda \ln GDPR - a_2\lambda \ln KR(-1) + (1-\lambda)\ln EMP(-1).$$

The parameter λ represents the speed of adjustment. If λ is large, firms quickly adjust their employment level to the desired level. If $\lambda = 1$, firms adjust their employment completely within one year. According to our estimate of λ, it takes firms about two or three years to adjust their employment to the desired level.

When we used this employment equation, we found that the substitution between capital and labor worked too strongly in the long-term extrapolation. The capital stock variable was, therefore, dropped in the alternative specification of the employment function.

2.7 Labor Force Function (Equation 22)

Labor force (LABF) is simply a function of population (N). Labor force may be exogenously determined by demographic factors. If data on wages were available they would be introduced into this equation.

2.8 Price Functions (Equations 25, 26, 27, and 57)

Two approaches were tried for specifying deflator functions in the core model. One approach is first to specify GDP defla-

tor in accordance with some theory, then to specify other deflators as a function of GDP deflator and other variables. The other is first to estimate individual deflator functions, then to obtain GDP deflator as the ratio of nominal GDP to real GDP. The latter approach is adopted in most other macroeconometric models.

According to the former, GDP deflator plays a central and crucial role in price determination. First, the monetary approach was applied to the specification of the GDP deflator function in the core model. Good results were not obtained, however, especially for the extrapolation. Consequently, the latter approach was adopted in the final version of the core model. In this case, private consumption deflator and investment deflator are essential. In each function the shift parameters of demand and supply functions are basically used as explanatory variables, for prices are assumed to be determined at the intersection of demand and supply schedules.

GDP deflator is determined as an implicit deflator by equation 51.

2.8.1 Private Consumption Deflator Function (Equation 25)

Private consumption deflator (PCP) is a function of real private consumption (CPR), labor productivity (GDPR/EMP), and price of refined oil for domestic consumption (PDROL) in Core Model-81. As mentioned, we sought to introduce a government-regulated price index into this function. PDROL was introduced in place of the price index. A dummy variable was used to eliminate the effect of the irregularity of private consumption in 1981 and 1982. In the 83 version, unfortunately, a significant estimate was not obtained for the coefficient of (GDPR/EMP).

ln PCP	Core Model-81	Core Model-83
Const.	−19.4192 (− 3.22)	−15.6669 (− 8.85)
ln CPR	1.9533 (3.61)	1.7698 (6.92)
$\ln\left(\frac{GDPR}{EMP}\right)$	− 1.0475 (− 1.04)	
ln PDROL (−1)	0.3339 (1.60)	0.1323 (0.89)
DUMPC	− 0.373625 (− 4.01)	− 0.2294 (− 4.01)
$\bar{R}^2$	0.986	0.990

2.8.2 Consumer Price Index Function (Equation 57)

Consumer price index (PCPI) was simply regressed on PCP, as both are of the same kind. PCP covers all goods and services, whereas the coverage of consumer price index is limited. The main difference theoretically is that consumer price index is of the Laspyres type and PCP is of the Paasche type.

2.8.3 Government Consumption Deflator Function (Equation 26)

Government consumption consists mainly of the compensation of government employees and the goods and services which the Government purchases. Government consumption deflator (PCG), therefore, should be a function of the wage rate of government employees and the price of the goods and services. But as the wage

rate was not available, PCG was regressed on a kind of domestic demand deflator $(CP+I)/(CPR+IR) = PCP*CPR/(CPR+IR)+PI*IR/(CPR+IR)$.

2.8.4 Investment Deflator Function (Equation 27)

Investment deflator (PI) is a function of labor productivity, money supply (SMB) and import deflator of investment goods (PMI). We tried to introduce real total investment (IR) in place of SMB, but a significant coefficient of productivity could not be obtained.

Because most investment goods are imported, PMI is assumed to be a dominant factor for PI, but the assumption was not fully supported by our results. This may be ascribed to construction investment.

2.9 Production Function and Capacity Output (Equations 1 and 58)

The production function of the Cobb-Douglas type was estimated. The capacity output equation was derived from the production function by shifting the production function upward by the amount of maximum residual within the sample period. (For details, see appendix B in Kuribayashi [1982].)

Capacity output was used in our model to compare real GDP with capacity output (GDPRC). GDPR/GDPRC ratio more or less expresses a kind of capacity utilization.

2.10 Tax Function (Equations 53 and 56)

Two tax functions were estimated in the core model: a net indirect tax equation and a direct income tax equation. When the core model and the fiscal submodel are integrated, these equations are replaced by the corresponding equations in the fiscal submodel.

3. System of Equations

Notes : 1. The symbol ♯ denotes exogenous variables.

2. The first figure in parentheses after an equation name shows the equation number in *Indonesia's Economic Development and Bappenas Macroeconometric Model, 1969-1980* by K. Kobayashi [1982], and the second figure is its number in *Model Makroekonometri Inti Indonesia* by Bappenas [1982].

3. RR denotes the coefficient of determination adjusted for degrees of freedom, s the standard deviation of disturbances and DW Durbin-Watson ratio.

4. The figures in parenthess below coefficients are t-values of the coefficients.

5. The sample period is from 1969 through 1983.

1. Real Gross Domestic Product (1, 1)

$$\ln(GDPR/EMP) = -0.885399 \underset{(-14.67)}{} + 0.6830 \underset{(13.94)}{\ln(KR(-1)/EMP)}$$

$RR=0.937 \quad s=0.0461 \quad DW=0.47$

For Model I

or

$$GDPR=CR+IR+XR-MR$$

For Model II

2. Real Private Consumption Expenditure (10, 14)

$$CPR=GDPR-(CGR+IR+XR-MR)$$

For Model I

or

CPR=392.24+0.3082(NNP-TY)/PCP
(0.85) (3.60)
+0.3475(SMB#+SMB#(−1))/2/
(0.52)
PCP+0.5296CPR(−1)
(3.29)
PR=0.996 s=170.4 DW=2.04

For Model II

3. Real Consumption Expenditure (9, 15)
CR=CPR+CGR#
4. Real Gross Domestic Private Fixed Capital Formation (12, 23)
lnIPR=−6.0734+2.3411 lnGDPR(−1)
(2.26) (1.41)
−0.9869 lnKPR(−1)
(−0.68)
+0.0609 ln(ΔCRPMS/PI)
(0.71)
RR=0.921 s=0.117 DW=1.26
5. Real Gross Domestic Fixed Capital Formation (11, 24)
IR=IPR+IGR#
6. Real Export of Crude Oil (14, 31)
XOILR=(XOIL$*415.0)/(PXOIL#/4.0094)*1/1000
7. Value of Oil Export in US $(15, 30)
XOIL$=PXOIL#*QXOIL
8. Quantity of Crude Oil Export (16, 29)
QXOIL=QOIL#+QMOIL#−QDOIL+QXOSD#
9. Quantity of Crude Oil for Domestic Use (17, 28)
QDOIL=1/0.7*(1/158.99*QDROL−QMROL#)
10. Quantity of Refined Oil for Domestic Use (18, 27)
lnQDROL=1.10478+0.3542 lnCR
(2.02) (2.54)
+0.6686 lnIR
(6.85)
−0.2672 ln(PDROL(−1)/PCPI
(6.22)
(−1))
RR=0.997 s=0.0278 DW=2.43
11. Real Export of Gas (19, 30)
XGASR=(XGAS$#*415.0)/PXGAS#*1/1000
12. Real Non-oil and Non-gas Exports (20, 32)
lnXNOSR=0.258415+0.9814 lnMWR#
(0.51) (12.3)
−0.1129 ln(PXNOS#(−1)/PWX#
(−2.43)
(−1))
−0.2451DUM8182
(−10.44)
RR=0.953 s=0.0303 DW=2.62
13. Real Total Export (13, 34)
XR=166.24+0.9422(XOILR+XGASR
(1.44) (11.29)
+XNOSR)
RR=0.900 s=113.26 DW=1.17
14. Real Imports of Consumption Goods (23, 41)
lnMCR=2.75952−1.7046 ln(PMC/PC)
(1.42) (4.88)
+0.2892 lnCR
(1.33)
RR=0.873 s=0.189 DW=1.43
15. Real Imports of Investment Goods (24, 42)
lnMIR=−0.7968−0.9797 ln(PMI/PI)
(−1.09) (3.27)
+0.7534 lnIR+0.2568 lnMIR(−1)
(3.50) (1.45)
RR=0.919 s=0.141 DW=0.94
16. Real Imports of Raw Materials and

Intermediate Goods (25, 43)

MRMR = −120.56−159.2 (PMRM/PGDP) +0.0984 GDPR
(−0.75) (−1.68) (10.43)

RR=0.984 s=48.32 DW=2.01

17. Real Imports of Services and Real Statistical Discrepancy (26, 44)

lnMSDR = −17.0284+2.6458 lnGDPR
(−6.99) (9.79)

RR=0.871 s=0.3289 DW=1.34

18. Real Total Import (22, 45)

MR=MCR+MIR+MRMR+MSDR

19. Real Depreciation (8, 3)

(1) DEPR = −745.65+1216.97(GDPR/KR(−1)) +0.0388 KR(−1)
(−4.44) (5.33) (18.17)

RR=0.987 s=19.49 DM=0.57

(2) DEPPR = −1225.18+564.222(GDPR/KPR(−1)) +0.1685 KPR(−1)
(2.70) (2.55) (13.14)

RR=0.982 s=32.34 DW=2.03

20. Real Capital Stock (7, 13)

(1) KR=KR(−1)+IR−DEPR

(2) KPR=KPR(−1)+IPR−DEPPR

21. Employment (4, 10)

lnEMP=3.22128+0.1702 lnGDPR +0.5587 lnEMP(−1)
(2.33) (2.19) (2.89)

RR=0.994 s=0.00938 DW=0.84
For Model I

or

lnEMP=2.21448+0.2273 lnGDPR −0.0862 lnKR(−1) +0.6810 lnEMP(−1)
(1.80) (3.28) (2.39) (4.00)

RR=0.996 s=0.00786 DW=1.52
For Model II

22. Labor Force (5, 11)

LABF = −26331.6+0.5635N♯
(−18.11) (52.38)

RR=0.995 s=550.85 DW=0.40

23. Unemployment (6, 12)

UNEM=LABF−EMP

24. Real Gross National Product (2, 2)

GNPR=GDPR+NFIAR♯

25. Private Consumption Deflator (32, 16)

lnPCP = −15.6669+1.7698 lnCPR +0.1323 lnPDROL(−1) +0.2294 DUM 7080
(−8.85) (6.92) (0.89) (−4.01)

RR=0.990 s=0.0641 DW=1.28

26. Government Consumption Deflator (29, 17)

PCG = −0.0642+1.0396((CP+I)/(CPR+IR))
(−1.04) (70.03)

RR=0.997 s=0.0684 DW=2.26

27. Investment Deflator (30, 25)

lnPI = −4.4014−0.4412 ln(GDPR/EMP) +0.5201 lnSMB♯+0.1351 lnPMI
(−2.27) (−0.69) (4.41) (1.45)

RR=0.994 s=0.0495 DW=1.57

28. Nominal Private Consumption Expenditure (44 or 31, 20)

CP=PCP*CPR

29. Nominal Government Consumption Expenditure (45, 21)

CG=PCG*CGR

30. Nominal Total Consumption Expenditure (43, 22)

C=CP+CG

31. Total Consumption Deflator (,18)
PC=C/CR

32. Nominal Gross Domestic Private Fixed Capital Formation
IP=PI*IPR

33. Nominal Government Investment
IG=PI*IGR

34. Nominal Gross Domestic Fixed Capital Formation (46, 26)
I=PI*IR (=IP+IG)

35. Nominal Oil Export (48, 36)
XOIL=XOIL$*RFEX#*1/1000

36. Nominal Gas Export (49, 39)
XGAS=XGAS#*RFEX#*1/1000

37. Nominal Non-oil and Non-gas Exports (50, 38)
XNOS=XNOS$*RFEX#*1/1000

38. Value of Non-oil and Non-gas Exports in US $ (21, 37)
XNOS$=XNOSR*PXNOS#*1000/415.0

39. Nominal Total Export (47, 40)
X=−74.40+1.0489 (XOIL+XGAS
(−1.01) (115.22)
+XNOS)
RR=0.999 s=196.9 DW=1.42

40. Export Deflator (34, 35)
PX=X/XR

41. Import Deflator for Consumption Goods (36, 46)
PMC=PMC$#*RFEX#/415.0

42. Import Deflator for Investment Goods (37, 47)
PMI=PMI$#*RFEX#/415.0

43. Import Deflator for Raw Materials and Intermediate Goods (38, 48)
PMRM=PMRM$#*RFEX#/415.0

44. Nominal Imports of Consumption Goods (52, 50)
MC=PMC*MCR

45. Nominal Imports of Investment Goods (53, 51)
MI=PMI*MIR

46. Nominal Imports of Raw Materials and Intermediate Goods (54, 52)
MRM=PMRM*MRMR

47. Nominal Imports of Services and Statistical Discrepancy (55, 53)
MSD=PMSD#*MSDR

48. Nominal Total Import (51, 54)
M=MC+MI+MRM+MSD

49. Import Deflator (35, 49)
PM=M/MR

50. Nominal Gross Domestic Product (39, 6)
GDP=C+I+X−M

51. Deflator for Gross Domestic Product (28, 5)
PGDP=GDP/GDPR

52. Nominal Gross National Product (40, 7)
GNP=GDP+PM*NFIAR

53. Nominal Net Indirect Tax
TI=141.46+0.03196 GDP
(3.89) (28.79)
RR=0.983 s=94.85 DW=1.20

54. Nominal Depreciation (42, 8)
DEP=PGDP*DEPR

55. Nominal Net National Product (41, 9)
NNP=GNP−DEP−TI

56. Direct Income Tax
TY=−47.66+0.02871 NNP
(−1.88) (32.03)
RR=0.987 s=66.11 DW=1.27

57. Consumer Price Index (33, 19)
lnPCPI=3.85035+1.02984 lnPCP
(208.66) (45.22)
RR=0.993 s=0.0573 DW=0.93

58. Capacity Output

$$\ln(GDPRC/EMP) = -0.86840 + 0.6830 \ln(KR(-1)/EMP)$$

59. Real Net Factor Income from Abroad

$$NFIAR = -68.11 - 0.1884(XOIL + XGAS) \quad (-2.32)\ (-14.29)$$

$$/PM$$

$$RR = 0.936 \quad s = 65.0 \quad DW = 1.46$$

4. Notation of the Variables

Notes: 1. The symbol # denotes exogenous variables.

2. Real =1973 constant price. Nominal=current price.

C =Nominal Consumption Expenditure

CG =Nominal Government Consumption Expenditure

CGR# =Real Government Consumption Expenditure

CP =Nominal Private Consumption Expenditure

CPR =Real Private Consumption Expenditure

CR =Real Consumption Expenditure

CRPMS# =Amount of Credit Supply to Private Sector by Monetary System

DEP =Nominal Depreciation

DEPPR =Real Private Depreciation

DEPR =Real Depreciation

DUM7080=Dummy Variable for Private Consumption Deflator (1 for 1970-1980, 0 for 1980-1983)

DUM8182=Dummy Variable for Non-oil and Non-gas Exports (1 for 1981-1982, 0 otherwise)

EMP =Total Employment

GDP =Nominal Gross Domestic Product

GDPR =Real Gross Domestic Product

GDPRC =Real Capacity Output

GNP =Nominal Gross National Product

GNPR =Real Gross National Product

I =Nominal Gross Domestic Fixed Capital Formation

IG =Nominal Gross Government Fixed Capital Formation

IGR# =Real Gross Government Fixed Capital Formation

IP =Nominal Gross Domestic Private Fixed Capital Formation

IPR =Real Gross Domestic Private Fixed Capital Formation

IR =Real Gross Domestic Fixed Capital Formation

KPR =Real Private Capital Stock

KR =Real Total Capital Stock

LABF =Total Labor Force

M =Nominal Total Import

MC =Nominal Imports of Consumption Goods

MCR =Real Imports of Consumption Goods

MI =Nominal Imports of Investment Goods

MIR =Real Imports of Investment Goods

MR =Real Total Import

MRM =Nominal Imports of Raw Materials and Intermediate Goods

MRMR =Real Imports of Raw Materials and Intermediate Goods

MSD =Nominal Statistical Discrepancy for Import Sector

MSDR =Real Statistical Discrepancy for Import Sector

MWR# =Real World Imports
N# =Population
NFIA =Nominal Net Factor Income from Abroad
NFIAR =Real Net Factor Income from Abroad
NNP =Nominal Net National Product
NNPR =Real Net National Product
PC =Consumption Deflator
PCG =Government Consumption Deflator
PCP =Private Consumption Deflator
PCPI =Consumer Price Index
PDROL# =Price of Refined Oil for Domestic Consumption
PGDP =GDP Deflator
PI =Fixed Capital Formation Deflator
PM =Import Deflator
PMC =Import Deflator for Consumption Goods
PMC$# =Dollar Price Index for Consumption Goods Imports
PMI =Import Deflator for Investment Goods
PMI$# =Dollar Price Index for Investment Goods Imports
PMRM =Import Deflator for Raw Materials and Intermediate Goods
PMRM$# =Dollar Price Index for Raw Materials and Intermediate Goods Imports
PMSD# =Import Deflator for Services and Statistical Discrepancy
PX =Export Deflator
PXGAS# =Price Index of Gas Export in US $
PXNOS# =Price Index of Non-oil and Non-gas Exports in US $
PXOIL# =Export Price of Crude Oil in US $ per barrel
PWX# =World Export Price
QDOIL =Quantity of Crude Oil for Domestic Consumption in million barrels
QDROL =Quantity of Refined Oil for Domestic Consumption in million liters
QMOIL# =Quantity of Crude Oil Import in million barrels
QMROL# =Quantity of Refined Oil Import in million barrels
QOIL# =Quantity of Oil Production
QXGAS =Quantity of Export of LNG
QXOIL =Quantity of Crude Oil Export in million barrels
QXOSD# =Statistical Discrepancy for the Quantity of Oil Export
RFEX# =Rate of Foreign Exchange
SMB# =Nominal Supply of Broad Money
TI =Nominal Net Indirect Tax
TIME# =Time Trend
TIR =Real Net Indirect Tax
TY =Direct Income Tax
UNEM =Unemployment
X =Nominal Total Export
XGAS =Nominal Value of Gas Export in billion Rp
XGAS$# =Nominal Value of Gas Export in million US $
XGASR =Real Gas Export in billion Rp
XNOS =Nominal Value of Non-oil and Non-gas Export in billion Rp
XNOS$ =Nominal Value of Non-oil and Non-gas Exports in million US $
XNOSR =Real Non-oil and Non-gas Exports in billion Rp
XOIL =Nominal Value of Crude Oil

Export in billion Rp

XOIL$ = Nominal Value of Crude Oil Export in million US $

XOILR = Real Crude Oil Export in billion Rp

XR = Real Total Export

IV Multiplier Analysis

One of the primary advantages of making use of econometric models for economic planning is to be able to evaluate policy effects quantitatively. The short- and medium-term impacts of policy variables on target variables are analysed with Core Model-81 in this section.

To measure the impacts of changes in an exogenous variable on endogenous variables, all endogenous variables are first solved over the pre-assigned period with given values of all exogenous variables. This set of estimates of all endogenous variables is usually called a "control solution" or "standard solution." Second, the values of specific exogenous variables are changed by a fixed amount and the model is solved for endogenous variables. We call this set of values of all endogenous variables a "disturbed solution." Then, the impacts can be assessed by comparing the disturbed solution with the control solution, the differences between them usually being taken.

With respect to real government investment (IGR) and real government consumption (CGR), each of them was increased by 100 billion rupiahs every year in each simulation. This is called "sustained increase" hereafter. The differences between the disturbed solution and the control solution for real GDP, total real demand and balances of international trade of goods and services are shown in Table 5. Multipliers can be obtained by dividing the values of each endogenous variable by the changes in real govenment investment or consumption, 100. To take real GDP for example, the impact multiplier

Table 5 IGR and CGR Multipliers

(unit: billion rupiahs)

		1983	1984	1985	1986	1987	1988
Real GDP	IGR	62.5	76.4	70.7	61.5	54.6	50.2
	CGR	81.6	104.4	100.7	91.3	84.4	80.5
Total Real	IGR	114.8	147.0	141.8	127.9	117.2	111.4
Demand	CGR	136.6	183.5	182.4	168.2	157.0	151.4
X-M	IGR	−297.9	−422.2	−466.6	−477.6	−492.2	−521.7
		(−0.331)	(−0.435)	(−0.458)	(−0.447)	(−0.438)	(−0.442)
	CGR	−171.2	−316.3	−356.1	−349.7	−341.8	−349.3
		(−0.190)	(−0.326)	(−0.350)	(−0.327)	(−0.304)	(−0.296)

Notes: 1. These figures are based on sustained increase of 100 billion rupiahs in real government investment and consumption respectively.
2. The figures in parentheses are measured in billions of U.S. dollars.
3. X = exports of goods and services at current prices.
M = imports of goods and services at current prices.

Table 6 QOIL, PXOIL, and RFEX Multipliers

		1984	1985	1986	1987	1988	1989
Growth Rate of Real GDP (%)	QOIL	0.08	0.11	0.10	0.08	0.07	0.05
	PXOIL	0.04	0.05	0.05	0.03	0.02	0.01
	RFEX	0.44	0.56	0.50	0.39	0.30	
Total Tax (billion rupiahs)	QOIL	80.0	275.5	530.0	859.4	1276.9	1783.1
	PXOIL	84.4	270.3	494.0	766.8	1074.3	1420.5
	RFEX	595.8	2440.6	4792.2	7620.6	10933.0	
X-M (billions of U.S. dollars)	QOIL	0.120	0.256	0.413	0.597	0.813	1.043
	PXOIL	0.133	0.265	0.415	0.573	0.726	0.885
	RFEX	0.744	1.593	2.668	4.064	5.863	

Notes: 1. Sustained one-percent increase for QOIL and PXOIL.
2. Sustained five-percent increase for RFEX.

is 0.625, and the medium-term multiplier reaches its highest value, 0.764, in the second year and declines in subsequent years. In developed countries such as the United States and Japan, the impact multiplier is usually around 1.3 and the medium-term multiplier peaks at around 2.0. These low multipliers for real government investment in the Indonesian economy are ascribed to high leakage through direct and indirect imports, as mentioned above concerning import functions. According to an econometric model for the Republic of Korea constructed by the Economic Research Institute, Economic Planning Agency, Japan, government investment multipliers are also less than 1.0. This may be a common feature of developing countries. In comparison with IGR multipliers, CGR multipliers, which are slightly larger than 1.0 at the peak, are larger.

Instead of a sustained, fixed amount of increase in an exogenous variable, the impacts of a sustained percentage increase were estimated for the quantity of crude oil production (QOIL), export price of crude oil (PXOIL) and foreign exchange rate (RFEX), and are shown in Table 6.

Comparison between QOIL and PXOIL shows that the sustained one-percent increase in crude oil production has a larger effect than the same increase in the export price of crude oil. Simply dividing the results for RFEX by five tells us that a sustained one-percent devaluation of foreign exchange has the same effects on the growth rate of real GDP as the same increase in crude oil production, but much larger effect on tax revenue and trade balance.

V Concluding Remarks

As mentioned in Repelita IV, macroeconomic models were employed in order to obtain a better consistency in the planned macroeconomic aggregates. Numerous policy simulations were conducted with the macroeconometric model before a final conclusion was reached. In our experience with Indonesian development planning, macroeconometric models can play a central

role and give fresh and deep insights into the problems and issues in the future and policy measuses for dealing with them.

One advantage of employing macroeconometric models for economic planning is that the actual course of the economy can easily be compared quantitatively with the planned one, and the planned policy measures can be revised if necessary, while implementing the plan year by year. This means that a rolling plan can be introduced.

For that purpose, the macroeconometric models have to be re-estimated with extended data and revised every year if necessary. The core model and the fiscal submodel have so far been re-estimated three times. Fairly stable parameters were estimated for structural equations, although a one-year extension of the data has a significant influence because of the smallness of the sample size.

Needless to say, there exist several shortcomings in the core model, which are mainly attributable to lack of data. These shortcomings have to be remedied and the core model revised in the following directions.

(1) Price equations have to be revised, introducing wage rate and government-regulated price index into them. In particular, the investment deflator function needs to be re-specified without money supply in the explanatory variables.

(2) It is desirable that the quantity of refined oil for domestic consumption should be disaggregated into components such as kerosene. This will be closely related to the energy submodel which has not yet been completed.

(3) If available, data on imports of investment goods which are directly related to government investment should be compiled and used in the core model.

(4) It is desirable that non-oil exports should be disaggregated at least into primary commodities, manufactured goods, and services.

(5) Reliable data on labor force, employment, and population have to be compiled, because they belong to the most important economic indicators in the Indonesian economy.

(6) Indonesian national accounting data do not include national disposable income and its appropriation accounts and income and outlay accounts by institutional sectors. Although this shortcoming is common in developing countries, high priority should be given to their compilation. If they are provided, our models will be markedly improved.

(7) Our macro models will be improved and refined by comparing them with macro models of other developing countries. In other words, some study and research will be needed on constructing the same kind of macro models for other developing countries.

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