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A Study on Spatial Structure in Indonesia

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Abstract

As is well known, regional disparities might be considered as a crucial problem because some evidence show that regional disparities may bring about to the crisis in social and economic. Unfortunately however, planners are, more often than not, at a loss to assign precise meaning to the information conveyed by the disparities. Accordingly, a policy towards which aim at reduce the regional disparities must be based on the detailed informations on the structure of disparities, mostly should be supported by empirical studies, rather than planners intuitions. In this respect, Multiregional Input-Output has been considered as a suitable tool in clarifying the structure of such disparities, so that the most appropriate policy in redressing the disparities can be fromulated.

Key words: Multiregional Input-Output, Regional population elasticity, Regional income elasticity, Distance elasticity.

1. Introduction

A study on regionalization in a country like Indonesia is vital due to the fact that characteristics among islands are significantly difference. (6) Unfortunately however, the number of such studies are very less, particularly a study on the economic interconnections among islands. A study by Soeroso and Giarratani for example, shows that prices play a minor role to the process of regional growth in Indonesia. (17) In addition they claim that growth differentials play a much more important role in regional adjustments, yet they have failed to assign the information on regional growth differentials. Further study by Kaneko et. al. clarified the characteristics of industrialization process in Indonesia. Broken down the economic structure into subsector level however, their attention has mainly been paid to the national level. (10) In other words, no information on the economic structure at regional level have been elaborated. Presumably the limited data on the regional has been responsible to the scarcely of the study on regionalization in Indonesia.

The purpose of this study is to show that having an uncomplete of necessaries data on regional level, the Multiregional Input-Output Model, namely Moses-Chenery Model, for Indonesia could be conducted. In addition, our concern is laid on the economic interdependencies among regions, because as was suggested by Moses, the levels of income, employment, etc, from a specific region will strongly be influenced by other regions. (13)

2. Theoritical background

(1) *Briefsketch of Multiregional Input-Output*

The movement of goods and services in interregional studies plays a key role because the goods and services from a specific region will be absorbed by final demand as well as input. (11) It is undoubtedly true, the effort to increase the volume of interregional commodities flow should be supported by a better transportation system.

For the sake of simplicity purpose, we assume there are only 3 regions having 3 sectors, as in Table I. Regions and regional flows will be described by supercripts ; commodities and commodity flows by subcripts. The coefficient of a^2_{31} for example, should be read as the amount of commodities of sector 3 required to produce a unit worth of sector 1 output in region 2. (see Table 1).

Parallel to the Leontief production function, Table 1 assume that the amount of each good absorbed by every industry in a region is strictly proportional to output. The reader may easily understand that each of the block matrix describes the technical structure of all industries in only one region. Furthermore, it is essential to know the movement of commodity both interregional and intraregional

Table 1. Regional Technical Coefficients

	Region I			Region II			Region III		
	1	2	3	1	2	3	1	2	3
Region I sector									
1	$a^1_{11}=\frac{x^1_{11}}{X^1_1}$	$a^1_{12}=\frac{x^1_{12}}{X^1_2}$	$a^1_{13}=\frac{x^1_{13}}{X^3_1}$						
2	$a^1_{21}=\frac{x^1_{21}}{X^1_1}$	$a^1_{22}=\frac{x^1_{22}}{X^1_2}$	$a^1_{23}=\frac{x^1_{23}}{X^1_3}$		block I				
3	$a^1_{31}=\frac{x^1_{31}}{X^1_1}$	$a^1_{32}=\frac{x^1_{32}}{X^1_2}$	$a^1_{33}=\frac{x^1_{33}}{X^1_3}$						
Region II sector									
1				a^2_{11}	a^2_{12}	a^2_{13}			
2		block II		a^2_{21}	a^2_{22}	a^2_{23}			
3				a^2_{31}	a^2_{32}	a^2_{33}			
Region III sector									
1							a^3_{11}	a^3_{12}	a^3_{13}
2					block III		a^3_{21}	a^3_{22}	a^3_{23}
3							a^3_{31}	a^3_{32}	a^3_{33}

(12) p. 806

Table 2. Trade Coefficients

	Sector 1 region			Sector 2 region			Sector 3 region		
	1	2	3	1	2	3	1	2	3
Sector 1 region									
1	$t_1^{11}=\frac{r_1^{11}}{R_1^1}$	$t_1^{12}=\frac{r_1^{12}}{R_1^2}$	$t_1^{13}=\frac{r_1^{13}}{R_1^3}$						
2	$t_1^{21}=\frac{r_1^{21}}{R_1^1}$	$t_1^{22}=\frac{r_1^{22}}{R_1^2}$	$t_1^{23}=\frac{r_1^{23}}{R_1^3}$		block I				
3	$t_1^{31}=\frac{r_1^{31}}{R_1^1}$	$t_1^{32}=\frac{r_1^{32}}{R_1^2}$	$t_1^{33}=\frac{r_1^{33}}{R_1^3}$						
Sector 2 region									
1				t_2^{11}	t_2^{12}	t_2^{13}			
2		block II		t_2^{21}	t_2^{22}	t_2^{23}			
3				t_2^{31}	t_2^{32}	t_2^{32}			
Sector 3 region									
1							t_3^{11}	t_3^{12}	t_3^{13}
2				block III			t_3^{21}	t_3^{22}	t_3^{23}
3							t_3^{31}	t_3^{32}	t_3^{33}

(12) p. 808

trade, which is usually called as trade coefficients for each commodity. Since we have 3 regions and 3 sectors, we will have also 3 block matrices of trade coefficients, as in Table 2.

If we denote the regional technical coefficients as "a" and trade coefficients as "t", the regional input output coefficient, namely A, will be found as a. t. Shortly speaking, the complete multiregional input-output system is representable as,

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

where

I: identity matrix
A: regional input-output coefficients
X: output
Y: final demand

As usual, a solution will be given by,

$$X=(I-A)^{-1}Y \quad (12)$$

Relating to our attention on the economic interdependencies among islands, Hermite Inverse Matrix has been chosen because as was written by Yamamura, a Hermitian matrix is conformable for a symmetrix matrix. (for a deatiled information on the operation on Hermite Inverse Matrix, the reader may refer to paper by (19)).

Due to space consideration, only 3 coefficients are reported in this paper, those are : regional direct and indirect coefficients (B) ; total input variations coefficients (C) ; total production variation coefficients (D).

The notations of B, C, and D could be defined as,

$$B=(I-A^{11})^{-1}$$

Going back to the operation of Hermite Matrix, the two regional input-output coefficients may be written as,

$$A=\left[\begin{array}{c|c} A^{11} & A^{12} \\ \hline A^{21} & A^{22} \end{array}\right]$$

then using Hermite Matrix, the original matrix could be partitioned as,

$$A=\left[\begin{array}{c|c} E^{11}+E^{11} & E^{12}+E'^{12} \\ \hline E^{21}+E'^{21} & E^{22}+E'^{22} \end{array}\right]$$

where,

$$E^{11}=(A^{11}+A'^{11})/2$$

$$E'^{11}=(A^{11}-A'^{11})/2$$

Furthermore, the partitioned matrices of input coefficients could be represented as,

$$C^{21}=A^{21}\cdot B^{1}$$
$$=E^{21}\cdot B^{1}+E'^{21}\cdot B^{1}$$

Finally, total production coefficients (D) could be defined as follows,

$$D^{12}=B^{1}\cdot A^{12}$$
$$=B^{1}\cdot E^{12}+B^{1}\cdot E'^{12}$$

We are now turning to the method of estimations due to the lack of regional data available.

(2) *Estimation Methods*

As is well known, the complete data at regional level of developing countries is a major constraint to develop a broaden study of regionalization, in particular the interconnections among regions. The main difficulty in implementing of many-region input-output models is that data on shipments of goods between sectors and between regions are not readily available. (12) The most detailed study in developing countries is a study by Ngo, who developed a core-periphery, tworegion input-output model of the Philippines by subtracting the Metro Manila region from the national input-output table. (16)

Indeed, a policy which refer only to national level or a closed region will face with difficulties since within a country there exist an interdependencies among regions and interdependencies among subregions within region.

Fortunately, in the absence of a complete information on regional level, some estimation methods have been introduced as the way out to overcome the difficulties. We will discuss some estimation methods associated to our study in the following Section.

—Regional technical coefficients

These coefficients are derived from two pieces of information: the value of output of each industry in each region and the value of purchases by each industry in a region from each industry in the nation as a whole. (12)
Unfortunately, the data on regional technical coefficients in Indonesia is not available yet. Luckily, method by Moses, permits us to substitute the unavailable block matrices of regional technical coefficients with national technical coefficients. (13) Accordingly, our matrix will consist of six block identical matric along diagonal where every block should be equal to the national technical coefficients.

—Trade coefficients

We are now turning to the crucial issue because we need both interregional trade and intraregional trade coefficients, however, the data on intraregional trade coefficients are not available yet.

The interregional trade coefficients reflects the closely interdependencies among regions because some goods and services produced in one region will be used as an input for other regions to sustain their level of production, and vice versa.

It is necessary, then, to estimate the flow of intraregional commodities due to unavailibility of such data. The estimation of intraregional commodities flow stands as a supplement part of this paper and will be discussed in the following Section.

The number of regions are: (1) Sumatera, (2) Java, (3) Kalimantan, (4) Sulawesi, (5) Bali, Nusa Tenggara Barat and Nusa Tenggara Timur, (6) Maluku and Irian Jaya.

The number of sectors are: (1) main staple fooa, (2) other agricultural product, (3) forestry, (4) livestock, (5) fishery, (6) mining, (7) manufacturing, (8) electricity, gas and water, (9) construction, (10) trade, (11) transportation, (12) financial, (13) public administration and (14) services. The data used in this paper is for 1980 however, the data on interregional trade for tertiary sector i. e. sector (8) to sector (14) is not available. As a consequence our trade coefficients will only consist of 7 trade coefficients while the rest are zero.

3. Estimation of intraregional commodity flow

Theoritically, transactions between and among all sectors both within a region or among regions can be measured in physical or in monetary terms. Practically however, transactions are usually measured in monetary terms, though this introduces problems because sometimes a changes in prices is not a result of a changes in quantity of inputs used. (12)

(1) *Why Gravity Model*

Considering that both intraregional and interregional trade coefficients are important parts in simulating the study on Multiregional Input-Output, there have been introduced several methods of estimating the interregional and intraregional trade flow. Selection, then, must be made because not all methods can be implemented satisfactory into a specific case, in particular into Indonesian case. The following are some methods of estimating the intraregional commodities flow, and judgments have also been given associated to the real situation in Indonesia.

—Location Quotient Method

The Location Quotient (LQ) for industry i in region r is generally defined as,

$$LQ_i^r = \frac{E_i^r/E^r}{E_i^n/E^n} \qquad (i=1, \cdots, n)$$

where,

E_i^r : employment of industry i in region r
E^r : total employment in region r
E_i^n : national employment of industry i
E^n : total national employment

The LQ method has been developed and become a common method for estimating both intraregional and interregional trade flows because the LQ method does not require a lot of information at regional level. (15)

—Cross Industry Location Quotient Method

The $CILQ$ method is the fllowing definition,

$$CILQ_{ij}^s = \frac{LQ_i^s}{LQ_j^s} = \frac{E_i^s/E_i^s}{E_j^s/E_j^n}$$

where,

LQ_i^s : location qoutient of sector s in region i
LQ_j^s : location quotient of sector s in region j
E_i^s : number of employment of sector s in region i
E_j^s : number of employment of sector s in region j
E_i^n : number of employment of sector n in region i
E_j^n : number of employment of sector n in region j

One advantage of both LQ and $CILQ$ method is other sectoral data can be used as a substitution data for employment e. g.: sectoral output, income, etc, if employment data is not available yet. Other advantages are both two methods do not require a lot of information on regional data as well as ease of handling.

Unfortunately however, a recent study by Harrigan et al. clearly shows that both LQ and $CILQ$ method tend to be a biased estimators because the actual value and estimated value are significantly difference. (8) Using the total intermediate imports to Scotland from RUK, Harrigan found that the percentage difference between actual value and estimated value by LQ method was around 79 percent, while using $CILQ$ method the percentage difference was 49 percent. For these reason, both LQ and $CILQ$ method will not be used for estimating the intraregional commodity flows in Indonesia.

—Commodity Balance Method

There are some reasons for not employing CB method in estimating the intraregional commodity flow : firstly, CB method requires a lot of information on regional data for which a major part of such data is not available yet, secondly a study by Harrigan shows that percentage difference between actual value and estimated value was around 70 percent and thirdly, CB method is a bit time consuming.

—Moses method

Unlike all the methods written before, Moses method presents as the most accurate method in estimating the data on total intermediate imports to Scotland from RUK. (8) The value of percentage difference is the smallest among all methods, it was 0.8 percent.

The main problem in estimating the interregional trade flows by Moses method is on data required. Unlike LQ and $CILQ$, Moses method requires a complete information on regional level. This requirement compells us not to use the Moses method in estimating the interregional commodity flow in Indonesia.

—Proportion of Other Region

The formulation may be written as,

$$q_i^s = \frac{X_i}{X_j} \cdot q_j^s$$

where,

q_i^s : intraregional flows of commodity s in region $\imath$

X_i^s : output of sector s in region i

X_j^s : output of sector s in region j

q_j^s : ntraregional flows of commodity s in region j

This method has been used not only for estimating the intraregional commodities flow, but also for several extension purposes. (18) We are unable to employ this method because there is no data on intraregional trade flows in Indonesia though only for one region.

—Gravity Potential Model

The formulation of the GP maybe written in the form,

$$T_{ij} = A_i B_j F_{ij}$$

where,

A_i : an origin factor

B_j : destination factor

F_{ij} : separation factor

The GP model above indicates that F_{ij} measures the separation between region i and j, while T_{ij} is the expected flow of people, commodities from region i to region j.

Having an information both on interregional trade flows and the distances among regions, the GP model seems to be the most approprite estimator compared to other methods written before.

(2) *Assumptions*

Actually GP model is derived from physical science, i. e. Newtonian. Unlike the physical science, the movement of people or commodities from one point/region to another point will strongly be influenced by the psychological factor. Accordingly, it is common knowledge that application of GP model in social science requires some assumptions. Due to the real situation in Indonesia, we adopt the following assumptions.

—The interregional trade flow by airplane is ignored

This assumption is based on the fact that the volume of interregional commodity flow by plane is very low, approximately less than 1 percent of total interregional commodity flow. (1)

—Every region has only one mainport

This assumption is actually far from reality because the facts show that each region has more than one mainport.

It must be kept in mind however, that region has usually been considered as a point. Based on this reason, we assume the value of each commodity in each region as a summation of commodity flow from each mainport within region according to the destination. The largest mainport sent or received, then, has been chosen as the representative mainport of the region (see Figure 1).

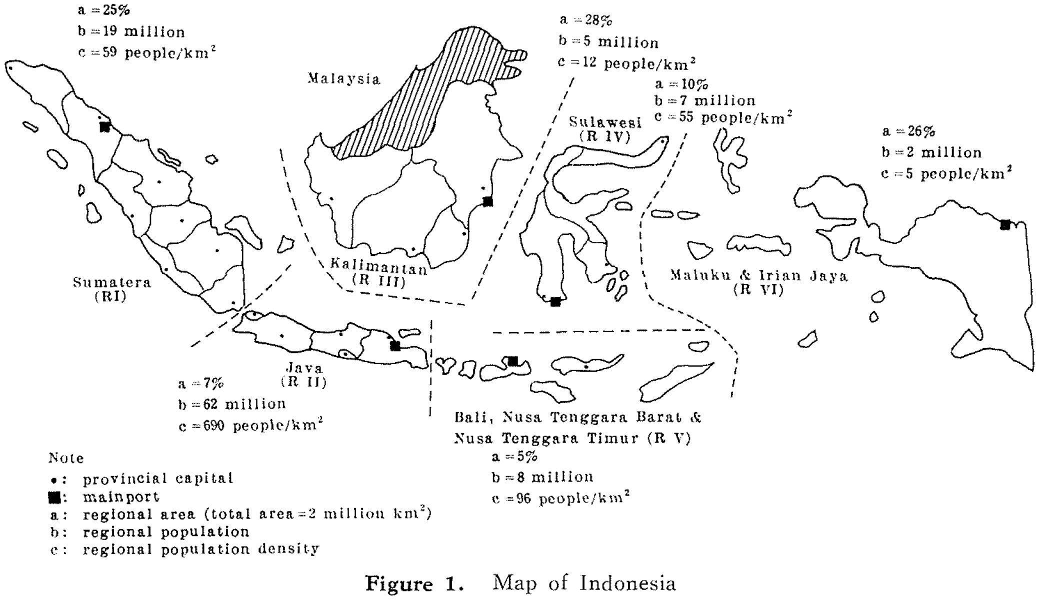

Figure 1. Map of Indonesia

Table 3. Intraregional Average Distance (in km)

Region I

sub region \ sub region	1	2	3	4	5	6	7	8
1	—	454	827	973	1,378	1,297	1,492	1,670
2		—	470	551	843	1,038	957	1,297
3			—	178	389	584	519	843
4				—	470	568	422	794
5					—	211	276	486
6						—	194	276
7							—	470
8								—

average distance : 19,927/28 = 712 km

Region II

sub region \ sub region	1	2	3	4	5
1	—	114	405	454	681
2		—	324	340	503
3			—	114	259
4				—	276
5					—

average distance : 3,470/10 = 347 km

Region III

sub region \ sub region	1	2	3	4
1	—	713	843	405
2		—	324	308
3			—	502
4				—

average distance : 3,095/6 = 516 km

Region IV

sub region \ sub region	1	2	3	4
1	—	357	438	940
2		—	341	649
3			—	551
4				—

average distance : 3,276/6 = 546 km

Region V

sub region \ sub region	1	2	3
1	—	940	568
2		—	162
3			—

average distance : 1,670/3 = 557 km

Region VI

sub region \ sub region	1	2
1	—	1,410
2		—

average distance : 1,410 km

—The distance among regions is assumed as the straightline distance among the mainports (in kilometer)

This assumption had to be done since there is no data on the regional shipments available at hand. The logic behind this assumption is, the speed per hour is common among ships, whether the ship is new or old. Accordingly, if the distance is double, the time needed for that route will also be double.

—Transport expenses in kilometer are common among regions

Actually this assumption is not in contradiction with the reality because if, factor markets are competitive, the differential of transport expenses, then, will be followed by adjusting of transport expenses until reach a condition where cost in kilometer are common among region. (14)

—It is introduced that the interregional commodity flow is a total commodity flows between two regions rather than commodity flows from region i to region j, or vice versa

This assumption has to be done because the volume of commodity from region i to region j is not equal to the volume from region j to region i. It is to say that the actual commodity flow is in contradiction with the fundamental law of GP model (see the problem of cross hauling). (11)

—The intraregional distance is assumed as the straightline distance among provincial capital

Interlaced to the common assumption that region is usually considered as a point, it permits us, then, to assume each province as a point also. Since each region is usually composed of more than one province, we will obtain the intraregional distance as the summation of the straightline distance among capitals within region divided by the number of line distances (see Figure 1 and Table 3).

(3) *Formal Model*

Regional income and regional population have been employed as an explanatory variables, however, each variable are applied separately. Both two variables have been selected under considerations that the two variables have the strongest influence in the movement of commodities. Putting the distance as another explanatory, the model maybe written as follows.

—Simple Gravity Model with Respect to Regional Income

The formulation of the model maybe written as follows,

$$F_{ij}=C\frac{Y_i Y_j}{D_{ij}^{\alpha}}$$

where,

F_{ij}: total commodity flow between region i and region j
Y_i : output of region i
Y_j : output of region j
D_{ij}: distance from region i to region j

C, α are constants.

One may define α as a percentage change in commodity flow divided by percentage change in distance. It is common knowledge that if the distance is getting longer the volume of commodity flow will decrease respectively. Accordingly, the value of α should be negative, other things being equal. The model above has been built on the assumption that the value of regional income ealsticity is equal to unity.

—General Gravity Model with Respect to Regional Income

The model is defined as follows,

$$F_{ij}=C\frac{(Y_i Y_j)^{\beta}}{D_{ij}^{\alpha}}$$

where β is constant.

Regional income elasticity (β) is defined as a percentage change in commodity flow divided by percentage change in regional output. Since commodity flow and regional output move in the same directions, the value of β should be positive, ceteris paribus. Unlike the previous model, the second model depicts the interaction of commodity within country as a function of regional income and the distance variable when this interaction is reflected in interregional commodity flow.

—Simple Gravity Model with Respect to Regional Population

$$F_{ij}=C\frac{P_i P_j}{D_{ij}^{\alpha}}$$

where,

F_{ij}: total commodity flow between region i and region j

P_i : population of region i

P_j : population of region j

D_{ij}: distance from region i to region j

C, α are constants.

Similar to the first model, the third model is considered under assumption that the value of regional population elasticity is equal to unity, while the distance elasticity is defined in an analogous way with the first model. The meaning of unity elasticity is, if regional population increase by one unit, the commodity flow will also increase by one unit.

—General Gravity Model with Respect to regional Population

The formulation maybe written as follows,

$$F_{ij}=C\frac{(P_i P_j)^{\gamma}}{D_{ij}^{\alpha}}$$

where γ is constant.

Elasticity of regional population (γ) is defined as a percentage change in commodity flow divided by percentage change in regional population. The value of γ must be positive because there is positive relationship between regional population and commodity flow.

(4) *Estimation of the Intraregional trade flows*

As is well known, the correlation coefficients of Gravity Model was usually

Table 4. Classification of Interregional Commodities Flow

No.	Sectoral	Commodities
1.	Main Staple Food	rice, maize
2.	Other Agricultural Product	coffee, tea, spices, tobacco, rubber
3.	forestry	wood
4.	Livestock	livestock, meat
5.	Fishery	fish
6.	Mining	salt, asphalt, products for heating, lighting and power, lubricants and related products, crude oil, benzine, kerosene, other petroleum products
7.	Manufacturing	wheatflour, sugar, animal feeds, food products, palm oil, cooking oil, other fatty substances and waxes, fertilizers, chemicals and allied products, paperpulp, paper, paperware, hides, leather, textiles, articles of clothing of all materials and made up textiles cement, non metalic mineral pottery, porcelein, glass, ores of precious metal, precoius stone pearls, iron, steel, base metals machinery, apparatus and appliances, electrical material, transport equipment and miscellaneous commodities

Table 5. Empirical Results of Parameter Estimation of α using Simple Gravity Model with Respect to Regional Income

Sector	Constant	α	R**
1. Main Staple Food	−13.984	−0.449 (−0.998)*	0.274
2. Other Agricultural Product	1.481	−2.599 (−2.719)	0.618
3. Forestry	18.954	−4.583 (−3.808)	0.740
4. Livestock	5.296	−1.531 (−1.313)	0.354
5. Fishery	−1.785	−0.641 (−0.588)	0.183
6. Mining	19.267	−2.585 (−2.987)	0.638
7. Manufacturing	16.532	−1.009 (−0.820)	0.153

$$F_{ij}=\frac{Y_i Y_j}{D_{ij}^{\alpha}}$$

* t value

** coef. of correlation

Table 6. Empirical Results of Parameter Estimation of α and β using General Grauity Model with Respect to Regional Income

Sector	Constant	β	α	R**
1. Main Staple Food	−1.579	0.079 (0.275)*	−0.515 (−1.198)*	0.370
2. Other Agricultural Product	−8.597	0.460 (1.242)	−2.777 (−2.936)	0.676
3. Forestry	17.240	0.246 (0.688)	−5.185 (−3.434)	0.752
4. Livestock	7.137	−0.086 (−0.158)	−1.506 (−1.228)	0.357
5. Fishery	−22.143	0.748 (0.817)	−0.229 (−0.185)	0.316
6. Mining	20.173	−0.040 (−0.224)	−2.568 (−2.849)	0.640
7. Manufacturing	−35.402	2.137 (4.881)	−2.770 (−2.821)	0.694

$$F_{ij}=C\frac{(Y_iY_j)^\beta}{D_{ij}{}^\alpha}$$

* t value
** coef. of correlation

Table 7. Empirical Results of Parameter Estimation of α using Simple Gravity Model with Respect to Regional Population

Sector	Constant	α	R**
1. Main Staple Food	15.441	−0.780 (−1.751)*	0.451
2. Other Agricultural Product	23.382	−2.212 (−1.592)	0.418
3. Forestry	25.436	−2.305 (−1.388)	0.372
4. Livestock	15.350	−1.380 (−1.186)	0.324
5. Fishery	12.485	−0.954 (−0.872)	0.266
6. Mining	24.326	−1.697 (−2.332)	0.543
7. Manufacturing	16.020	−1.985 (−1.506)	0.483

$$F_{ij}=C\frac{P_iP_j}{D_{ij}{}^\alpha}$$

* t value
** coef. of correlation

Table 8. Empirical Results of Parameter Estimation of α and γ using General Gravity Model with Respect to Regional Population

Sector	Constant	γ	α	R**
1. Main Staple Food	5.942	0.425 (1.630)*	−0.589 (−1.356)*	0.599
2. Other Agricultural Product	−9.264	1.438 (3.932)	−1.453 (−1.520)	0.814
3. Forestry	9.627	0.855 (1.570)	−2.347 (−1.500)	0.544
4. Livestock	6.215	0.594 (1.336)	−1.677 (−1.460)	0.480
5. Fishery	−17.019	1.125 (2.075)	0.179 (−1.800)	0.609
6. Mining	10.743	0.544 (1.946)	−1.257 (−1.800)	0.681
7. Manufacturing	−9.147	1.540 (4.260)	−1.475 (−1.513)	0.645

$$F_{ij} = C\frac{(P_i P_j)^{\gamma}}{D_{ij}^{\alpha}}$$

* t value

** coef. of correlation

found very small, in fact some result gave unsatisfactory results, however, the results should be considered conscientiously. (9) Though the Gravity concept both for social and physical science are based on the same fundamental law however, having a difference meaning on masses will bring also to the difference results. (7)

An analysis of parameters will be discussed in the first chance and will be continued by estimation of intraregional trade flows. The list of commodities is presented in Table 4 while the value of each parameter are presented in Table 5 to Table 8.

—Analysis of parameters

a. Main staple food

Using the first model the result shows that the value of α was -0.449 while the value of R and t test were 0.274 and -0.988 respectively. This result implies that a 1 percent increse in distance leads to a 0.499 percent decline in volume of commodity flow.

Though the land area of region II is the smallest compared to other regions (7 percent from total Indonesian land), however, region II produces the highest of main staple food among regions. Having the capital city of Indonesia however, region II has been experiencing tremendous population influx urbanisation resulting in gradual depletion of fertile land under cultivation. A vast majority of Indonesia's population is concentrated in region II, the consequential socioeconomic and political pressure is the highest in region II, accordingly rapid development gradually encompassed more and more peripheral areas in its folds sharply reducing the agricultural land stock.

Recently two programs have been implementing by government which aim to bring the supply of national foods equal to its demand. The first program is called intensification and the second is extensification. The former has only been implementing in region II due to the gradual depletion of fertile land region in region II. The latter is what its name indicates, this program is based on the consideration of how to extensify the land cultivation. Accordingly, this program has only been implementing in other regions since there are a wide of potential land for cultivating.

b. Other agricultural product

The fourth model gives the best result of estimating in the sense that the value of correlation coefficient is the highest among four models. On the contrary third model is considered as the worst model because the value of R was only 0.418.

Unlike main staple food, the highest volume of such commodities flow is come from region IV, approximately 160 thousands ton. In addition, 99 percent from that 160 thoudands ton will go to region II. This movement indicates that local supply of this commodities in region II is not sufficient to meet its demand. One interesting point is, region I had actually been developed under colonial regime as an estate and shifting cultivation area. The contribution of region I on the interregional trade flows does not reflect as the main producer of such commodities, however. There is supposition, supported by data, that the highest share of production of other agricultural products in region I has been exporting to other countries.

c. Forestry

Among four models, the second model serves the best result compared to the rest models. The value of R was 0.752, the value of α and β were -5.185 and 0.264 respectively. This result indicates that it if the distance gets longer by 1 percent will lead to a remarkably decrease in the flow of commodities by more than 5 percent. Model 3 on the contrary, stands as the worst one due to the low value of correlation coefficient.

The data on land utilization by island shows that region III has the highest of state forest, while the lowest is in region V. It is not surprising, the highest contribution on the interregional forestry flow is came region III. The role of region III as a forestry products is becoming important because the recent data on export of commodities show that the value in monetary terms of export of forestry ranks number two after petroleum. In recent years, the international market price of petroleum has been going down resulting not only to the declining of government revenue but also influence the balance of trade of Indonesia. In this respect, more attention should be paid to the effort of promoting the non-petroleum export commodities.

d. Livestock

General Gravity model with respect to regional population represents the best result among the four models. The value of R was 0.480 while the value of α and γ were -1.677 and 0.594. The value of t test however, all model give the unsatisfatory results, the range is between -0.158 to -1.46. Because the value of R was 0.342, the third model is considered as the worst model.

Having the highest average of steppe pasture, region V stands as the most important producer of livestock. A share of interregional livestock flow from region V is almost 80 percent from total livestock flow, where 90 percent from its percentage went to region II. The gap between supply of and demand for livestock in region II has been fulfilled by sending livestock from region V, and presumably this movement pattern will be continued in the future.

e. Fishery

The highest value of correlation coefficient is represented by model 4, that was 0.609, while the lowest was model 1, that was 0.183.

As a Gravity model, the value of R of 0.609 maybe considered as a good result, however, that result should be considered in more deeply. Though the value of R is a bit satisfactory, however, the value of distance elasticity was found to be 0.179. As a consequence, the result implies that both distance and the flow of fisheries will move in the same direction. In other words, the longer the distance the greater the volume of fisheries will flow. The finding above, in fact, is in contradiction with the theoritical background written before. Data on fisheries flow show that 95 percent of that total flow is mainly distributed from other regions to region II. This anomaly depicts a situation where there is strong "unknown variable" influence the behavioural of interregional fisheries flow. This presumption is supported by data for example, the longest distance from region II is region VI, however, the flow of fisheries from region VI to region II is higher compared to region IV. Again having the distance only 420 km to region II, however, the output flow from region III to region II is smaller compared to region I, though the distance from region I is longer than 420 km. Presumably this phenomenon is caused by the fact that a surplus of supply for and demand of fisheries in the nearer distance region from region II was less than the one in the longer distance region from region II. As a consequence, those surpluses will go to region II neglecting the role of distance as an influence variable.

f. Mining

Again model 4 gives the best result among four models. The value of R was 0.810 and the value of α and γ were -1.257 and 0.544.

On the mean while, the worst result is represented by the third model bacause the value of R was 0.543 and -1.697 for the value of α.

Indonesia is one of petroleum export countries. It is not disputably that for Indonesia petroleum is considered as the most strategic commodity export due to the fact that the highest share of gov't budget is financed by pertroleum revenue. Once government is in a difficult position, the path of development will also being obstruct respectively. During the oil boomed period, Indonesia has enjoyed the beneficiaries as a petroleum producer. The annual rate of growth of GDP from 1970 to 1980 was 7.5 percent. In recent years however, Indonesia is facing to the difficulties due to the significantly decrease of the international price of petroleum. As a result, the average rate of growth of GDP from 1980 to 1985 was at the average of 3 percent. To overcome the difficulties, Indonesian government is implementing a policy which aim to promote the production of non-petroleum exports.

g. Manufacturing

The best model is represented by model 2 which the value of coefficient correlation was 0.694 while the value of α and β were -2.780 and 2.137. On the other hand, model 1 gives the bad result, the value of R is the lowest among 4 models.

—Estimation of Intraregional commodities flow

If one wants to select the best model among 4 models, it is necessary then to compare the value of correlation coefficients, the value of t tests, the value of each parameters, etc. Based on such considerations, finally, model 4 has been selected as the most appropriate model among them. The already known parameters of fourth model, then, will be used to estimate the flow of intraregional commodities flow. The new formulation of Gravity Model maybe written as follows,

$$E(F_{ii}) = C\frac{(P_i P_i)^{\gamma}}{D_{ii}{}^{\alpha}}$$

where,

$E(F_{ii})$: expected intraregional commodities flow

P_i : population of region i

D_{ii} : intraregional distance of region i

C, α, γ are already known parameters.

Based on the definition of trade coefficients written before, the value of each coefficient can easily be found by dividing intraregional and interregional commodities flow by total of each commodity for each region, however, due to the space consideration both the flow of interregional trade and the value of trade coefficients will not be reported.

4. Analysis of some experimental results

So far, we have found the regional technical coefficients by replacing the diagonal block matrix of regional technical coefficients with national technical coefficients. Since we already divided Indonesia into 6 regions, accordingly there will be 6 identical blocks along diagonal matrix which each block consists of 14.14 matrix. Furthermore the trade coefficients have already been obtained by using Gravity Model (a detailed discussion on the stability of trade coefficients could be seen in paper by Moses). (13)

Due to a vast majority of Indonesia's population is concentrated in region II (around 60 percent in 1980) and also that region II is a bit developed than other

Table 9. Intraregional Commodities Flow (estimation) unit : ton

Sector \ Region	I	II	III	IV	V	VI
1. Main Staple Food	30,577	127,389	10,993	15,398	12,797	2,697
2. Other Agricultural Product	41,940	3,562,596	1,105	3,576	1,931	16
3. Forestry	123,377	4,395,096	22,902	42,277	28,453	593
4. Livestock	1,581	21,483	498	760	578	30
5. Fishery	1,337	16,747	51	137	87	7
6. Mining	829,849	7,400,070	263,287	394,352	308,045	26,291
7. Manufacturing	329,720	36,179,384	6,529	23,110	11,968	78

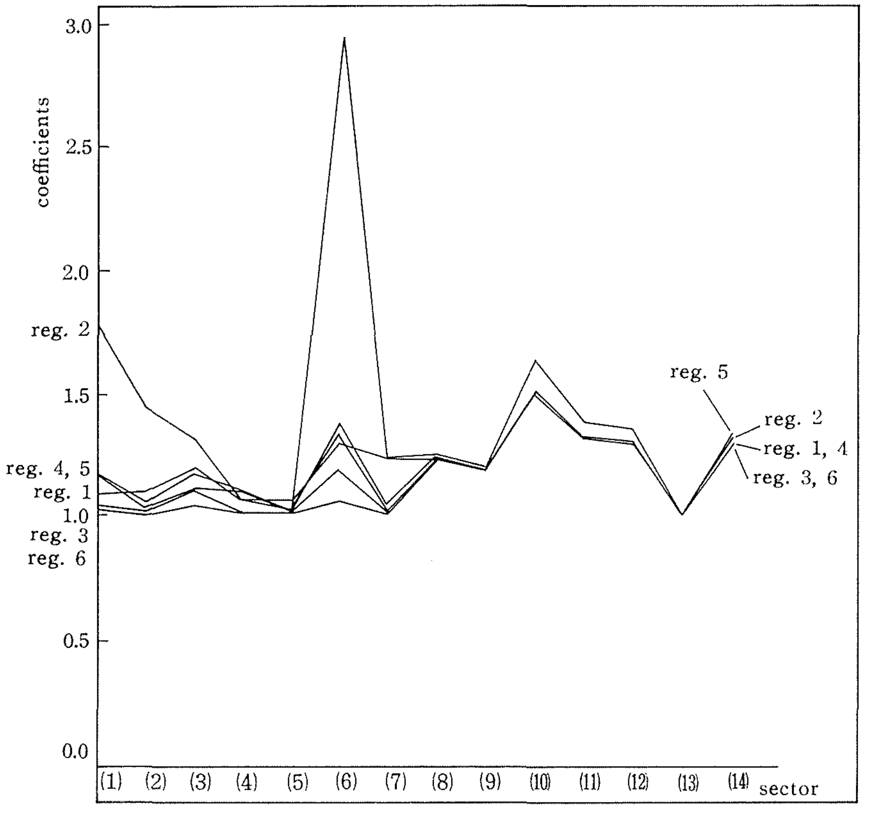

Figure 2. The Total Direct and Indirect Production Coefficients (column).

regions, we may, then, propose our hypothesis that the Multiregional Input-Output Coefficients of Indonesia for 1980 will strongly be influenced by region II.

Figure 1 and Figure 2 show that sector (1) to sector (7) among regions are significantly difference while the value of production coefficients of sector (8) to sector (14) are found to be approximately the same among regions. It is caused by the facts that both intraregional and interregional trade for the first 7 sectors

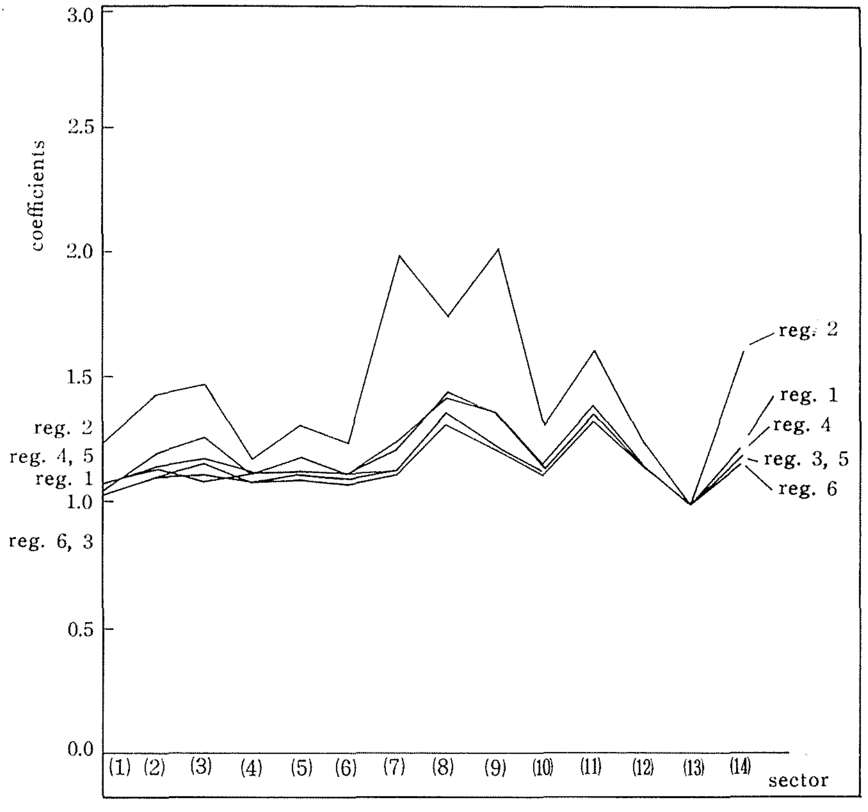

Figure 3. The Total Direct and Indirect Production Coefficients (row)

are exist while the rest sectors are zero. For the first 7 sectors, our hypothesis should be accepted satisfactory because almost all 7 sectors in region II show the highest value of production coefficients among 6 regions. Inversely, the lowest values of production coefficients is represented by region VI. The production coefficient of manufacturing sector (07) in region II stands as the highest value among all coefficients. Within Indonesia it can be argued that concentration of large and foreign owned industry in region II, i. e. Jakarta, is essentially the result of two factors : first, most of this industry is geared to the domestic market and therefore locates in Jakarta where the middleclass with its quickly-growing disposable income is largest. Second, bureaucracy plays a key role in Indonesia industry, so most firms would prefer to locate in Jakarta where their acces to central government is best achieved. (5) Figure 3 and Figure 4 seem to strengthen our hypothesis, the value of manufacturing sector (07) in region II is undoubtedly the highest among sectors and regions. Table 10 shows that almost three fourth of total investment has been accounted in manufacturing sector while investment in livestock was zero during four years. Unlike domestic investment, the fluctuation of foreign investment has close relationship with the fluctuation in international economic as

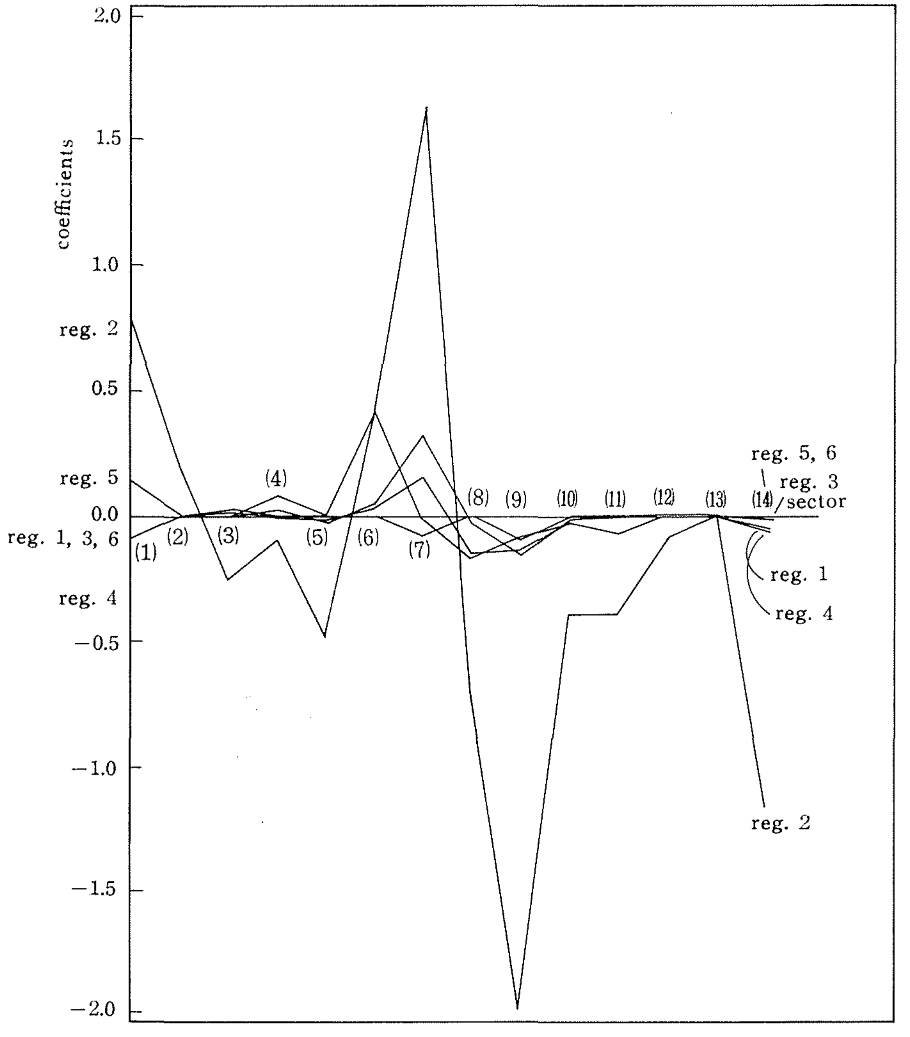

Figure 4. The Total Input Variation Coefficients (column).

well as that home economic. In 1979, the total foreign investment was $ 1,252 million, however, the investment has sharply decreased during recession time to became $ 30.2 million in 1982. Table 11 also indicates that sectors such as manufacturing, trade, and financial have been considered as the most attractive sectors for foreign investment. Table 12 indicates that the correlation between domestic investment and regional population was quite weak. Region V for example, though the number of population is higher compared to region VI, however, the total domestic investment is actually less than region VI. The highest per capita domestic investment is region III, while the lowest is region V. Unlike domestic investment, the highest of total foreign investment is accounted in region I, and region V stands as the lowest region in receiving foreign investment.

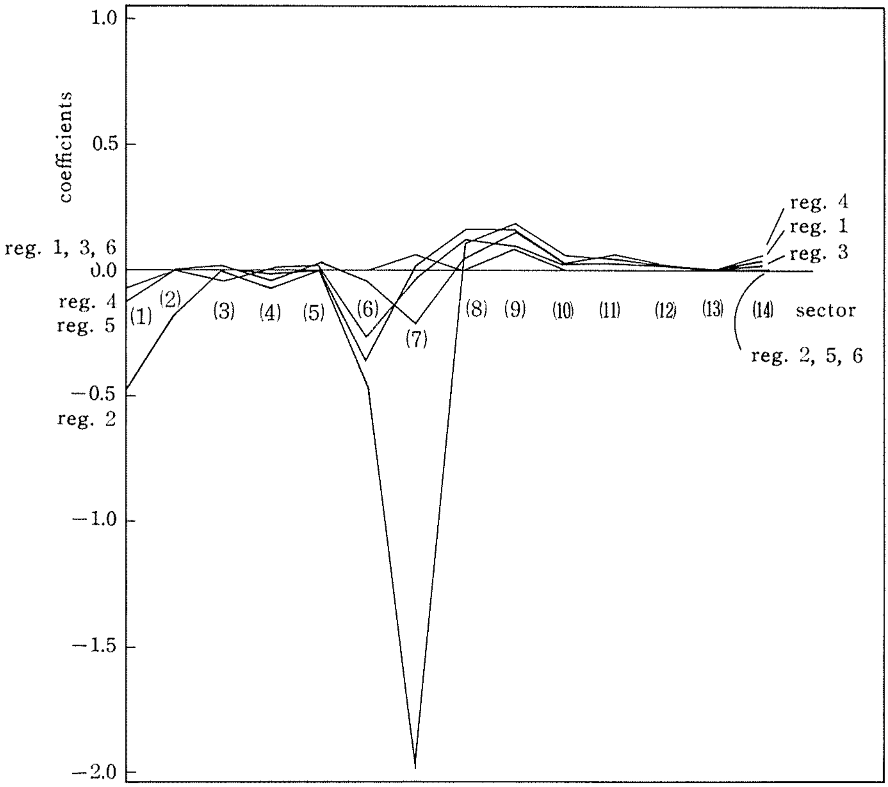

Figure 5. The Total Input Variation Coefficients (row).

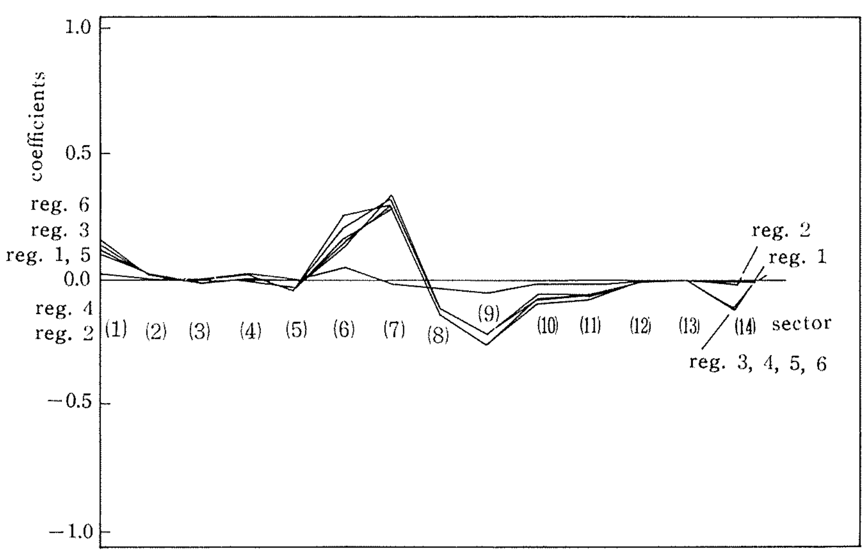

Figure 6. The Total Production Variation Coefficients (column).

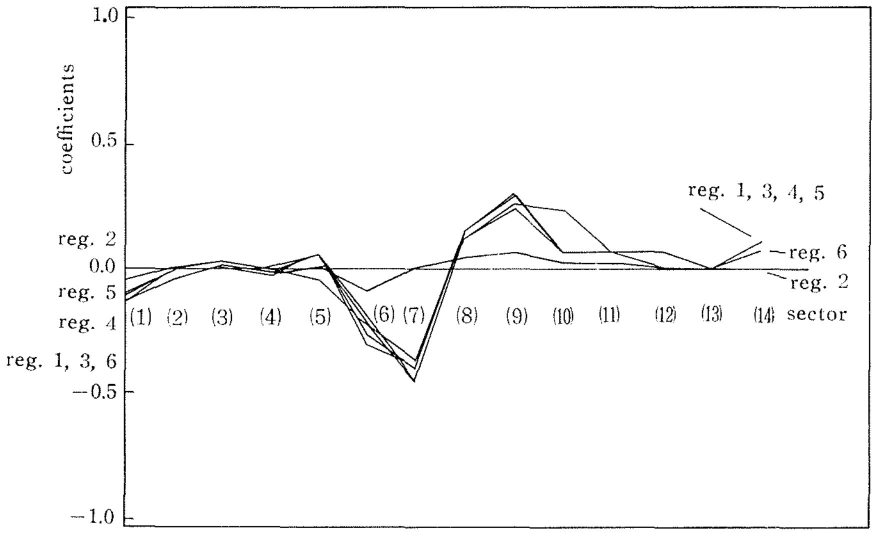

Figure 7. The Total Production Variation Coefficients (row).

Table 10. Approved Domestic Investment Projects by Economic Activity for 1979–1982

(unit million rupiah)

Sector \ Year	1979	1980	1981	1982
1. main staple food	33,638	65,768	148,513	475,001
2. other agricultural product	—	—	—	—
3. forestry	81,802	11,466	—	13,898
4. livestock	—	—	—	—
5. fishery	2,772	6,082	751	3,490
6. mining	32,882	37,093	11,115	462,690
7. manufacturing	502,343	2,586,649	1,122,605	2,212,541
8. electricity	—	—	—	418,585
9. construction	2,060	8,250	—	—
10. trade	10,835	11,766	32,875	53,276
11. transport	16,936	49,035	58,910	22,361
12. financial	3,778	1,350	29,460	72,100
13. public administration	—	—	—	—
14. services	1,583	2,952	—	30,506
Total	688,629	2,780,411	1,404,229	3,764,448

Table 11. Approved Foreign Investment Projects by Economic Acitivity for 1979–1982

(unit million $)

Sector \ Year	1979	1980	1981	1982
1. main staple food	18.2	4.0	1.1	—
2. other agricultural product	—	—	—	—
3. forestry	23.3	16.0	—	—
4. livestock	—	—	—	—
5. fishery	36.8	1.0	—	—
6. mining	—	—	—	—
7. manufacturing	1,126.2	693.7	258.2	2.4
8. electricity	—	—	—	—
9. construction	—	—	—	—
10. trade	3.0	63.2	—	4.3
11. transportation	—	31.6	—	—
12. financial	44.5	—	1.7	22.0
13. public	—	—	—	—
14. administration services	—	4.4	—	1.5
Total	1,252.0	813.9	261.0	30.2

Table 12. Approved Domestic and Foreign Investment by Region (total 1979–1982)

Region	Domestic inv. (million rupiah)	investment per capita (thousand rupiah)	Foreign inv. (millon $)	investment per capita (thousand $)	Population (1980; 1000 people)
I	1,545,967	55.2	1,576.3	0.056	28,016
II	4,992,614	54.7	695.4	0.008	91,270
III	971,146	144.5	69.6	0.010	6,723
IV	305,494	29.3	7.0	0.001	10,410
V	36,749	4.3	0.0	0.000	8,487
VI	324,324	125.5	57.7	0.022	2,585
National	8,176,294	55.4	2,406.0	0.016	147,491

note: exchange rate in 1987 $1=Rp 1650,— (rupiah)

5. Conclusion and further research

Imposing the Gravity Potential Model to overcome the lack of some necessaries data properly, the Multiregional Input-Output Table for Indonesia finally has been solved satisfactory, though the complete results will not be reported.

Due to the less number of study on regionalization in Indonesia, our finding result might be presents what is believed to be first Multiregional Input-Output Table for Indonesia. In addition, we are concerned to elaborate in more detail the interdependencies among regions, therefore our attention should mainly be focused to the problem associated with the cause and effect of interdependencies. Firstly, our finding results indicate that region II should be considered as the most advance region, and essentially this result are caused by the fact that the share of population of region II is the highest among all regions and the fact that the deliberate policy for development of region II had been done since colonial regime. If a major goal of regional development policy is to achieve structural transformation, i. e. to change the input coefficients, accordingly more attention should be paid to the development of other regions, in particular region V and region VI. Secondly, regional population policy should be embodied in regional development policy which emphasized should be given to the reduction of population share of region II. This effort can be done by sending people from region II to other regions which have a low density of population. Thirdly, within Indonesia it can be argued that resources endowment in region V is the poorest among all regions. Data on interregional trade flows indicate that the most potential output from region V is only livestock products. In this line, investment can be allocated in region V where priority is given to the industry which will give the highest amount of value added.

The 1980 Population Census shows that for the total population, the labor force participation rate was 50.2 percent meaning that about one half of the population aged 10 years and over are in the labor force. The Population Census also shows that region IV has the lowest of labor force participation rate (around 42 percent) while the highest is in region III (54 percent). The rate of laborforce participation will remarkably increase in the 1990 due to the several factors : (1) the structure of population is termed as young pupulation structure, (2) the limited capacity for formal education.

Unfortunately however, in recent years the fluctuation of international oil price has brought about to the government revenue resulting in the low growth of GDP. For Indonesia, the role of government in the direction to development is vital in the sense that the highest share of development budgest is financed by government. This condition clearly indicates that the number of unemployment will gradually increase affecting not only to the decreasing in labor productivity but also will be a crucial problem.

Considering that unemployment rates varies among regions, it is necessary then to know the detail information on the supply of and demand for regional employment, so that it is hoped the regional employment policy can be formulated as well as the national employment policy.

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