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OPTIMIZATION OF EAST JAVA ECONOMY BY APPLYING GOVERNMENT POLICY TO MAXIMIZE EMPLOYMENT ABSORPTION (Linear Programming Input-Output Model)

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Abstract. One of many objectives of development plan is creating high economy development which is supported by employment absorption. This research has a purpose to know the economic development in East Java in 2006-2008 as a result of the regulation of economic policy to maximize employment absorption. This research is using linear programming input-output model that is used to know the optimal value of East Java economy in 2008, shown by total output and final demand when employment absorption is maximized. The result of the research shows that there is an increasing value of output and final demand in East Java. This final demand increase must be done to maximize employment absorption. Employment maximization will increase for 2 years, that will create more jobs.

Keywords: Linear Programming, Input-Output , optimum value

1. Introduction

Economic planning can be described as deliberate governmental attempt to coordinate economic long-term decision-making and influence, direct, and in some cases even control, the level and growth of a nation's or regional's economic variables (income, consumption, employment, investment, saving, exports and imports, etc) in order to achieve a predetermined set of development objectives.

Economic planning models can be divided into three basic categories: (1) aggregate growth models, involving macroeconomic estimates of planned or required changes in principal economic variables; (2) multisector input-output models, which determine the production, resource, employment, and foreign exchange implications of a given set of final demand targets within an internally consistent framework of inter-industry product flows; (3) project appraisal and social benefit-cost analysis, which specify the detailed selection of specific investment projects within each sector based on the social benefit and cost of the project (Todaro, 1989). This paper uses the second category of basic economic planning, i.e. the multisector input-output model and combine with linear programming in order to maximize employment in East Java. The purpose of this research is to determine optimal East Java economy 2008 because of the economic policy to maximize employment absorption.

East Java is one of the provinces in Indonesia which has enough high economic growth compared with the other provinces. In 2001-2007, the East Java economic growths were 3.76%, 3.80%, 4.78%, 5.43%, 5.84%, 5.6%, and 5.98%; in the same year, the national economic growths are 3.7%, 5.1%, 4.1%, 5.13%, 5.6%, 5.5%, and 6.3%. The economic growth in East Java should be maintained and planned to achieve deliberately target, i.e. employment absorption.

2. Input-Output Model Definition

Input-Output Analysis is developed by Wassily W. Leontief in 1930s. This analysis divides the economic system into several sectors. Input-output table relates several sectors in the economy, and the main emphasis in input-output analysis is at the side of production (Miller and. Blair, 1985).

The input-output table gives a good plan to measure and explore the inter-industry flow from the input and output for several sectors in the economy. The rows in input-output table show the distribution from certain sector to the other sectors and the columns show the purchase which has done by certain sector to the other sector (Jensen and West, 1986). The Input-Output Table is shown in Table 1.

Table 1. The Input-Output Table

Output Allocation / Input Structure			Mediate Demand – Production Sector 1	2	3	Final Demand	Total Output
Mediate Input	Production Sector	1	Z11	Z12	Z13	Y1	X1
		2	Z21	Z22	Z23	Y2	X2
		3	Z31	Z32	Z33	Y3	X3
Primary Input			V1	V2	V3		
Total Input			X1	X2	X3		

Intermediate sectors of the input-output table show flow of product from i sector to j sector. The monetary value of the product flow from i sector to j sector is given Z_{ij} notation. Total output of i sector i is given X notation, and total final demand can be calculated by:

$$X_i = \sum_{i=1}^{n} Z_{ij} + Y_i \tag{1}$$

where:

X_i : total output

Z_{ij} : monetary value of the product flow from i sector to j sector

Y_i : final demand of i sector

The output of i sector is distributed to the other sectors, and also distributed to final users. Those final users are the economic players in the economy that can be classified aggregately into household consumption, government expenditure, and exports.

From the input-output table, the technical coefficient (a_{ij}) can be determined as:

$$a_{ij} = Z_{ij} / X_j \tag{2}$$

$$Z_{ij} = a_{ij}.X_j \tag{3}$$

By substituting equation (3) to equation (1), we can get:

$$X_i = \sum_{i,j}^{n} a_{ij} X_j + Y_i \tag{4}$$

Equation (4) can be expressed with these equations:

$$\begin{array}{l} a_{11}X_1 + a_{12}X_2 + a_{13}X_3 + \ldots + a_{1n}X_n + Y_1 = X_1 \\ a_{21}X_1 + a_{22}X_2 + a_{23}X_3 + \ldots + a_{2n}X_n + Y_2 = X_2 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ a_{n1}X_1 + a_{n2}X_2 + a_{n3}X_3 + \ldots + a_{nn}X_n + Y_n = X_n \end{array} \tag{5}$$

By moving *X* to the left side, we can get these simultaneous equations:

$$\begin{array}{l} X_1 - (a_{11}X_1 + a_{12}X_2 + a_{13}X_3 + \ldots + a_{1n}X_n) = Y_1 \\ X_2 - (a_{21}X_1 + a_{22}X_2 + a_{23}X_3 + \ldots + a_{2n}X_n) = Y_2 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ X_n - (a_{n1}X_1 + a_{n2}X_2 + a_{n3}X_3 + \ldots + a_{nn}X_n) = Y_n \end{array} \tag{6}$$

Equation (6) can be written in matrix form:

$$\begin{bmatrix} (1-a_{11}) & -a_{12} & \cdots & -a_{1n} \\ -a_{21} & (1-a_{22}) & \cdots & -a_{2n} \\ \vdots & & & \vdots \\ -a_{n1} & -a_{n2} & \cdots & (1-a_{nn}) \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{bmatrix} = \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} \tag{7}$$

This matrix can be written in short form:

$$(I - A)X = Y \tag{8}$$

Where I is identity matrix and A is input coefficient matrix, that contains a_{ij} as its elements. By solving *X* with its relationship with *Y*, then based on matrix rule we can get:

$$X = (I - A)^{-1} Y \tag{9}$$

Where $(I - A)^{-1}$ is the inverse matrix from $(I - A)$ or it can be called *Leontief Invers* matrix.

3. Linear Programming

Linear programming uses mathematical model to describe problems of allocating limited resources among competing activities in the best possible (Hillier and Lieberman, 2005). This problem involves selecting the level of certain activities that compete for scarce resources that are necessary to perform those activities. General model of linear programming is:

$$\text{Maximize (minimize) } Z = c_1 X_1 + c_2 X_2 + \ldots + c_n X_n \tag{10}$$

Subject to:

$$\begin{aligned} & a_{11} X_1 + a_{12} X_2 + a_{13} X_3 + \ldots + a_{1n} X_{n1} = b_1 \\ & a_{21} X_1 + a_{22} X_2 + a_{23} X_3 + \ldots + a_{2n} X_{n2} = b_2 \\ & \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ & \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ & a_{\cdot n1} X_1 + a_{n2} X_2 + a_{n3} X_3 + \ldots + a_{nn} X_n = b_n \\ & X_1 \geq 0, X_2 \geq 0, \ldots, X_n \geq 0 \end{aligned} \tag{11}$$

where:
X_j = decision variable
a_{ij} = technology coefficients
c_j = objective function coefficients
b_i = right side coefficients

4. Linear Programming applied to Input-Output Analysis

The input-output model is not only a descriptive technical device, but also value free and neutral from the point of view of policy. The strength of input-output analysis – its technical aspects and its value free character – are viewed as weakness from another perspective. In order to overcome this weakness, the input-output analysis is combined with linear programming. Two major advantages can be obtained from combining linear programming and input output analysis. The first relates to the problem of coefficient stability over time and the second to the problem of the absence of limitations on capacity in the regional economy (Hewings, 1986).

Singgih (1991) combined input-output model and linear programming to optimized multi sectors Indonesian economy. The programming model is:

$$\text{Maximize } Z = \sum_i c_i x_i \tag{12}$$

Subject to:

$$x_i - \sum_i a_{ij} x_i \geq or \leq Y_i \tag{13}$$

Where a_{ij} represents the interindustry coefficients; c_i represents coefficients of objective function; x_i represents sectoral output of the input-output and Y_i represents right hand constraints.

5. East Java Input-Output Table

This research is using East Java Input-Output Table data in 2000 (Biro Pusat Statistik Jawa Timur, 2001) that has been updated in 2006 based on Product Domestic Regional Bruto (PDRB) of East Java using the current prices. The data from Input-Output Table that is tabulated in this research consists of 18 intermediate sectors, 6 demand sectors and 5 primary input sectors. This East Java Input Output Table is presented using IO71 software (West, 1993). To simplify the analysis, that input-output table is aggregated into 9 sectors.

Table 2. Sectoral Classification

Agriculture	Agriculture
Mining	Mining
Industry	Industry
EGC	Electricity, Gas and Clean Water
Construction	Construction
THR	Trading, Hotel and Restaurant
T&C	Transportation and Communication
Financial	Financial, Rent and Company Service
Service	Services

6. Industrialization Objectives

The objective of industrialization in East Java is maximizing the employment. Employment coefficient can be obtained by measuring the employments used in the sectors for each billion rupiah output from those sectors (employment/output).

Table 3. Objective Function Coefficient

Sector	Coefficient
Agriculture	67.99
Mining	6.86
Industry	8.06
EGC	2.85
Construction	47.27
THR	18.23
T&C	29.57
Financial	5.64
Service	41.51

7. Economic Growth Boundary

In several processes in economic production, the constraints that are determined are the minimum value of final demand and the maximum of the total output from each sector.

7.1 The Minimum Boundary of Final Demand

The growth of final demand is very important for industrial development. Each sector must produce more than final demand requirements for each sector. Table 3 shows the value of final demand requirement in 2008. Because of the lack of specific information about the demand growth in 2006-2008, it is assumed that the demand growth in the same sector in 1994-2000 will occur in 2006-2008. Table 4 shows the constraints of the final demand for each economic sector.

Table 4a. The demand in the End of 2006 and 2008

Sector	2006 (billion, Rp)	Annual Growth (%)	2008 (billion, Rp)
Agriculture	43506.59	19.79	62432.94
Mining	4706.44	4.36	5126.18
Industry	141696.95	0.7	143683.74
EGC	3398.78	8.83	4025.65
Construction	15686.75	21.16	23027.26
THR	48485.86	0.77	49234.21
T&C	4098.32	-7.82	3482.59
Financial	12861.56	-11.72	10022.7
Service	10826.71	-1.05	10601.11

Table 4b. Minimum Boundary of Final Demand

Constraints	Variables					
	Agriculture	Mining	Industry	EGC	Construction	THR
Agriculture	0.85	-0.06	-0.1	0	0	-0.19
Mining	0	0.89	0	0	-0.1	0
Industry	-0.18	-0.15	0.81	-0.15	-0.31	-0.16
EGC	0	0	0	0.89	0	-0.02
Construction	0	0	0	0	1	0
THR	-0.14	-0.18	-0.14	-0.22	-0.17	0.84
T&C	-0.02	-0.03	-0.03	-0.07	-0.04	-0.07
Financial	-0.02	-0.06	0	-0.06	-0.03	-0.07
Service	-0.05	-0.04	0	-0.06	0	-0.08

Table 4c. Minimum Boundary of Final Demand (continuation)

Constraints	Variables			Relations	RHS
	T&C	Financial	Service		
Agriculture	0	0	-0.01	≥	62432.94
Mining	0	0	0	≥	5126.18
Industry	-0.29	-0.12	-0.2	≥	143683.74
EGC	0	0	-0.03	≥	4025.65
Construction	0	0	0	≥	23027.26
THR	-0.29	-0.31	-0.36	≥	49234.21
T&C	0.98	-0.02	0	≥	3482.59
Financial	-0.01	0.95	0	≥	10022.7
Service	-0.04	-0.09	0.83	≥	10601.11

7.2 The Maximum Boundary by Sector Output

The total output cannot be increased unlimited because several factors constrained by that sector growth. Table 5 shows upper limit value for each sector in 2008. Because there is no specific information about total output growth in 2006-2008, it is assumed that the growth of total output in the same sector in 1994-2000 will be occurs in 2006-2008. Table 6 shows upper limit constraints for each economic sector.

Table 5. Sector Upper Limit

Sector	2006 (billion, Rp)	Annual Growth (%)	2008 (billion, Rp)
Agriculture	124252.6	75.93	384599.91
Mining	14417.44	46.61	30988.99
Industry	279411.97	43.01	571416.86
EGC	12128.78	38.65	23317.66
Construction	15686.75	37.66	29725.96
THR	180085.86	36.92	337617.95
T&C	30337.32	48.18	66609.56
Financial	34166.56	31.18	58798.23
Service	49124.71	36.81	91946.43

Table 6a. Boundary of Sector Upper Limit

Constraint	Variables					
	Agriculture	Mining	Industry	EGC	Construction	THR
Agriculture	1	0	0	0	0	0
Mining	0	1	0	0	0	0
Industry	0	0	1	0	0	0
EGC	0	0	0	1	0	0
Construction	0	0	0	0	1	0
THR	0	0	0	0	0	1
T&C	0	0	0	0	0	0
Financial	0	0	0	0	0	0
Service	0	0	0	0	0	0

Table 6b. Boundary of Sector Upper Limit (continuation)

Constraints	Variables			Relations	RHS
	T&C	Financial	Service		
Agriculture	0	0	0	≤	384599.91
Mining	0	0	0	≤	30988.99
Industry	0	0	0	≤	571416.86
EGC	0	0	0	≤	23317.66
Construction	0	0	0	≤	29725.96
THR	0	0	0	≤	337617.95
T&C	1	0	0	≤	66609.56
Financial	0	1	0	≤	58798.23
Service	0	0	1	≤	91946.43

8. Research Results

After the objective function equation of industrialization and constrains for linear programming model are obtained, the data is processed using LINDO software and the optimal value is calculated from the objective function and optimal solution for each sector and sensitivity analysis.

The optimal solution of the linear programming applied to input-output for East Java economy can be shown in Table 7. Table 7 shows the optimum value from linear programming that can be considered as total output from each sector.

Table 7. Optimal Solution

Variable	Optimal Solution (billion, Rp)
Agriculture	384600
Mining	30989
Industry	571417
EGC	23318
Construction	29726
THR	337618
T&C	66610
Financial	58798
Service	91946

Table 8 shows the value of sector output growth when the employment is maximized. The data from Table 8 shows that the biggest growth is reached by Agriculture sector (209.53%). The employment maximization will create 27495430 jobs or increases by 1.53%.

Table 8. Sector Output Growth

Variable	IO 2006	Max Employment	
	Total Output (billion, Rp)	Total Output (billion, Rp)	Growth (%)
Agriculture	124253	384600	209.53
Mining	14417	30989	114.94
Industry	279412	571417	104.51
EGC	12129	23318	92.25
Construction	15687	29726	89
THR	180086	337618	87.48
T&C	30337	66610	119.56
Financial	34167	58798	72.09
Service	49125	91946	87.2
TOTAL I	739612	1595022	
Average Growth			108.56
Employ.	17986270	45481700	
Emp. Growth		27495430	1.53

Table 9 shows the possibility of the final demand growth when the employment is maximized. The final demand is calculated by multiplying (I – A) with $X_{optimum}$.

Table 9. Final demand growth

Variable	IO 2006	Max Employment	
	Total FD (billion, Rp)	Total FD (billion, Rp)	Growth (%)
Agriculture	43507	201693	363.59
Mining	4706	12018	155.35
Industry	141697	276824	95.36
EGC	3399	5830	71.53
Construction	15687	29726	89.5
THR	48486	61805	27.47
T&C	4098	11602	183.1
Financial	12862	15007	16.68
Service	10827	11018	1.77
Average Growth			111.59

Table 9 shows that the average final demand growth is 111.59%. Also, 3 sectors must grow more than 100% in 2 years: Agriculture 363.59%; Transportation and Communication 183.1%; dan Mining 155.35%.

10. Conclusion

This research addresses the economic technique of input-output linear programming analysis with the objective of maximization of employment. From the research can be concluded that as a result of maximize employment, East Java economy in 2006-2008, will create 27,495,430 jobs. Overall, average output grew 108.56% and the average final demand grew 111.59%.

Final demand is a very important for stimulating the growth of a sector in economy. East Java government should stimulate the growth of the final demand of these sectors by introducing specific policies aimed to achieve the objective function.

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