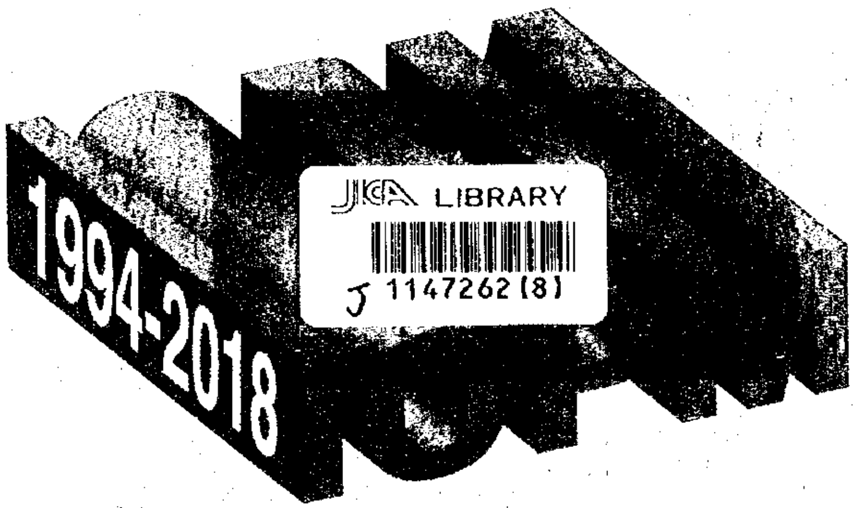
JAPAN INTERNATIONAL COOPERATION AGENCY
IN COOPERATION WITH
NATIONAL DEVELOPMENT PLANNING AGENCY(BAPPENAS)
REPUBLIC OF INDONESIA

DEVELOPMENT STUDY OF ECONOMIC MODEL FOR PLANNING EXERCISES, LONG TERM PROGRAMMING MODEL IN THE REPUBLIC OF INDONESIA

FINAL REPORT
(SUMMARY)



NOVEMBER 1998

DAIWA INSTITUTE OF RESEARCH LTD.
ENGINEERING CONSULTING FIRMS ASSOCIATION, JAPAN

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PREFACE

In response to a request from the Republic of Indonesia, the Government of Japan decided to conduct the Development Study of Economic Model for Planning Exercises, Long-term Programming Model in Indonesia and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Tomohiro Abe, Senior Managing Director, Daiwa Institute of Research Ltd. and consisted of Daiwa Institute of Research Ltd. and Engineering Consulting Firms Association, JAPAN, to Indonesia seven times between September 1995 and November 1998. In addition, JICA set up a steering committee headed by Prof. Dr. Takao Fukuchi, Asahi University, which examined the study from technical points of view.

The team together with the committee held a series of discussions with the concerned officials of the Government of the Republic of Indonesia. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of the economic and social development of the Republic of Indonesia as a effective planning tool, and also to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the study.

November 1998

Kimio Fujita
President
Japan International Cooperation Agency

FOREWORD

This document is the final report of three years study of "Development Study of Long-Term Model For Economic Planning" which was asked by and implemented in collaboration with National Development Agency (BAPPENAS) of Indonesian Government. When BAPPENAS asked JICA to consider this Development Study, the Government of Indonesia planned to further increase per-capita income and join to middle-income group after 25 years, and engaged in the Sixth Repelita and also in the Second 25 Years Plan after 1994. The basic framework of planning model of this study, Input-Output Multi-Periods Programming Model (IOPM), was proposed and constructed as a useful tool to consider the interrelationships of these plans and various important structural constraints, and efficiently prepare these plans in a consistent manner.

The development study aimed to construct IOPM for coming 25 years; and calculate out the optimum figures of basic variables (26 sectors, 5 periods, 5 variables) for coming 25 years on national as well as regional basis; and clarify the importance of long-term constraints, necessary speeds of resources accumulation, and regional tasks; and clarify the feasible and optimum growth path and future policy issues. These scheduled tasks were implemented by national as well as regionally decomposed versions.

As the economy of Indonesia has been hit by Asian economic crisis after the summer 1997, the government of Indonesia has tackled many urgent tasks of crisis management and social safety network. Even in such a crisis period, it is still important to keep in mind the medium problems like debt management and efficient utilization of labor force. After the crisis period, a new development plan will be needed based on new vision and wider scope. The basic framework of IOPM can be also a useful policy tool to prepare a recovery plan for the normal growth path, and to formulate the future sustainable growth path. The Team hopes that IOPM can be utilized in various occasions as a useful policy tool for future development of Indonesian economy.

November 1998

Takao Fukuchi
Chairman
Steering Committee

November 1998

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Fujita

Letter of Transmittal

Submitted with this letter is our final report on Development Study of Economic Model for Planning Exercises, Long-term Programming Model in the Republic of Indonesia. This study aimed to build the Input-Output Multi-Period Programming Model (IOPM) including its mastery technology transfer to National Development Planning Agency of the Republic of Indonesia (BAPPENAS) and to forecast the development path of coming twenty-five years under various development targets and structural constraints. IOPM is expected to serve to check the feasibility, consistency and optimality of long-run planning such as the Second Twenty-five Year Plan (PJP II).

The report contains main simulated results of both national IOPM and two-region IOPM and also the research of selected important development issues. The economic circumstance of the Republic of Indonesia drastically changed by the current economic crisis erupted in the summer of 1997. Taking these change into consideration, we modified both IOPM's and recalculated the future growth paths. The main results are also provided in this final report.

We are indeed grateful for the advice, encouragement and support afforded to us by the staff of the Agency as well as the Ministry of Foreign Affairs of Japan, and the staff of Embassy of Japan in Jakarta. On this occasion we also wish to express our gratitude for the assistance provided by the personnel of BAPPENAS.

Tomohiro Abe
Leader
JICA Study Team

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Executive Summary

(1) Purpose of the Project: Three Basic Requirements for Planning Framework

The IOPM project started in April 1995. The main purpose was to construct a suitable quantitative framework to prepare a double-track economic planning system: medium-term plan and long-term plan. When the government prepares a series of medium-term five years plan on one hand, and a long-term plan on the other, it is highly desirable to prepare figures which satisfy three conditions: feasibility, consistency and optimality. Each planned figure must be feasible so that it satisfies structural constraints. All the planned figures must be consistent, so that their implications are in harmony. Finally the planned figures must be optimal so that they achieve the development targets as closely as possible. When the Government of Indonesia (GOI) prepares a series of Five Year Plans (Repelitas) and Twenty-five Year Plans (PJP II), such a quantitative framework is expected to check the consistency between targets and constraints, to confirm the feasibility of planned figures, and to show the optimality of planned figures in achieving the development targets.

(2) Proposed Framework: IOPM (National Basis and Two-Regions)

After JICA was asked to prepare such a quantitative framework, the JICA Study Team proposed, as a useful tool for this purpose, an Input-Output Multi-Periods Programming Model (IOPM). This model is based on I-O Table of 1993 with 28 sectors, and considers three main structural constraints of capital, skilled labor and foreign currency. It then calculates the optimum growth path of the Indonesian economy, which maximizes a weighted sum of consumption stream and capital stock in the final period. Actually, the Study Team constructed two versions of this IOPM: one on a national basis and another on a two-region basis. The IOPM on the national basis contains 650 variables of 5 types(output, consumption, investment, export and import for final demand), 26 sectors, and 5 periods(five consecutive periods of five years). It calculates the optimum values of these variables simultaneously. The IOPM on the two-region basis divides Indonesia into two: Java and Outside Java, so that the number of variables is about doubled, and calculates the optimum values of the variables of both regions to maximize the set target. In these exercises, the targeted questions to be answered were: what are the feasible and optimum growth paths in PJP II period on a national basis; are the planned figures consistent and feasible; what are the adequate planned figures in the coming Repelita VII period; and what is the well-balanced pattern of regional development in the PJP II period.

(3) Influence of Recent Economic Crisis

As the current economic crisis erupted in the summer of 1997, the JICA Study Team was additionally asked to take into consideration the impact of the shock, and to recalculate the future growth path. The Study Team implemented this additional information based into both the national basis and two-region basis IOPM models. The main projections are summarized below as classified into four combinations: national versus two-region basis, and with and without economic crisis.

1) Main Results (National IOPM): Development Path without Economic Crisis

It was postulated that the skilled labor could shift from the agricultural sector to the non-agricultural sector only gradually while the constraints of capital and foreign currency were levied nationwide; the foreign currency earning by export sectors could be utilized to import by other sectors or for final demand use. In the optimum growth path, limited resources such as labor, capital, and foreign currency, were found to be fully utilized based on technological changes, changes of sectoral decomposition, and intersectoral resource movements. Based on various experiments, the feasibility and optimality of a rapid development path with an average growth rate of 8.6 percent was ascertained (experiment Case 4). In that case, based on a strong industrialization trend, the per capita GDP of Indonesia will reach 3,800US$ by year 2018 at the end of PJP II period. This is similar to the current per capita GDP of Brazil. In addition, the GDP share of the manufacturing sector will increase from 22.0% to 37.6%. As a whole, it was concluded that the development path scheduled in PJP II Plan is basically attainable, and the economy of Indonesia will successfully catch up with the middle-income group of developing countries. These results were reported at the end of 1996.

2) Main Results (National IOPM): Development Path with Economic Crisis

We considered several cases of changing future exchange rate. In Case B1-44, the rate is scheduled to change from 2,087Rp/$ in 1993 to 5,805Rp/$ in 2018. We revised the model in various aspects: (i) the initial conditions(the values of the first period) were adjusted under the consideration of the influence of recent economic crisis; (ii) the future export and import prices were changed based on the pass-through effects due to the change of the future exchange rate; and (iii) the nominal foreign currency constraints in future periods were revised accordingly. The loss of economic growth, or the social cost of the economic crisis due to deterioration of the exchange rate is clearly seen by lowering the overall growth rate and by slowing down the speed of industrialization. The average growth rate decreased by 2.0% from 8.6% to 6.6% after the shock (Case B1-44). The GDP share of manufacturing decreased from 37.6% to 34.4% after the shock. The per-capita real GDP level (1993 price) in 2018 with the shock was similar to that of 2013 without the shock. This implies a delay of economic growth by 5-6 years. The loss in nominal terms would be far bigger because of the quick deterioration of the exchange rate after 1997 will persist for some years before regaining the previous level.

3) Main Results (Two-Region IOPM): Development Path without Economic Crisis

The average growth rate in PJP II period was 7.6%(Java), 10.2%(Outside Java) and 8.9%(Indonesia) when skilled labor is mobile between regions. This is roughly comparable with the average growth rate of the national IOPM. However with the limitation of interregional labor movement, the growth rate of Java increased to 9.2%, while that of Outside Java decreased to 8.5%. The overall growth rate of Indonesia remained the same. The fact that the growth rate of Outside Java is bigger (smaller) than that of the national average when the labor is (not) freely mobile implies: (i) the increase of interregional resource movement accelerates the development of the national economy; and (ii) Outside Java region has a better potential capacity of development when capital, labor and foreign currency are freely mobile. In other word, the resource allocation is over-concentrated in Java region.

4) Main Results (Two-Region IOPM): Development Path with Economic Crisis

In this model the exchange rate changes from 2,087Rp/$ in the first period, to 7,000Rp/$ in the third period and after. The national average growth rate decreased to 7.3% from 8.9% in the standard case without shock. The Java rate drastically decreased from 9.2% to 4.6%, while that of Outside Java slightly increased from 8.5% to 9.5%. This implies that (i) Indonesia as a whole incurred considerable damage due to the shock, but (ii) Outside Java gained while Java was damaged. In Outside Java, the manufacturing sector, especially the resource-based industries, drastically increased their share of GDP. This reflects the fact that the big depreciation of the exchange rate damages the import-dependent manufacturing sector, while it favors the exporting industries mainly based on domestic resources, which are mainly located in outer regions.

(4) Additional Tasks

The current exercise proved that the IOPM is a useful tool for checking feasibility, consistency and optimality of medium-term plans (such as Repelita VII) and long-term plans (such as PJP II). There are two groups of additional tasks: 1) extension and improvement of the current IOPM, and 2) deeper and more comprehensive analysis of the current economic crisis.

1) The Extension and Improvement of Current IOPM

(i) Use of I-O Table 1995

The current IOPM was based on I-O Table of 1993, which is a tentative table, and did not divide the technical coefficients into domestic and imported components. This separation was made only in I-O Table of 1990. It has ,thus, been impossible to project the changing trend of import coefficients for the future. Comparing the 1995 Table with the 1990 Table, we can adequately project the import coefficients, and assess the trend of import substitution and related matters.

(ii) Extension of Two-Region Table to Five-Region Table

The current two-region IOPM divides Indonesia into Java and Outside Java. It is highly desirable to construct a five-region IOPM, and to assess issues like Transmigration problem, and interregional equity issue.

2) Comprehensive Analysis of Current Economic Crisis

As a results of current economic crisis, proposed two additional tasks are needed to respond to the planning needs under the new environment: short-term crisis management, and medium-term and long-term debt management.

(i) Short-Term Crisis Management (Stopping Economic Free Fall)

One of the results of the social safety net needed for vulnerable groups is an addition to the acceleration of inflation, which gives pressure for further exchange rate depreciation. What measures are effective to cut such a vicious cycle, and stop the free fall of the economy ? This task urges the use of various short-term models.

(ii) Medium-Term and Long-Term Debt Management

The external (official and private) and also domestic (government) debts are accumulating, and pose a tremendous pressure of debt servicing in the future. What are the relations between short-term and long-term capital movements and the exchange rate? What is the relation between debt management and the real economy ? What measures are effective to dispose of accumulated debts? What is the long-term cost of the disbursement of current subsidies in the future?

3) Necessity of a Combined Use of IOPM and Short-Term Models and Debt Model

These discussions urge three considerations: (i) new models are necessary to assess the short-term problems and debt issues; (ii) the treatment of short-term problems needs to be assessed also from the long-term point-of-view; and (iii) an adequate combined use of these models with IOPM will be very useful to assess currently important issues (like fiscal stance, inflation, adequate level of exchange rate, social safety nets, employment creation, and others) in a comprehensive manner.

Chapter 1

Long Term Perspective of Indonesian Economy by National IOPM

1.1 Description of the Basic Framework of National IOPM

During the decade of 1990's, the economy of Indonesia has been undergoing drastic structural changes, and experiencing a turning point for the modernization. "An important feature of the 1991 national accounts is that for the first time in the nation's history the output of manufacturing exceeded that of agriculture. This is an historic turning point in Indonesian economic development" (Hill, 1992,p.5). The share of agricultural employment was 50.4 per cent in 1990 (Manning, 1995, p.60), the employment share of non-agricultural sector will become dominant in the near future. The PJPII will be an important driving force in this important period of structural changes toward further modernization of the Indonesian economy. The main purpose of modeling exercises of this study project is to explore the various feasible development paths and to compare these paths under different policy targets, and to present some useful information about the possible and desirable future structural changes and the corresponding necessary policy actions.

The main component utilized in this report is a multi-period input-output mathematical programming model. This model is basically a combination of (1) the modern optimization methodology of mathematical programming theories and (2) the wide and dynamic description of the whole national economy by I-O Table.

The IOPM is a large scale mathematical planning model, so that both the cost of implementation and the benefit of utilization are also expected to be quite large. At the cost side, the construction of IOPM requires a great deal of statistical data and of supporting information for the model building. At the benefit side, IOPM is an extremely useful tool to get insight into the dynamic structure of the economy from a general equilibrium point-of-view, as it seeks the optimal growth path of the economy under various important structural constraints. We will try to present various different scenarios for multi-period development process. Accordingly, it is quite important to recognize the actual structure of the model, and relevant data requirements on one hand, and then the scopes and the implications of the different scenarios on the other.

In Indonesia, the preparation and the systematization of various data sets in the form of social accounting matrix (SAM) was tried at national basis (see Keuning, 1991 and 1994), but the SAM has not been utilized for the policy making purposes so far. There are some discussions to extend SAM at regional basis in the future (see Tirta, 1991). The construction and application of IOPM for long term planning would further stimulate the better preparation of statistical system and the wider use of SAM for policy purposes.

LP is a part of mathematical optimization tools that assumes (1) linear technology constraints where the input coefficients of resources of each production activity are fixed, (2) linear optimization target in which the price of product of each activity is fixed, (3) non-negativity of the variables that the level of activity or the production level is non-negative. In general, when there are n activities (or products) and m resources, LP seeks to find out the optimum combination of m activities (kinds and volumes of products) which maximizes the total sale (sum of prices and production volumes).

It is well recognized that, for a LP problem, there exists another linear programming problem, which is dual to the original problem. This dual programming problem minimizes the total resource cost, postulating that the price of i-th product does not exceed the accounting cost of i-th activity. Based upon the duality theorem, the maximum sale coincides with the minimum resource cost when the optimum solution exists. Thus the most simplified form of a linear programming problem can be specified as follows: Each vector is defined as a column vector.

(maximizing problem)

$$MAX \quad P'X \tag{1-1}$$

$$AX \leqq 0 \tag{1-2}$$

$$X \geqq 0 \tag{1-3}$$

(minimizing problem)

$$MIN \quad S'V \tag{1-4}$$

$$A'V \geqq 0 \tag{1-5}$$

$$V \geqq 0 \tag{1-6}$$

where

$P = (p_1, ..., p_n)'$, $X = (X_1, ..., X_n)'$, $A = (A_1, ..., A_n)$, $A_i = (a_{1i}, ..., a_{mi})'$, $S = (S_1, ..., S_m)'$, $V = (V_1, ..., V_m)'$

1) The input coefficient of j-th resource (a_{ji}) of i-th activity (A_i) is fixed.
2) The price of i-th product (P_i) and the endowment of k-th resource (S_k) are fixed.
3) The activity level of i-th activity or the output of i-th product (X_i) and the shadow price of k-th resource (V_k) are non-negative. The optimum solution gives the optimal combination of m activities (X^*) and m shadow prices of resources (V^*). When $n < m$, (m-n) disposal activities are added to secure non-negative solution. The accounting price of each activity is defined as the sum of the product of the input coefficients and the corresponding resource shadow prices. When an activity is adopted in the optimum solution, its price exactly matches to its accounting cost. When an activity is not adopted, its accounting cost exceeds its price. This Simplex Criterion identifies the selected activities of same number with resources. When a structural constraint is dull in the optimum solution, its shadow price becomes zero, implying that an additional input of the resource does not contribute to increase the total sale so that its marginal productivity is zero.

Until now, the method of linear programming is usually applied to specific issues to figure out the optimal program of some activities; for example, Arifin (1993) applied to the local transmigration problem.

Another main component of IOPM is I-O Tables for Indonesian economy. The input-output analysis starts out from the division of national economy into many sectors (at most 540 sectors as in the USA). By obtaining the tabled description of the inter-industry transactions of basic year among production sectors and final demand sectors, we may calculate the technical coefficient matrix A, assuming that the production function in each sector is fixed coefficient type without joint-output. The Leontief inverse matrix of (U-A) describes the overall multiplier repercussion effects of one unit increase of final demand (Y), where U stands for identity matrix.

$$(U\text{-}A)\,X = C + I + E \qquad (1\text{-}7)$$

$$X = (U\text{-}A)^{-1} \times (C + I + E) \qquad (1\text{-}8)$$

When the coefficient row vectors of capital (k), of labor (l) and of import (m) are given, the various quasi-inverse matrices (QK, QL, QM) can be calculated by multiplying these coefficient vectors to the Leontief inverse matrix.

$$QK = k \times (U\text{-}A)^{-1} \qquad (1\text{-}9)$$

$$QL = l \times (U\text{-}A)^{-1} \qquad (1\text{-}10)$$

$$QM = m \times (U\text{-}A)^{-1} \qquad (1\text{-}11)$$

These quasi-inverse matrices represent the direct and indirect additional needs of resources like capital, labor and foreign currency by one unit increase of final demand component. When the capital requirement can be given in a matrix form, then QK is also a matrix which shows the capital requirement by investment goods after an adding vector is multiplied from left-hand side. The change in capital utilization rate is an important factor to decide the short-term capital-output ratio (see, Jansen-Kuyvenhoven, 1987), but in this study we assume that the rate is fixed at the average level since we are dealing with long-term projections. Several interesting studies can be implemented based upon the inverse and quasi-inverse matrices.

The use of input-output technique for economic analysis is relatively new in Indonesia. In the past, there were a few studies employing I-O Table to empirically study some policy issues. The scarcity of studies mainly originated from the technical and economic difficulties of preparing I-O Tables. To quote a few: Kuyvenhoven, Arie and Huib Poot (1986) used the I-O Table in 1980, and grouped 79 manufacturing subsectors into three groups (highly labor-intensive, labor-intensive, intermediate labor-intensive), and ranked each subsector according to labor coefficient, import coefficient, and capital coefficient. These ordering is useful to identify the optimum industrial structure when a specific resource constraint is politically emphasized. Fane-Phillips (1991) and Wymenga (1991) analyzed the degree of economic protection, and calculated the effective protection rates. Poot (1991) analyzed the industrial linkages utilizing I-O Table. Fujita-James (1992) calculated the employment multiplier. Siregar (1993) also calculated the income and employment multipliers for agricultural sectors.

The current IOPM is a programming model, and seeks to find out the optimal multi-period growth path of the Indonesian economy under the various important structural constraints and with the various planning targets. The construction of IOPM follows the following three steps:

(1) specification of the important structural constraints
(2) specification of target function
(3) addition of some side conditions

(1) Specification of the Important Structural Constraints

There are several important structural constraints which restrict the expansion of the Indonesian economy. Among them we considered the following most important ones.

1) Capital constraint: the capital requirement cannot exceed the currently existing average capital stock (K(t)).

$$k\,X(t) \leqq [K(t)+K(t-1)]\,/\,2 \qquad (1\text{-}12)$$

$$K(t) = K(0) + (1-d)^{t-1}\,I(1) + \ldots + (1-d)\,I\,(t-1) + I(t) \qquad (1\text{-}13)$$

Here the current capital is defined as the sum of initial stock plus investment of preceding periods with corresponding rate of depletion, assuming that the invested capital is depleted by a depreciation rate (d) in each period.

2) Foreign currency constraint: the use of foreign currency by import cannot exceed the foreign currency earning by export plus the maximum permissible value of trade balance deficit in dollar terms (F(t)).

$$Pm(t)\,[m\,X(t) + M^*(t)] \leqq Pe(t)\,E(t) + F(t) \qquad (1\text{-}14)$$

Here Pe(t) or Pm(t) denotes the row vector of export price or import price in dollar terms. In this case, m stands for a diagonal matrix with import coefficients as diagonal elements. The M*(t) stands for the final demand part of the import.

3) Labor constraint: the use of skilled labor is limited by its supply (L(t)).

When l stands for a row vector with spectral coefficient of skilled labor requirement, the constraint is written as follows:

(2) Specification of Target Function

The main component of maximizing target is the sum of the discounted flow of consumption (C(t)) over the planning period (T). Another component is the capital stock at the end of the period (K(T)) evaluated by a coefficient (β). This component is necessary due partly to avoid the complete concentration to consumption to the end of planning period, and also to consider the carry-overs of productive capacity for the further generations at the end of the planning period.

$$\sum_{j=1}^{T} C(j)/(1+\rho)^{(j-1)} + \beta K(T)/(1+\rho)^{(T-1)} \qquad (1\text{-}16)$$

(3) Side Conditions

The IOPM is a multiperiod planning model, the solution of which differs from the continuation of successive one-period planning solutions, and exhibits the Turnpike property: 1) the investment concentrates to the former planning periods and the expenditure pattern gradually shifts to consumption, therefore 2) the subsectoral pattern relatively concentrates to investment goods producing subsectors first and then gradually shifts to consumption goods subsectors. But when this Turnpike property is too strong, and the levels of consumption and of other variables change too radically in a short time, then such drastic changes are not socially acceptable. Therefore in this occasion, it is necessary to mitigate this Turnpike property by adding some conditions which limit the short-term changes within certain intervals.

A possible condition to secure a reasonable interval is to require the short-term change of variable R(X(t)) within five per cent range compared with the previous period.

$$(1-0.05)\, X(t-1) \leqq X(t) \leqq (1+0.05)\, X(t-1) \qquad (1\text{-}17)$$

We can combine these constraints and target and specify the IOPM after rewriting and adding some conditions including the non-negativity constraints. The current IOPM is designed for five consecutive quinquennial periods. Output vectors (X), consumption vectors (C), investment (I), export vectors (E) and final good import vectors (M*) of each period are endogenous variables.

Once the coefficients and values of structural constraints are given, then IOPM seeks to find out the optimum solution: output, consumption, investment and export vectors in each period, and the value of sum of discounted consumption flows. Also we can calculate the shadow prices for structural constraints using the coefficient matrix of optimum solution: shadow prices of output, capital, foreign currency and labor of each period.

Naturally, the cost and the benefit match when an activity is included in the optimum solution. But we can evaluate the another activity based upon the shadow prices. For example, when some products are not exported in i-th period, we can calculate it's accounting price, and figure out the ordering of priorities based upon the differences between export price and accounting cost. One of basic characteristics of the programming model like IOPM is the indicative role of shadow price system to suggest the accompanying price system matched with the optimum solution. Thus these prices are different from market prices, which change according to the balance between demand and supply conditions. There are another type of models which describe the market clearing function of market prices; like Altemeier-Tabor-Daris (1991) model for Indonesian agricultural sector. Sometimes it will be interesting to compare the system of shadow prices with market prices in certain sectors.

1.2 Data Preparation for Model

(1) Prediction of Future Technical Coefficients

At first we estimated future input coefficient matrices by 5 non-survey methods, namely, (i) RAS method, (ii) RECRAS method, (iii) Lagrangean multiplier method, (iv) Two-stage RAS-Lagrange method (TSRL method) and (v) Error minimum method. Data utilized in the estimation are input coefficient matrices of 1985 and 1990 both in real term. As a result of the application of 5 non-survey methods to predict input coefficient of 1990, we have found (i) RAS method, (ii) RECRAS method and (v) Error minimum method are proven to be applicable for our purpose. Then we employed those three methods to predict input coefficients of 1995, 2000, 2005, 2010 and 2015. The evaluations of respective results lead us to the conclusion that RECRAS method is the most suitable for prediction of input coefficient matrices, because; a) availability of data needed for long-term prediction, b) stability of input coefficients when long-term prediction is conducted as a first step.

We developed a new method to forecast input coefficients, upon obtaining a new I-O Table at 1993 price in June, 1996. We call it RECRAS-QP (Quadratic Programming) method. This method is similar to TSRL method which has been used to forecast input coefficients so far, with one difference that forecast of input coefficients is formulated as quadratic programming problem. Since this method formulates forecast of input coefficients as quadratic programming problem, it is flexible enough to incorporate the insight of experts and information obtained by survey methods into its constraints. Therefore, it is possible to improve its accuracy by incorporating such information as we go obtaining them in the future.

(2) Estimation of Capital Coefficient and Depreciation Rate

We first concentrated our attention on estimating capital stock by 9 sectors including K_0 (benchmark capital stock data of 1980) reflecting accumulated net investment before 1980. Two types of methods were tested for the estimation. One is the linear regression model utilizing depreciation estimated by BPS. The other is exponensial regression model utilizing depreciation derived from ADB data. Estimated capital stock by 9 sectors was divided into 26 sectors by investment share of each sector. And then time series of output by 26 sectors at 1993 price was estimated from revised average annual growth rate of output by 26 sectors derived from both output by 9 sectors and I-O Tables of 1985, 1990 and 1993 by 26 sectors. After those work, capital coefficients of 26 sectors for IOPM were calculated from those data by two formula of both Incremental Capital Output Ratio (ICOR) and Average Capital Coefficients (ACC).

(3) Estimation of Skilled Labor Coefficients

Labor coefficients for total employment and skilled labors are estimated. Skilled labors here are defined as engineers, technicians and skilled laborers. Percentage of skilled labors in total employment is extremely low in agricultural sector, while high in manufacturing sector. Labor coefficient of total employment in agricultural sector becomes quite high while that of skilled labors becomes exetremely low. Not much difference is seen in these two coefficients in manufacturing sector. A very large gap is seen between these two coefficients especially in 22nd trade, 23rd restaurant/hotel,and 24th transportation sectors.

(4) Estimation of Export (Import) Prices and Import Coefficient

Export and import prices were predicted by linear regression using the export (import) price indices of 20 industries excluding service sector from 1981 to 1993 which were collected in the starting year of this work (1995). Because of the lack of export (import) price indices for service sector (23rd restaurant & hotel, 24th transportation, 25th finance, 27th other service), export (import) prices of total sector are utilized for those sectors. Import coefficient matrix here is defined as the ratio of import for intermediate goods to total input in each sector.

1.3 Explanation of Optimum Solutions of National IOPM

(1) History of Improving National IOPM

In programming exercise, many Versions of IOPM were constructed and different kinds of optimum solutions were calculated under the different combination of objective function, structural constraint, and side condition. The numbering to Versions was given carefully in such a manner as the numbering of Version increases, IOPM improves. After Version 20, the results of simulation were categorized by the date when they were derived.

As far as calculation by IOPM after September Seminar 1996 is concerned, we have examined simulations by using following 8 viewpoints which reflect BAPPENAS comments: 1) achievement of the higher growth rate of GDP as the passage of periods, 2) achievement of the reasonable share of GDP in manufacturing sector, 3) improvement in the growth rate of GDP, export and import in light industry,4) restraint on the consumption growth rate in agriculture sector,5) improvement in GDP growth rate of sectors (4, 9, 13, 19, 27), 6) achievement of the reasonable growth rate of investment, 7) restraint on the growth rates of output and GDP in sector 8, 8) achievement of the reasonable share of GDP in agriculture sector. At the same time, we modified IOPM of Version 20.4B-1 as follows: (1) Evaluation parameter in objective function; evaluation for consumption of sectors (1-5,8) is assumed to decline as the corresponding consumption level increases, (2) Structural constraint; skilled labor constraint is divided into two parts; one for sectors (6-19) and another for sectors (1-5, 20-27), (3) Side condition; 1) imports for final demand of sectors 27 is fixed to the initial figure, 2) imports for final demand of sectors (8-19) are assumed to be in the range of 80 to 150 % of the corresponding import for final demand of the previous period, 3) exports of sectors (1-7, 12,22) are assumed to be in the range of 80 to 150 % of the corresponding export of the previous period, (4) estimation method for export (import) prices; export (import) prices are derived from linear regression model, using 1983-1993 export (import) price indices, (5) assumption for export prices; export prices of manufacturing sectors are assumed to rise by 10% as the passage of each period, (6) assumption for skilled labor coefficient in sector 8;skilled labor coefficient of sector 8 is assumed to rise by 10 % as the passage of each period. After those work, we selected 18 cases and sent them to BAPPENAS at the end of 1996.

(2) Summary of Optimum Solutions of National IOPM

1) Assumptions of Each Case

18 cases mentioned above are divided broadly into two parts in accordance with the assumption of skilled labor coefficients. One is those cases with an assumption that skilled labor coefficients of

sectors (9-27) decline by 10 % as the passage of each period. The other is those cases with an alternative assumption that skilled labor coefficients of sectors (9-27) decline by 15 % as the passage of each period. In each assumption of skilled labor coefficient's change, there are several cases in accordance with different assumptions of evaluation parameters for consumption, of skilled labor supply and of side conditions for exports.

2) Observation

(i) Annual Growth Rate of GDP

Annual GDP growth rate of 18 cases are presented on Table 1-1. The lowest growth scenario attains average 8.0 % (Case 1-1, Case 2-1), while the highest growth scenario attains average 8.8 % (Case 6, Case 6-2) during the planning period. The increase in GDP growth rate is seen as skilled labor constraint eases.

Table 1-1 Annual Growth Rate of GDP in Each Case (Unit :%)

	0-1 (R-VI)	1-2 (R-VII)	2-3 (R-VIII)	3-4 (R-IX)	4-5 (R-X)	0-5 Average
Case 1	7.5	7.8	8.3	8.3	8.5	8.1
Case 1-1	7.5	7.9	8.0	8.2	8.4	8.0
Case 1-2	7.3	7.9	8.4	8.2	8.5	8.1
Case 2	7.8	8.1	8.6	8.7	8.3	8.3
Case 2-1	7.9	7.8	8.0	8.2	8.1	8.0
Case 2-2	7.6	8.2	8.7	8.7	8.3	8.3
Case 3	7.8	8.1	8.6	8.7	8.8	8.4
Case 3-1	7.9	7.9	8.0	8.3	8.5	8.1
Case 3-2	7.7	8.2	8.6	8.7	8.7	8.4
Case 4	7.6	8.4	8.9	8.8	9.2	8.6
Case 4-1	7.8	8.3	8.8	8.6	8.9	8.5
Case 4-2	7.6	8.3	8.7	8.8	9.1	8.5
Case 5	8.0	8.6	9.0	9.2	8.9	8.7
Case 5-1	8.0	8.4	8.9	9.2	8.7	8.6
Case 5-2	7.9	8.6	9.0	9.1	8.8	8.7
Case 6	8.0	8.6	9.0	9.3	9.3	8.8
Case 6-1	8.0	8.4	8.9	9.2	9.2	8.7
Case 6-2	7.9	8.6	9.0	9.2	9.2	8.8

Source: JICA Study Team

(ii) Sectoral Share of GDP

Sectoral share in total GDP is presented on Table 1-2. As shown on that Table, as the passage of each period, agriculture's share of GDP declines, while manufacturing's share of GDP increases. Agriculture's share of GDP in the last period is about between 7 and 11 %, while manufacturing's share of GDP is about between 32 and 38 %. The GDP share of other sectors in the last period is about between 48 and 55 %.

Table 1-2 Sectoral Share of GDP

(Unit:%)

			0	1 (R-VI)	2 (R-VII)	3 (R-VIII)	4 (R-IX)	5 (R-X)
Case 1		1.Agriculture(1-5)	19.1	17.8	15.5	12.7	9.8	7.4
		2.Mining (6-7)	10.9	8.2	6.3	5.0	4.1	3.6
		3.Manufacturing(8-19)	22.0	26.1	28.9	31.6	34.2	36.6
		4.Others (20-27)	48.0	48.0	49.4	50.7	52.0	52.5
	Case 1-1	1.Agriculture(1-5)	19.1	17.5	15.5	12.1	9.5	7.5
		2.Mining (6-7)	10.9	8.2	6.2	4.9	4.0	3.3
		3.Manufacturing(8-19)	22.0	26.4	29.8	33.1	35.8	38.2
		4.Others (20-27)	48.0	47.9	48.6	49.9	50.8	51.0
	Case 1-2	1.Agriculture(1-5)	19.1	17.0	15.0	12.6	9.4	7.2
		2.Mining (6-7)	10.9	8.3	6.3	4.9	4.1	3.5
		3.Manufacturing(8-19)	22.0	25.5	27.9	30.1	32.4	34.3
		4.Others (20-27)	48.0	49.2	50.9	52.3	54.1	55.0
Case 2		1.Agriculture(1-5)	19.1	17.4	15.0	13.1	11.9	9.2
		2.Mining (6-7)	10.9	8.8	7.7	7.0	6.5	6.3
		3.Manufacturing(8-19)	22.0	26.1	28.6	30.7	32.3	34.3
		4.Others (20-27)	48.0	47.8	48.7	49.2	49.3	50.2
	Case 2-1	1.Agriculture(1-5)	19.1	17.8	15.5	13.7	12.0	9.1
		2.Mining (6-7)	10.9	8.6	7.5	5.7	4.5	4.3
		3.Manufacturing(8-19)	22.0	26.6	29.4	32.1	34.3	36.6
		4.Others (20-27)	48.0	47.1	47.6	48.5	49.2	50.0
	Case 2-2	1.Agriculture(1-5)	19.1	17.1	14.8	13.1	11.6	9.0
		2.Mining (6-7)	10.9	8.8	7.8	7.1	6.6	6.4
		3.Manufacturing(8-19)	22.0	25.6	27.6	29.3	30.7	32.2
		4.Others (20-27)	48.0	48.5	49.8	50.6	51.1	52.4
Case 3		1.Agriculture(1-5)	19.1	17.4	15.2	13.4	12.2	11.2
		2.Mining (6-7)	10.9	8.8	7.7	7.0	6.5	6.0
		3.Manufacturing(8-19)	22.0	26.1	28.6	30.7	32.3	33.9
		4.Others (20-27)	48.0	47.8	48.5	48.9	49.0	48.8
	Case 3-1	1.Agriculture(1-5)	19.1	18.0	15.7	13.9	12.6	11.7
		2.Mining (6-7)	10.9	8.6	7.5	5.7	4.5	3.4
		3.Manufacturing(8-19)	22.0	26.5	29.4	32.1	34.3	36.4
		4.Others (20-27)	48.0	46.9	47.3	48.3	48.7	48.5
	Case 3-2	1.Agriculture(1-5)	19.1	17.1	14.8	13.1	12.0	11.0
		2.Mining (6-7)	10.9	8.8	7.8	7.1	6.6	6.1
		3.Manufacturing(8-19)	22.0	25.6	27.6	29.3	30.5	31.7
		4.Others (20-27)	48.0	48.5	49.8	50.6	51.0	51.2
Case 4		1.Agriculture(1-5)	19.1	16.9	14.6	12.1	8.9	6.7
		2.Mining (6-7)	10.9	8.2	6.2	4.9	4.2	3.8
		3.Manufacturing(8-19)	22.0	26.1	29.1	32.0	34.8	37.6
		4.Others (20-27)	48.0	48.8	50.1	51.0	52.1	51.9
	Case 4-1	1.Agriculture(1-5)	19.1	17.5	15.0	12.5	9.4	7.0
		2.Mining (6-7)	10.9	8.2	6.2	4.9	4.2	3.6
		3.Manufacturing(8-19)	22.0	26.5	29.9	33.1	36.1	38.9
		4.Others (20-27)	48.0	47.8	48.8	49.5	50.4	50.4
	Case 4-2	1.Agriculture(1-5)	19.1	16.8	14.5	11.5	8.8	6.7
		2.Mining (6-7)	10.9	8.2	6.2	4.9	4.1	3.6
		3.Manufacturing(8-19)	22.0	25.7	28.0	30.5	32.6	34.8
		4.Others (20-27)	48.0	49.3	51.3	53.1	54.5	54.9
Case 5		1.Agriculture(1-5)	19.1	17.2	14.6	12.6	11.0	8.3
		2.Mining (6-7)	10.9	8.8	7.8	7.0	6.5	6.4
		3.Manufacturing(8-19)	22.0	26.0	28.6	30.8	33.0	35.3
		4.Others (20-27)	48.0	48.1	49.0	49.6	49.5	50.1
	Case 5-1	1.Agriculture(1-5)	19.1	17.3	14.8	12.8	11.5	8.6
		2.Mining (6-7)	10.9	8.7	7.6	6.9	6.4	6.1
		3.Manufacturing(8-19)	22.0	26.6	29.6	32.2	34.3	36.7
		4.Others (20-27)	48.0	47.5	48.0	48.0	47.9	48.5
	Case 5-2	1.Agriculture(1-5)	19.1	16.7	14.3	12.5	11.0	8.3
		2.Mining (6-7)	10.9	8.9	7.7	7.0	6.4	6.2
		3.Manufacturing(8-19)	22.0	25.6	27.6	29.3	30.9	32.7
		4.Others (20-27)	48.0	48.8	50.3	51.2	51.6	52.7
Case 6		1.Agriculture(1-5)	19.1	17.2	14.6	12.6	11.3	10.0
		2.Mining (6-7)	10.9	8.8	7.8	7.0	6.5	6.1
		3.Manufacturing(8-19)	22.0	26.0	28.6	30.9	32.9	34.9
		4.Others (20-27)	48.0	48.0	49.0	49.6	49.4	49.0
	Case 6-1	1.Agriculture(1-5)	19.1	17.3	14.9	13.0	11.7	10.5
		2.Mining (6-7)	10.9	8.7	7.6	6.9	6.3	5.9
		3.Manufacturing(8-19)	22.0	26.6	29.6	32.2	34.2	36.3
		4.Others (20-27)	48.0	47.4	47.8	47.9	47.8	47.3
	Case 6-2	1.Agriculture(1-5)	19.1	16.7	14.3	12.5	11.3	10.2
		2.Mining (6-7)	10.9	8.9	7.7	7.0	6.4	5.9
		3.Manufacturing(8-19)	22.0	25.6	27.7	29.3	30.8	32.4
		4.Others (20-27)	48.0	48.8	50.3	51.2	51.5	51.4

Source: JICA Study Team

Chapter 2

Long Term Perspective of Indonesian Regional Economies by Multi-Regional IOPM

2.1 Basic Framework of Multi-Regional IOPM

(1) Introduction

The decomposition of national I-O Table into multiple number of regions is another useful way of extending the basic Input-Output system, and strengthening its analytical capacity and widening the policy making relevancy. The national IOPM handles the national aggregates of final demands, intermediate demand and primary inputs. In the actual world, the decomposition of final demand, technical structure represented by technical input coefficients and by primary inputs may differ greatly by regions. If such structural differences are large enough, the actual multiplier repercussion effects can be reasonably assessed only through a regionally decomposed IOPM, and must differ from the result of the national IOPM which handles the relation between national averages, and suppresses the regional structural differences.

The simplest form of IOPM for two regions can be described as follows:

(Two-region IOPM)

$$\max \quad W_1'C_1 + W_2'C_2 \qquad (2\text{-}1)$$

subject to:

$$(U_1 - A_{11})X_1 - A_{12}X_2 \geqq C_1 + Y_{11} + Y_{12} \qquad (2\text{-}2)$$

$$-A_{21}X_1 + (U_2 - A_{22})X_2 \geqq C_2 + Y_{21} + Y_{22} \qquad (2\text{-}3)$$

$$C_1, C_2, X_1, X_2 \geqq 0 \qquad (2\text{-}4)$$

where Ci, Xi and Wi(i = 1, 2) stand for consumption, output and consumption evaluation column vectors of i-th region(i = 1, 2). Aij stands for the input coefficient matrix from i-th region to j-th region. Yij shows the final demand originated in j-th region and directed to i-th region. The export and import of final goods are included in the final demand component (Yii), while the interregional transaction of intermediate inputs appear to the left-hand sides of (2-2) and (2-3). The interregional erosion of final demand is explicitly described by Yij ($i \neq j$).

The model specification above is very simple, but still it points out two important merits compared with the national version. (a) The evaluation vector can differ among regions. So when the governmental emphasizes the regional equity target, it can be explicitly considered in the target function. (b) The developed (underdeveloped) region has different decomposition of final demand and different input structures. These differences would result in the different comparative advantage structures originated from demand and supply sides. So two-region IOPM, even if simple, can take into consideration the regionally different development emphasis and the different technical features originated from the different development stages.

Indonesia is a big country in her population size as well as the geographical extension. Thus there exist great regional differences in demand compositions and industrial complexities as well as technical levels. To adequately reflect these differences, the subdivision of national economy and the decomposition of IOPM into five regions is highly desirable. However, as the number of region increases, the limited availability of statistical data greatly diminishes the accuracy of empirical works. In every country concerned, especially the statistical estimation of interregional transaction of goods, services and demands requires quite different sources of data, and poses an extreme difficulty for data preparation. The geographical feature of Indonesia with many islands and scattered in a wide area makes such data compilation work more difficult.

JICA TSQ Team tried to prepare the full-version of five-region interregional I-O Table in cooperation with the LPEM stuffs, and we also tried to construct a more compact two-region IOPM. The final objective of regional IOPM modeling work is to break down the planned national figures into regions, so that the regional implication of national development plan can be assessed explicitly. This report includes the results of preparation of five-region interregional I-O Table and two-region IOPM, and some related preliminary calculations as the necessary and important steps to the final target.

(2) Consistency Issues with the National IOPM

Though our data preparation task faces many difficulties to extend the IOPM into regional dimensions, another methodological consistency problem arises from the design of modeling works. We have already constructed a national IOPM, which enables to find various optimal paths across the PJP II period. The multi-regional IOPM to be constructed may or may not be consistent with the national model. First, the I-O Tables between the two may not be consistent each other even at the base year observations. If the construction work of interregional I-O Table is done from the locally collected survey materials, the aggregation of the regional data will not usually match the national table, even if it is conceptually expected to be consistent. To assure the statistical consistency, we needed to implement some assumptions and conditions onto the compilation process of the interregional I-O Tables. The coefficients of national I-O Table must be weighted averages of intra-regional coefficients with the weights being the regional shares of the sectoral outputs. This means that the base regional tables must have as detailed subdivision of sectors as possible to minimize aggregation errors. Depending on the base year selected, these detailed tables may not be available nor be possible to construct. We needed to augment this with some heuristic assumptions during the table compilation processes of interregional I-O Table.

Second, even if the base year interregional I-O Table is constructed as being consistent with the national I-O Table, there remains a task of forecasting the interregional input coefficient matrix for the future planning periods to enable our multi-regional IOPM operational. Most Turnpike models in the past, even for national aggregate level, have assumed the production technologies (i.e., input coefficients A), to remain fixed in the future periods. Our national IOPM, however, assumes future transitional changes in technological coefficients as well as value added ratios etc. These future changes in technical coefficients are critical in the development processes such as in Indonesia. Development process in an open economy generally requires introduction of foreign capitals and technologies, especially for the industrialization. This means that technical production coefficients would generally shift toward modern global standard technology during the development process. The popular method to update input coefficients is well known RAS method. The RAS method requires at least two tables at different time periods to extrapolate. For our national IOPM, we have explored several RAS variant methods and developed RECRAS-QP method, which we adopted as the best consistent and operational predictor for our model. For multi-regional IOPM, we also need to develop a certain methodology to forecast future interregional input coefficient matix. Unlike national I-O Tables, we have been able to compile only one interregional I-O Table at the base year, 1993. We have alleviated this difficulty by extending RECRAS-QP method with side conditions of being consistent with the future national input coefficients, which we have already predicted and utilized. The RECRAS-QP method which we have developed is essentially equivalent to the RECRAS method which requires side information on value-added ratios, but our RECRAS-QP method is flexible enough to incorporate various exogenous side information as constraints.

Third, even if all the coefficients and parameters of the multi-regional IOPM are consistent with the corresponding ones of the national IOPM, we may not have a consistent optimal solution when the regional solution values are aggregated to national level. In one view, multi-regional IOPM is a regional break down of the national economy so that there may be quite a few interregional immobility and irreversibility of factors and commodities. While the national IOPM assumes free mobility of these among the implicit regions, the multi-regional IOPM imposes more realistic and specific constraints to the allocation of resources. This means that the optimal value of the target function for multi-regional IOPM would be less than that of the national IOPM. This is theoretically backed up by the well-known Le Chatelier Principle in mathematics. On the other hand, another view states that since the regions are characterized by different technologies in the multi-regional IOPM, there will be gains from trade among regions, which stem from the principle of comparative advantages. This suggests that the optimal value of the multi-regional IOPM may exceed that of the national IOPM. The both arguments seem to be correct and we may not preclude either of the possibilities. The realty will be a mix of the both theoretic outcomes. We can only expect that our optimal solution path of multi-regional IOPM will not be the same as that of national IOPM, but not far different.

(3) Regional Dimension Issues of IOPM

Though we have intended to incorporate regional dimensions into our IOPM analysis, the number of regions to decompose the whole Indonesian economy was a matter of discussion at great deal. With anticipated difficulties in data preparations, we have perceived possible two set of regional decompositions, five- region and two-region. The five-region decomposition of Indonesia consists of SUMATRA, JAVA (including BALI), KALIMANTAN, SLAWESI, and OTHERS. The two-region decomposition consists of JAVA (including BALI) and OUTSIDE JAVA. The five-region decomposition is mainly from geographical reasons and it may involve large variations among the regional socio-economic characteristics. The five-region decomposition is preferable from a standpoint of regional policy making. The more detailed description of the geographically widespread economy is better suitable in finding any local economic problems and to make counter policies to them. However, the five-region decomposition of islands, in view of I-O Table compilation and the utilization, has many statistical and analytical difficulties since the rural regions are quantitatively and qualitatively (or socio-economically) quite different from the main JAVA island, industrial compositions, populations, natural resource endowments and the development stages to name a few. In some regions, some industries are virtually null or totally dependent to the other regions. Even if the accurate interregional I-O Table of the five-region decomposition is available, to build a five-region interregional dynamic model for policy making purposes requires a great amount of supporting side information other than I-O Table. These regional supplemental data availability are worse than province levels since most of the regional statistics are the aggregates or the averages of the province level statistics. If any of provinces in a region lacks the statistics, so does the region. We face analytically serious difficulties.

The preparation and compilation of the actual five-region interregional I-O Table has been a consecutive array of difficulties and delays. Not only the delay of data collection due to various local reasons, but also due to the conceptual troubles in compilation process to deal with the insufficient and inconsistent data. As a result, our desired task to build a five-region IOPM was forced to alter the scheme. First, to grasp some five-region economic prospects consistent with the national IOPM optimal projection, we have considered a conventional method to disaggregate the national sectoral GDP into the regional sectoral GDPs. The task was done by extrapolating regional shares of sectoral GDPs from the past time series. The experiment produced fairly reasonable figures for the beginning of the next century, the year 2001, and presented at the September seminar in 1997. The forecast, however, can not be extended to the more distant future due to the statistical reliability.

The second best alternative for the construction of the multi-regional IOPM is to adopt a two-region decomposition. Two-region interregional I-O Table has the advantages of analytical simplicity and well-balanced magnitude in terms of statistical properties. The JAVA region outstands among five regions in many respects, but in two-region decomposition, most of the observations become relatively comparable levels after regions outside of JAVA are consolidated to one region. The conceptual framing and compilation of the two-region interregional I-O Table has been started in 1997 by the members of JICA Study Team, independent of and in parallel to the five-region interregional I-O Table compilation tasks by the local consultants. The current two-region interregional I-O Table we utilized is based on a preliminary five-region interregional table prepared by the Team. Utilizing the five-region trade coefficient matrix surveyed by the LPEM and by the aggregation, the two-region interregional I-O Table was estimated and compiled by a quadratic programming methodology which incorporates the consistency condition with the corresponding national I-O Table. The extension of the two-region interregional I-O Table to the future periods are also estimated by a quadratic programming model keeping the aggregation consistency with the one of national IOPM.

2.2 Regional Decomposition of Sectoral GDP in RepelitaVII Period.

Harmonized regional development is an important development target. The mechanism of regional development is multifaceted. Based on the changing comparative advantage structure and the changing factor endowment and regional market size of each region, each industry shows a different pattern of growth. So in general, the development of i-th sector and of j-th region depends on the i-th sector specific factor, j-th region specific factor and on their interaction effects. Here we concentrated to the sector specific factor, and calculated the regional decomposition of sectoral GDP for case 1 and case 4 based on the regional share of each sector. We extrapolated the j-th region's share of i-th sector (S_{ij}) based on the next formula (i=1,...,26; j=1,...,5).

$$S_{ij}\,(2001) = S_{ij}(\text{average in 91-93}) + (9/8) * (S_{ij}(\text{average in 91-93}) - S_{ij}(\text{average in 83-85}))$$

So, $$S_{ij}\,(2001) = (17/8) * S_{ij}(\text{average in 91-93}) - (9/8) * S_{ij}(\text{average in 83-85}) \qquad (2\text{-}5)$$

We calculated the regional GDP by sectors and their shares for case 1 and case 4 either by the decomposition based on the formula (simple extrapolation case), and by the decomposition based on the same current share in the future (fixed current share case). When the extrapolated value is negative, we assumed the share as average between 1991 and 1993.

Table 2-1 GDP Share of Five Regions (Unit: %)

Region	Share(1993)	Ext.Total	Case(1)	Case(4)
Sumatra	24.0	18.9	20.0	19.7
Java	59.5	64.8	64.2	64.5
kalimantan	9.2	8.9	9.1	8.8
Sulawesi	3.9	3.7	3.2	3.1
Other	3.4	3.7	3.5	3.6
Total	100.0	100.0	100.0	100.0

Note: The third column is the extrapolated share of total. The fourth and fifth columns are calculated by (1) calculating the regional GDP of each sector (sectoral GDP multiplied by regional share extrapolated), (2) aggregating the sectoral regional GDP by sectors, (3) aggregating the regional GDP to national total, (4) then calculating the regional shares accordingly.

The general tendency is as follows. Compared with the share at 1993,

1) The share of Java will increase by 4.7 % (case 1) or by 5.0 % (case 4).
2) The share of Other will increase by 0.1 % (case 1) or by 0.2 % (case 4).
3) The share of Kalimantan will decrease by 0.1 % (case 1) or by 0.4 % (case 4).
4) The share of Sulawesi will decrease by 0.7 % (case 1) or by 0.8 % (case 4).
5) The share of Sumatra will decrease by 4.0 % (case 1) or by 4.3 % (case 4).

As a whole, the exercise above indicates that the concentration of economic activity to the island of Java will continue into the future. When the proper regional policies (like the change of resource endowment with transmigration schemes of population and of factories, and special investment promotion, and others) taken into consideration, another pattern of regional development would emerge. Naturally this result solely considers the sector-specific factor, so it is very tentative in nature.

2.3 Data Preparation for Model

(1) Two-Region Interregional Input Coefficient Matrix

The two-region interregional Input coefficient matrix is compiled by aggregating the five-region interregional Input coefficient matrix (the latest version 1998/7/15), independently prepared by a member of the Team. It is then adjusted by mathematical programming method so as the intermediate demands of both regions to be consistent with the one of national I-O table of the same base year, 1993. The extension of the two-region interregional I-O Table toward the future periods during the planning span is done by quadratic programming model with side information, such as rates of changes of value added ratios and of input coefficients from the national IOPM.

(2) Intermediate Demand Import Coefficient Matrix

The intermediate demand import coefficients are calculated from the two-region interregional I-O Table. Since we have no sufficient information on the dynamic changes of these intermediate demand import coefficients, we assume the matrix to be constant over the planning periods.

(3) Final Demand Trade Coefficient Matrix

Final demand trade coefficient matrix is calculated from the two-region interregional I-O Table of 1993, which is based on the five-region interregional I-O Table developed by a member of the Team. This matrix is also assumed to be constant over the future planning period due to the lack of information

(4) Investment Pattern Matrix

The calculation of investment pattern vector for each region is also based on the preliminary two-region interregional I-O Table, except for the Java's 4,Forestry which is replace by the national IOPM's investment share to avoid negative share.

(5) Capital Coefficient Vector

Capital coefficient vectors for both regions are assumed to be the same as that of national IOPM. They are also set to be constant over the whole planning periods.

(6) Capital Stock

The initial Capital stock at 1993 for the national IOPM is divided into the two regions with the regional output shares of 1993.

(7) Skilled Labor Coefficient Vector

The regional coefficient vectors of skilled labor for Java and Outside Java are assumed to change over time depending on the groups of sectors as in the national IOPM.

sectors 1-7	:	No changes overtime.
sector 8	:	10% increase in every period (5 years)
sectors 9-26	:	15% decline in every period (5 years)

(8) Skilled Labor Force

The regionally available skilled labor forces for Java and Outside Java are both divided into 2 groups;

Group 1	:	sectors 1-5 & 20-27
Group 2	:	sectors 6-19

The growth rate of total labor force in each region is assumed to be common 5.5%. However, the growth rate of labor force in the sectors of group 1 is assumed to be lower 5% so that the remaining group 2 takes the higher growth rate.

The initial (1993) endowments of regional skilled labor force for each sector were calculated from the 1993 output and the labor coefficient vectors.

(9) Foreign Currency Reserves at the End of Each Period

The foreign currency reserve at the end of each period are set to 0 ($) for current versions.

(10) Depreciation Rate

The depreciation rate of the capital stocks are assumed to be 4. 74% per period as in the national IOPM.

2.4 Explanation of Optimum Solutions of Two-Region IOPM

(1) Assumptions of Each Case

Two-region IOPM enable us to calculate various optimum solution under the different combination of objective function, structural constraint, and other side-condition. Here we take up 2 cases, case0 and case0-1, and explain essence of respective cases. The difference in cases is different assumptions of skilled labor constraint. Assumption of skilled labor: Skilled labor constraint of each cases is as in the following;

Case0 : Skilled labor constraint is divided into two parts, one for sectors(1-5,20-27) and another for sectors(6-19).

Case0-1 : Skilled labor constraint is set by 2 regional group, Java and Outside Java, and is divided into two parts, one for sectors(1-5,20-27) and another for sectors(6-19).

(2) Optimum Solutions

Table 2-2 Annual Growth Rate of GDP (Unit:%)

Case	Region	0-1 (R-VI)	1-2 (R-VII)	2-3 (R-VIII)	3-4 (R-IX)	4-5 (R-X)	0-5 Average
Case0	Java	9.2	9.2	8.8	7.1	4.0	7.6
	Outside Java	8.9	10.3	9.2	10.6	12.0	10.2
	Java + Outside Java	9.1	9.6	9.0	8.6	8.0	8.9
Case0-1	Java	9.3	9.8	9.4	8.4	9.0	9.2
	Outside Java	8.3	9.0	9.2	8.6	7.5	8.5
	Java + Outside Java	8.9	9.5	9.3	8.5	8.4	8.9

Source: JICA Study Team

Table 2-3 Annual Growth Rate of GDP Composition in Each Case (Unit:%)

	Case	Region	0-1 (R-VI)	1-2 (R-VII)	2-3 (R-VIII)	3-4 (R-IX)	4-5 (R-X)	0-5 Average
Consumption	Case0	Java	7.0	9.1	8.5	7.5	7.8	8.0
		Outside Java	8.4	8.9	7.7	6.6	7.3	7.8
		Java + Outside Java	7.5	9.0	8.2	7.2	7.6	7.9
	Case0-1	Java	7.0	9.3	8.2	7.9	7.9	8.1
		Outside Java	9.1	8.4	8.2	6.5	7.4	7.9
		Java + Outside Java	7.7	8.9	8.2	7.4	7.7	8.0
Investment	Case0	Java	7.2	7.1	9.9	4.0	-100.0	-100.0
		Outside Java	12.8	14.8	9.8	15.6	22.2	15.0
		Java + Outside Java	9.3	10.4	9.9	10.3	11.0	10.2
	Case0-1	Java	7.5	10.2	11.6	10.1	9.7	9.8
		Outside Java	9.5	9.6	9.0	9.4	9.8	9.5
		Java + Outside Java	8.2	10.0	10.7	9.9	9.7	9.7
Export	Case0	Java	7.9	7.5	7.5	5.6	-0.5	5.5
		Outside Java	8.1	9.3	10.6	11.7	5.0	8.9
		Java + Outside Java	8.0	8.5	9.3	9.3	3.2	7.6
	Case0-1	Java	7.3	8.2	8.3	4.6	10.1	7.7
		Outside Java	7.9	9.1	10.6	10.9	6.6	9.0
		Java + Outside Java	7.6	8.6	9.6	8.4	7.9	8.4
Import	Case0	Java	5.8	7.3	8.4	7.0	2.5	6.2
		Outside Java	5.1	8.9	8.6	11.0	14.7	9.6
		Java + Outside Java	5.7	7.6	8.4	7.8	5.8	7.1
	Case0-1	Java	5.5	7.8	8.7	8.0	8.5	7.7
		Outside Java	4.7	7.7	8.8	8.4	7.4	7.4
		Java + Outside Java	5.3	7.8	8.8	8.1	8.3	7.6

Source: JICA Study Team

Table2-4 Sectoral Share of GDP at the End of Planning Period (Unit:%)

Sector (IO Code)	Initial			Case0			Case0-1		
	Java	Outside Java	Total	Java	Outside Java	Total	Java	Outside Java	Total
Agriculture(1-5)	16.7	23.9	19.6	5.9	8.6	7.4	4.6	10.8	6.9
Mining(6-7)	2.4	21.9	10.3	0.9	12.9	7.5	1.0	14.6	6.0
Manufacturing(8-19)	27.1	18.6	23.7	46.6	33.6	39.5	42.8	36.8	40.6
Light Industry(8-10,19)	15.8	7.6	12.5	13.9	6.5	9.8	10.9	7.3	9.5
Resource-based Industry(11-15)	6.7	10.5	8.2	15.9	19.1	17.6	15.4	23.6	18.4
Machinery(16-18)	4.6	0.5	2.9	16.9	8.0	12.0	16.4	5.9	12.6
Electricity, Gas & Water(20)	1.5	0.5	1.1	2.4	0.7	1.4	2.0	0.8	1.6
Construction(21)	6.9	8.0	7.4	0.4	17.4	9.7	10.0	7.7	9.1
Services(22-27)	45.5	27.0	38.0	43.8	26.9	34.5	39.7	29.2	35.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: JICA Study Team

(3) Observation

The average annual growth rate of GDP in PJPII period was 7.6% (Java), 10.2% (Outside Java) and 8.9% (Indonesia) when the skilled labor is mobile between regions. This is roughly comparable with the average annual growth rate of GDP in national IOPM. However, with the limitation of the interregional labor movement, the growth rate of GDP in Java increased to 9.2%, but that of Outside Java decreased to 8.5% while the growth rate of GDP in Indonesia remained same. The fact that the growth rate of GDP is bigger (smaller) than the national average when the labor is (not) freely mobile implies: (i) the increase of interregional resource movement contributes to accelerate the development of the national economy; and (ii) Outside Java has a better potential capacity of development when capital, labor and foreign currency are freely mobile. In a word, the resource allocation is over-concentrated in Java region.

Chapter 3

Analysis of Current Economic Crisis by IOPM

3.1 Current Exchange Rate Shock and IOPM Modeling

The recognition of current exchange shock urges some amendments to the current version of IOPM in following points: JICA Study Team tried some simulations considering following 1) - 4), except 5),

1) The Initial Condition Adjustment Effect: The first period of IOPM corresponds to 1994-98 years. As the current shock would decrease the GDP, the initial condition (growth rates in first period) must be adjusted accordingly.
2) The Relative Price Effect: Export and import prices will change according to the Pass-through effects after devaluation. This implies that a tactful projection of these prices is necessary for future simulations.
3) The Trend Adjustment Effect: The future path of export price and exchange rate makes necessary to change the upper and lower boundaries of export growth accordingly.
4) The Scaling-down Effect: When GDP in Rupiah terms is converted into dollar terms, the future depreciated exchange rate will force to keep GDP in dollar terms to a half or one third compared with the trend value.
5) The Liquidity Constraint Effect: The consideration of liquidity constraint will be necessary even after the second period. It implies that the foreign currency holding at the end of each period could be evaluated with a positive evaluation coefficient in the target function.

3.2 Exercises by National IOPM

(1) Assumption of Each Case

We tried to exercise some currency shock simulations by incorporating three points: 1) Initial Condition Adjustment Effect, 2) Relative Price Adjustment Effect, and 3) Trend Adjustment Effect. Under these assumptions, Case B1-17, Case B1-44 and Case B1-46 are assumed as currency shock simulation. These Cases are constructed from the standard base case of the Case4, with the macro GDP growth rate = 5.8 per cent of the 1st period combined with some scenarios of future exchange rates, and various cases of β and of sectoral export(import) upper-lower bounds.

1) Initial Condition Adjustment Effect: Since the period of Repelita VI is almost over, we tentatively assumed the real growth rate in 1998 as zero per cent, and so, the average growth rate in Repelita VI period(1994-98) turns out to be as 5.8 per cent. Naturally the sectoral growth rates may differ, and so we set an upper and lower ceiling for growth rate of each sector, which turns out the average growth rate about 5.8 per cent.

2) Relative Price Adjustment Effect: We first observed the past trends of foreign price, domestic price and exchange rate, and then estimated the Pass-through coefficients(β) for exports and imports. For projection work, we adopted (i) the average Pass-through coefficient for export except a few cases, because the estimates varied too greatly among sectors, but (ii) adopted different estimates by sectors for imports, because the estimates by sectors were in many cases reasonable.

We assumed two cases for future trends of exchange rate: In one case, we assumed a stable rate after the second period, and in the other case, a very small depreciation after second period, 1 per cent per year. The forecasted levels of exchange rates are as follows:

Table 3-1 Two Cases for Future Trend of Exchange Rate (Unit: Rp/US$)

Case	1993	(R-VI)	(R-VII)	(R-VIII)	(R-IX)	(R-X)
CaseB1-17	2087	3934	5000	5000	5000	5000
CaseB1-44, CaseB1-46	2087	3934	5000	5255	5523	5805

3) The depreciation of exchange rate would result in the increase of competitive power of export, and increase in the export growth potential. Therefore, in simulations, the upper and lower ceilings of export and import growth are set wider than those of standard Case 4. Case B1-17 is set them only in the first period, while Case B1-44 and Case B1-46 are set them in the first period and after second period. The deference between Case B1-44 and Case B1-46 is width of the upper and lower ceilings.

(2) Results of Currency Shock Simulations

Table 3-2 Optimum Solutions of National IOPM

(1) Annual Growth Rate of GDP in Each Case (Unit: %)

Case	0-1	1-2 (R-VII)	2-3 (R-VIII)	3-4 (R-IX)	4-5 (R-X)	0-5 Average
Case 4	7.6	8.4	8.9	8.8	9.2	8.6
B1-17	5.8	4.8	5.9	7.8	9.0	6.6
B1-44	5.8	4.7	6.1	7.7	8.9	6.6
B1-46	5.8	4.6	6.8	8.6	10.1	7.2

(2) Annual Growth Rate of GDP Component in Each Case (Unit: %)

	Case	0-1 (R-VI)	1-2 (R-VII)	2-3 (R-VIII)	3-4 (R-IX)	4-5 (R-X)	0-5 Average
Consumption	Case 4	7.5	7.8	8.1	7.5	7.6	7.7
	B1-17	2.0	3.6	4.0	6.4	8.1	4.8
	B1-44	2.0	3.4	4.0	5.2	8.0	4.5
	B1-46	2.0	3.3	3.9	5.1	8.2	4.5
Investment	Case 4	5.5	9.6	10.3	10.9	11.4	9.5
	B1-17	-2.5	0.3	12.4	11.7	10.9	6.4
	B1-44	-2.4	0.2	11.8	12.1	9.9	6.1
	B1-46	-2.3	0.1	14.1	13.7	11.7	7.2
Export	Case 4	7.0	7.2	8.5	8.8	9.3	8.1
	B1-17	14.7	8.6	4.6	6.4	8.2	8.4
	B1-44	14.7	8.5	5.3	7.3	8.5	8.8
	B1-46	14.7	8.6	5.9	8.4	10.2	9.5
Import	Case 4	4.4	6.9	8.2	8.6	9.2	7.4
	B1-17	-1.8	3.2	4.5	6.6	8.2	4.1
	B1-44	-1.8	3.1	4.1	6.3	7.5	3.8
	B1-46	-1.8	3.1	4.8	7.5	9.2	4.5

(3) Sectoral Share of GDP at Final Period in Each Case (Unit: %)

Sector (IO Code)	Initial	Case 4	B1-17	B1-44	B1-46
Agriculture(1-5)	19.1	6.7	8.9	9.1	8.9
Mining(6-7)	10.9	3.8	4.4	3.0	3.1
Manufacturing(8-19)	22.0	37.6	35.7	34.4	32.5
Light Industry(8-10,19)	11.2	8.2	16.0	16.5	14.0
Resource-based Industry(11-15)	8.0	17.0	11.7	10.4	10.3
Machinery(16-18)	2.8	12.4	7.9	7.6	8.3
Electricity, Gas & Water(20)	0.9	1.8	1.3	1.3	1.3
Construction(21)	7.1	9.0	6.9	6.5	7.4
Services(22-27)	40.1	41.1	42.9	45.6	46.8
Total	100.0	100.0	100.0	100.0	100.0

Note: Case 4 in above tables is standard base case without currency shock.
Source: JICA Study Team

(3) Observations: in exercising currency shock simulations utilizing National IOPM, are founding following points:

1) Import capacity deteriorates.
2) Investment activity fluctuates.
3) Export grows rapidly.
4) Consumption level aggravates.
5) GDP growth rate decrease.
6) Enormous development efforts needed.

3.3 Exercises by Two-Region IOPM

(1) Assumption of Currency Shock Simulations

JICA Study Team tried to exercise some currency shock simulations utilizing Two-Region IOPM in the same way as National IOPM by incorporating three points: 1) Initial Condition Adjustment Effect, 2) Relative Price Adjustment Effect, and 3) Trend Adjustment Effect.

After these simulations utilizing National IOPM were made, we received new information of GDP growth rate, exchange rate, and other current macro economic data. With these new information, the macro GDP growth rate of the 1st period utilizing in Two-Region IOPM is revised to 4.8 per cent.

A future trend of exchange rate is also revised. Exchange rate is now assumed to depreciate from 3,934Rp/$(first period) to 7,000Rp/$(second period), but is pegged since then at 7,000Rp/$. Based on this change, the Import price and Export price are re-estimated by using Path-through coefficient for currency shock simulations.

Under these assumptions, Case 1-1 of currency shock simulation is constructed from the standard base case of the Case 0-1.

(2) Results of Currency Shock Simulations

Table 3-2 Optimum Solutions of Two-Region IOPM

(1) Annual Growth Rate of GDP in Each Case (unit: %)

Case	Region	0-1 (R-VI)	1-2 (R-VII)	2-3 (R-VIII)	3-4 (R-IX)	4-5 (R-X)	0-5 Average
Case 0-1	Java	9.3	9.8	9.4	8.4	9.0	9.2
	Outside Java	8.3	9.0	9.2	8.6	7.5	8.5
	Java + Outside Java	8.9	9.5	9.3	8.5	8.4	8.9
Case 0-1	Java	2.2	6.1	3.9	4.3	6.7	4.6
	Outside Java	8.2	10.8	8.7	9.8	10.2	9.5
	Java + Outside Java	4.8	8.4	6.6	7.7	9.0	7.3

(2) Annual Growth Rate of GDP Composition in Each Case (unit: %)

	Case	Region	0-1 (R-VI)	1-2 (R-VII)	2-3 (R-VIII)	3-4 (R-IX)	4-5 (R-X)	0-5 Average
Consumption	Case 0-1	Java	7.0	9.3	8.2	7.9	7.9	8.1
		Outside Java	9.1	8.4	8.2	6.5	7.4	7.9
		Java + Outside Java	7.7	8.9	8.2	7.4	7.7	8.0
	Case 1-1	Java	2.0	2.0	2.6	2.8	6.7	3.2
		Outside Java	2.0	2.0	3.1	4.7	9.0	4.2
		Java + Outside Java	2.0	2.0	2.8	3.5	7.6	3.6
Investment	Case 0-1	Java	7.5	10.2	11.6	10.1	9.7	9.8
		Outside Java	9.5	9.6	9.0	9.4	9.8	9.5
		Java + Outside Java	8.2	10.0	10.7	9.9	9.7	9.7
	Case 1-1	Java	-33.3	38.0	-1.8	14.4	8.6	2.3
		Outside Java	9.3	5.4	9.6	9.9	10.8	9.0
		Java + Outside Java	-9.0	12.6	5.8	11.2	10.1	5.8
Export	Case 0-1	Java	7.3	8.2	8.3	4.6	10.1	7.7
		Outside Java	7.9	9.1	10.6	10.9	6.6	9.0
		Java + Outside Java	7.6	8.6	9.6	8.4	7.9	8.4
	Case 1-1	Java	10.5	5.2	5.9	-2.1	-3.4	3.1
		Outside Java	17.6	17.3	10.6	11.1	10.3	13.4
		Java + Outside Java	14.5	13.2	9.4	8.6	8.8	10.9
Import	Case 0-1	Java	5.5	7.8	8.7	8.0	8.5	7.7
		Outside Java	4.7	7.7	8.8	8.4	7.4	7.4
		Java + Outside Java	5.3	7.8	8.8	8.1	8.3	7.6
	Case 1-1	Java	-6.7	4.0	2.7	4.9	5.8	2.1
		Outside Java	2.2	8.3	9.0	8.9	8.1	7.3
		Java + Outside Java	-4.7	5.3	4.8	6.5	6.8	3.6

(3) Sectoral Share of GDP at Final Period in Each Case (Unit: %)

Sector (IO Code)	Initial			Case 0-1			Case 1-1		
	Java	Outside Java	Total	Java	Outside Java	Total	Java	Outside Java	Total
Agriculture(1-5)	16.7	23.9	19.6	4.6	10.8	6.9	7.9	10.8	9.9
Mining(6-7)	2.4	21.9	10.3	1.0	14.6	6.0	0.9	4.1	3.1
Manufacturing(8-19)	27.1	18.6	23.7	42.8	36.8	40.6	45.5	53.6	51.0
Light Industry(8-10,19)	15.8	7.6	12.5	10.9	7.3	9.5	20.9	6.0	10.8
Resource-based Industry(11-15)	6.7	10.5	8.2	15.4	23.6	18.4	12.9	44.4	34.3
Machinery(16-18)	4.6	0.5	2.9	16.4	5.9	12.6	11.7	3.2	5.9
Electricity, Gas & Water(20)	1.5	0.5	1.1	2.0	0.8	1.6	1.7	0.6	0.9
Construction(21)	6.9	8.0	7.4	10.0	7.7	9.1	5.2	5.5	5.4
Services(22-27)	45.5	27.0	38.0	39.7	29.2	35.8	38.9	25.4	29.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: Case 0-1 in above tables is standard base case without currency shock.
Source: JICA Study Team

(3) Observations: In exercising currency shock simulations utilizing Two-Region IOPM, are founding following points:

1) Growth rate of GDP decreases.

2) Growth Rate of GDP Component.

(i) Import capacity deteriorates.

(ii) Export grows rapidly.

(iii) Investment activity fluctuates.

(iv) Consumption level aggravates.

3) The Share of Resource-based industry in " Outside Java" drastically increases.

Chapter 4

Selected Development Issues

4.1 Balance of Payments and External Debt

In this section, we consider balance of payments and debt problems in the context of planning model. Firstly, we discuss background of the problems and discuss several theoretical underpinnings. Secondly, we discuss a simulation model. Thirdly, we discuss probabilistic approaches. Fourthly, we discuss renewed concern about early warning system of currency crisis. A brief comment concludes this section.

The time series profile of current account during the projected period is hump shaped. Current account worsens at first, but improves in the latter period. Non-oil export growth is the main engine of Repelita VI. Current situation already deviates from the Plan. Increased current account deficits are financed by other capital flows, that is, direct foreign investment, private loans, and short-term capital finance. Hence, it resulted that the unfavorable developments created volatile capital movements. These observations invite well-balanced analysis of the issue .

The simulation model used here is basically a collection of accounting systems. More sophisticated models might incorporate optimization of objective function such as the linear programming. However such procedures are less useful when a model is used to provide input information to the parent model. Another possibility is the estimation of macro econometric model. It would seem that a compromising approach is required: computer simulation. The availability of efficient, flexible, and inexpensive personal computer enables us to overcome uncertainties at simulation. If the criteria cannot be translated into precise mathematical values, rather than search for the optimum solution, it can be simulated. Although computer simulation lacks the elegance of mathematical programming and does not provide general or best solutions, it does provide good solutions.

A number of econometric studies have attempted to identify the determinants of debt default problem. The two probabilistic models used here in showed that debt situation of Indonesian government is not without problem. Default function approach showed that most variables are improving and reducing the probability of default. However if we take the political factor seriously, then the probability of default increases significantly. At the unit root tests the insolvent data showed improvement of the future fiscal policy. Of course, these results need careful consideration. In particular, default function results depend on the specification. Also, the unit root tests are known to have weak power. However, even these points are taken into account, the results are reasonably robust.

Recent attacks on the Southeast Asian currencies brought new interest in the vulnerability of emerging countries. The fact is simple, huge shift of funds had occurred from Thailand, and eventually had contagion around the East Asia. At the same time, the need for early warning system of the currency crises is to be called for. Earlier, Mexican crisis attracted many researchers, and one already has tentative results. Renewed interests in the indicator approach to the currency crises are present. It is an evaluation using the nonparametric approach.

Developing countries gained access to external financing through globalization and integration to the world economy. At the same time, they experienced greater exposures to international disturbances. While sound economic policy is important, it is necessary to prepare for the surprises of sudden currency crises because they are hard to predict. To reduce vulnerability to such shocks, it is recommended to reform the debt policy. In particular, the idea of the Asset Liability Management (ALM) of private firms is useful. For instance, the changes in the dollar value of the external debt between 1993 and 1995 were due to cross-currency movements, primarily the appreciation of yen. In the case of Indonesia, export revenues were mainly in dollar while a little less than half of the external debt was in yen. One way of looking at Mexico's crisis is that the problem was not the level of burden of debt, rather the composition of debt structure of currencies and maturity.

The simulation model discussed above uses the parameters that are calibrated artificially. However, this type of model is expected to be useful in the long-term programming exercises because back-solving capabilities are invaluable to provide necessary constraint conditions such as the foreign exchange ceilings. Furthermore, it can be modified to calculate the present value of current account and debt. At the same time, one must use alternatives such as probabilistic approaches and indicator approach.

4.2 Industrial Development

During the first long-term plan period, Indonesia's industrial sector experienced a very rapid growth at an average rate of 12% per annum in real term. In the final year of the Repelita I, the share of industry in the national product, including oil and gas industries, was only 9.6%. The rapid industrial growth resulted that the share of industry went up to 20.7% in 1992. This percentage share of industry to the national product has exceeded that of agriculture since 1991.

In the second long-term plan, the objective of industrial development is to establish a strong and modern industrial sector that is capable of promoting a self-reliant and dependable economy. For that purpose it is necessary to improve the competitive capacities, to disperse industries through out the country, to strengthen the small and medium industries, and to establish dependable physical and institutional facilities. The quantitative targets were set as; 1) the share to GDP to be 32%, 2) absorption of labor force to be 27.5%, 3) average annual growth rate of manufacturing value added to be 9.2%, and 4) average annual growth rate of non-oil manufacturing to be 9.8%.

In the period of 1993-1996, the manufacturing industry achieved an annual growth rate of 11.6%, and accounted for 25.5% of GDP in 1996. Excluding oil and gas processing, the growth rate of manufacturing sector reached at 12.8% during the same period, and its share to the GDP amounted to 22.8% in 1996. Compared to the target annual growth rate of Repelita VI , actual performance of industrial sector surpassed those targets up to 1996.

As the IOPM is an optimal programming model with an objective function to be maximized under some structural constraints, it is important to note what conditions are implicitly and explicitly included in the model structure. Among several criteria for resource allocation and subsectoral development, the IOPM considers 'growth' as its target, and the three criteria of 'capital-saving,' 'net-foreign-currency-earning' and 'skilled-labor-saving' are set in the model by the structural constraints of capital, foreign currency holding and skilled labor, respectively. Therefore, among the industrial subsectors, those industries with low capital and low skilled labor coefficients, and with high net foreign-currency-earning ratios are given high priority to grow in the IOPM.

The government industrial strategy, on the other hand, put an emphasis to overcome the existing difficulties, i.e. to promote industries with intensive use of skilled labor as well as advanced technologies.

Comparing the growth rates of manufacturing sectors in the IOPM solution with those of Repelita VI targets, the most prominent feature of the IOPM solution is the emphasis on machinery industry at the first stage of PJP II period. The average annual growth rate of this group during the Repelita VI period is 18.4%, while the target growth rate of basic metals and capital goods industry in Repelita VI was 12.6%.

The second feature of the IOPM solution is the relatively slow and declining progress of the light industry in the long run. Even during the Repelita VI period, the light industry of the IOPM solution is expected to grow only 7.8% on the average. On the other hand, in the scenario of the Repelita VI, the target growth rate of agro-industry was set to 8.2%, which was below the average rate of manufacturing sector but with slightly increasing rate of growth during the Repelita VI period.

The percentage share of manufacturing industry in GDP was targeted to 32.5% at the end of PJP II period, while the IOPM solution indicates 36.6% of industrial share at the same stage of the planning period. In reality, the performance of the first two years of the Repelita VI period showed rapid industrialization process, achieving the industrial share to GDP of 23.9% in 1995, while the figure of targeted share by the end of Repelita VI was 24.1%. The contribution of non oil-gas manufacturing sector to GDP was 21.3% in 1995, which means the targeted figure of 21.3% was already reached in the second year of the same period.

4.3 Resources and Energy

Indonesia is one of rich countries in energy resources in Asian region. Indonesia is the third oldest oil producer in the world. Production began more than a century ago. The oil production from 1980 to date is still kept at 1.5 million barrel per day (b/d). In the early 1980's, oil accounted for nearly two-thirds of the Government revenues. However, with the growth of Indonesian economy and other industries, the ratio of the Government revenue from the oil sector gradually declines and becomes 18% at present. As for the oil reserves, it is said that the rate of reserves to production will last about 10 years when the present production level is maintained. In 1995 MIGAS estimated that crude production would decrease at about five percent a year to 1.35 million b/d in 1997, to 1.15 million b/d in 2000, and to 1.065 million b/d in 2005. However, actual production in 1997 was 1.54 million b/d and the output until April 1998 is keeping at 1.52 million b/d. As for the crude oil production of Indonesia in the future, it is influenced by the discovery of new oil fields and the improvement of enhanced oil recovery (EOR) technique. For its purpose, the investment fund is necessary and the low oil price at present is a negative factor.

Indonesia has also abundant natural gas resources. Indonesia's estimated gas resources are 5,961 billion cubic meter (bcm), of which 3,198 bcm are proven and probable reserves. Natural gas production in 1996 reached 88.6 bcm. This was the energy equivalent of 1.6 million b/d of oil, or roughly equivalent to Indonesia's 1996 crude production. The annual growth rate of natural gas production from 1980 was 7%. Indonesia is already the world's largest LNG exporter and about half of natural gas is consumed at the LNG plant, followed by the electric power plant and the fertilizer plant. The Pretamina expects that Indonesia's natural gas production will grow to 93.0 bcm during the Second 25 Year Development Plan. However, the future production will depend on the increase of the LNG demand in Asian countries and the construction of the pipeline to the neighboring countries. Asia consumed about 51 million tons of LNG in 1995. Assuming its consumption continues to increase in the future, total demand is expected to reach 82 million tons by 2000.

Despite its abundant coal reserves, coal development in Indonesia was not aggressively carried out until the early-1980's when coal demand for power plant in Asian region rapidly increased. Coal production in Indonesia increased from 10 million tons in 1990 to 50 million tons in 1996. Assuming its trend continues to increase in the future, total production is expected to reach 101 million tons in minimum and 152 million tons in maximum by 2005. Especially, it is expected that export to Thailand, Malaysia, and the Philippines will increase. Domestic consumption for IPP will also increase and reach 50 million tons by 2005.

Typical energy resources in Indonesia are oil, gas and coal. As for crude oil, its production will not increase in the future. However, production of natural gas and coal are expected to increase with the increase of demand in Asian countries and domestic consumption. These resources are very important to earn foreign currency. With the Indonesian economic crisis in 1997, the energy demand in Indonesia will temporarily stagnate for one or two years. But the energy demand will gradually increase according with the recovery of the economy. Indonesia will have surplus energy resources by economic crisis. It will contribute to reconstruct Indonesian economy by turning these to the exportation.

In this study, energy supply and demand in the future was calculated from the solution of IOPM model. Energy prices for calculating energy supply and demand are estimated based on past energy balance tables and I-O Tables in Indonesia as follows:

Production of oil and gas	:	Rp207,515/toe (US$99.43/toe)
Crude oil export	:	Rp265,408/toe (US$17.35/bbl)
Crude oil import	:	Rp303,805/toe (US$19.86/bbl)
Coal for power generation	:	Rp137,708/toe (US$39.59/tce)

In this study, many simulations were carried out by IOPM model. Amount of energy supply and demand were calculated using the solutions of Case 1 and 4. The estimated future production of Oil and Gas of IOPM changes lower than that of MIGAS plan till the year of 2011 and reaches almost the same level in the year of 2016. As for the estimated future consumption of coal for power generation, the coal demand grows slightly faster than that of DOC(Directorate of Coal) forecast, but the difference is very small. Export and import of crude oil in the future of IOPM increase year by year. These forecasts are different from the MIGAS plan. However, amounts of net oil export gradually decrease. This means the increase of domestic consumption of oil products. In IOPM model, amounts of export and import of oil reach almost the same level after 2016. On the other hand, MIGAS expects domestic consumption of oil products will increase constantly and Indonesia may become net oil importer between 2004 – 2008. Comparative examination of energy supply and demand in Case 1 and 4 can be concluded that the solution of IOPM produces values fairly close to the reality though there exist minor differences.

4.4 Environment

The major environmental issues in Repelita VI and PJP II are the following three issues:

1) Strain on Indonesia's stock of key natural resources (land, forests, water and energy) as a critical ecosystems (including ground water aquifers in cities, and watersheds and coastal and ecosystems throughout Indonesia);

2) Increase of industrial pollution (including water pollution, air pollution, and toxic and hazardous waste) and urban pollution (human waste, solid waste and vehicle emissions);
3) Environmental degradation due to poverty (pollution, erosion of natural resources, unsustainable production practices, unsafe disposal of human and other wastes).

Indonesia's priorities for sustainable development are 1) Water pollution, 2) Solid waste, 3) Air pollution and 4) Forest resources management.

The Environment Impact Management Agency (BAPEDAL) is responsible for implementation of environmental policies. Besides BAPEDAL, the following ministries are in charge of respective environmental problems; Ministry of Industry and Trade, Ministry of Forestry, Ministry of Public Works, Ministry of Labor, and Ministry of Mining and Energy.

The water quality standards were established by four categories of water use, for pH, TDS, DO and other parameters. The effluent standards are also established for 14 kinds of industry. Clean River Program is being implemented for 32 rivers which are indicating some improvement in water quality. Among the most serious source of industrial water pollution, there are; plywood, pulp and paper, paint, textile, sugar, rubber and tanning industry.

The air quality standards were established for 9 substances including sulfur dioxide (SO_2), carbon monoxide (CO) and nitrogen oxide (NOx). The emission standards were also established for four kinds of industry; iron and steel, pulp and paper, coal fired power plant, and cement industry. Blue Sky Program has been launched to improve air quality by setting up target for stationary and mobile sources.

As a long-term environmental issue, water use by industry is considered as critical. Unit consumption rate by industry group is estimated in this study. Based on the study by Ministry of Industry and Trade, the following unit consumption rate of water by sub-sector of industry is being estimated. The unit water use is expressed by litre per second per ha of factory area.

Food, beverage and tobacco	1.0 liter/sec/ha
Textile, garments, and leathers	0.5 liter/sec/ha
Wood, bamboo, rattan and willow	0.2 liter/sec/ha
Paper and paper products	5.0 liter/sec/ha
Chemical, petroleum, coal, rubber and plastic products	1.0 liter/sec/ha
Nonmetallic mineral products except petroleum and coal	0.5 liter/sec/ha
Basic metal industries	1.0 liter/sec/ha
Fabricated metal products, machinery and equipment	0.4 liter/sec/ha
Other manufacturing industries	0.4 liter/sec/ha

4.5 Poverty Issue and Income Distribution

The major objectives of this chapter are to review the performance of poverty reduction by the Government of Indonesia since 1970, to analyze the present situation of poverty and income distribution in Indonesia and to formulate a basic framework of comprehensive approach toward further poverty reduction and equitable distribution.

The incidence of absolute poverty in Indonesia has decreased from 60% in 1970 to 11.3% of the population in 1996.

The Government of Indonesia has targeted reducing poverty to 6% by the end of the Repelita VI (1994/95-1998/99) and to zero during the Repelita VII (1999/2000-2003/04).

The Government of Indonesia successfully decreased the incidence of absolute poverty due to the performance of macro economic policy and management: the high rate of economic growth, inflation control, population control, transmigration, etc.

However, the speed of a decrease of poverty incidence gradually slowed down. The trend suggests that the policies and measures at the Central Government level which may be defined as "macro economic policy and management approach" had a limited effect on poverty reduction, or a limit of trickle-down effect.

This means that the macro economic policy and management alone can not eradicate absolute poverty. A micro socio-economic approach is needed to reduce the absolute poverty in the areas or villages where the macro approach is difficult to attain. It became harder to reach the poor left behind by the central government level policy and management. Therefore, more efforts should be made on a village level approach toward poverty reduction during the second long-term development plan. This does not always mean that during the second long-term plan (PJP II), the central government level approach is less important than the village level approach. Both are needed and complement each other.

The micro socio-economic approach at the village level is also important for promotion of equity in income distribution.

A micro socio-economic approach at the village level is divided into three categories: 1) provision of basic social services (BSS), 2) development of basic rural infrastructure (BRI), and 3) income generation/employment creation(IG/EC). This approach is also financed by the government.

We have also recognized that the government approach (macro level approach and micro level approach) can not eradicate all poverty in the country. An approach with non-government organization is needed to supplement what the government approach is not able to do. The non-government approach can be divided into two sub-approaches: an approach by NGOs, POs, etc. and an approach by private enterprises.

The nature of poverty varies from country to country. The causes and background of poverty are complicated and multidimensional in any country. There is no panacea to poverty reduction. In Indonesia, many police and programs have been undertaken to reduce poverty over the last three decades. A framework of approaches toward poverty reduction can be formulated on the basis of the experiences and lessons.

At present, the country is being faced with serious monetary and economic crisis. It is reported that economic growth rate for coming years has to be decreased, basic consumer goods prices are increasing and a number of unemployment is going up. This situation easily increases poverty incidence as well as inequality of income distribution in Indonesia.

Although Indonesia is facing the economic crisis, the Government should make an effort to create such environment that both the governmental approach and the non-government approach can work effectively to overcome poverty and inequality issues.

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