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RESEARCH REPORT No. 5

Socio-Economic Development As An Objective Of Peace: Quantitative Implications

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INTRODUCTION

We feel that peace cannot be realized by just aiming at an ism or a principle of peace. If each ism is based on a different ideology, then we can easily reach a point of conflict between one ism and another, thus we have an ideological dispute. In this case, theoretical approaches based on any given ideology have certain limitations, even though they may contribute to the advancement of theoretical techniques, methods, and ways of thinking.

In this paper, we would like to present not only a wider framework of study but also empirical results of our analysis. It may suggest a new field of peace science. That is, we do not consider peace as a matter of principle, but as a positive target of the society. The "positive" has the meaning of "practical" or "operational". It is nonsense if targets of the society are not practical or operational ones.

We chose social development as one of the positive targets which seem to be one of the basic objectives of peace. Our basic assumption is that "poverty creates conflicts". Poverty does not simply mean economic poorness. There are so many kinds of poverty, say, poverty of socio-cultural standards, education, social overhead-capital, application of new techniques, administration, and even in political achievements. Such multi-dimensional poverty creates various kinds of conflict. This is a reason why we propose a multi-dimensional framework for considering the problem of peace and conflict.

One of our main concerns has been to quantitatively grasp the actual structure of society according to the social system (framework). For this purpose we built a social system model which consisted of various social, cultural, political and economic variables. Then we empirically estimated a positive social model. The results of simulation analysis

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* The author wishes to thank Dr. Carl Trocki for improving the presentation of this paper.

using this moderl are explained later.

Another question we want to examine here is whether or not socioeconomic development leads to social injustice. Professors lsard and Liossatos' conclusion[1] was that "economic development generally leads to greater social injustice'. Their conclusion was derived from the examination of an optimal space-time development model.

We are not going to address this question directly or in a simplistic manner, but would like to consider it within the wider framework of social development. Since social processes are so complicated, nobody can examine their interrelations by employing such a simple economic model with only a few social variables. We really need to develop an operational multi-dimensional framework.

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1 Isard, W., and P. Liossatos, "Social Injustice and Optimal Space-Time Development", *Journal of Peace Science*, Vol. 1, No. 1 (Autumn. 1973) pp. 69–93.

1. A SOCIAL MODEL

1.1 Framework and Procedure

Firstly, we shall briefly explain the framework and procedure of model building, concepts of variables and results of the estimation. We have aimed at constructing not the usual economic model with just a few additional social variables, but a well-balanced social model. A basis of our framework owes something to T. Person's social system[1] or the general social model of W. Isard[2].

Our system consists of the following four basic sectors: (1) economic, (2) political, (3) social, and (4) cultural sectors. These basic sectors are assumed to be surrounded by (5) human resources, (6) foreign relations, and (7) natural environment. We have also selected several important indicators or variables for each sector, taking into account results of our previous works[3] and others[4]. Then, we constructed a normative "socio-economic model".

For the estimation procedure, we employed cross-national data which covered ninety-seven countries (both developed and under-developed) for 1968. These data are mostly based on the "per capita" or "ratio" concept. The simple least square method was applied for estimating parameters of each equation.

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1 Persons. T., and N.J. Smelser, *Economy and Society: A Study in the Integration of Economic and Social Theory*, 1956

2 Isard, W., et. al., *General Theory: Social, Political, Economic and Regional*, MIT Press, 1969

3 Takamori, H., and S. Yamashita, "Measuring Socio-economic Development: Indicators, Development Paths, and International Comparisons", *The Developing Economies*, June 1973

4 Including Adelman, I., "An Econometric Model of Development: Reply", *The American Economic Review*, March 1970

TABLE 1 NOTATION

	Code	Name of Variable	Unit
Economic Sector	GDP	per capita gross domestic products	10 US dollar
	ENGC	per capita energy consumption	100 Kg
	ELCT	capacity of electric power generation per 100 thousand people	Mega Watt
	CONS	per capita private consumption	10 US dollar
	INDP	share of manufacturing in GDP	per cent
Cultural & Educational Sector	LITE	literacy (ratio to total population over 15 years old)	per cent
	ELMT	share of elementary school graduates	per cent
	FIST	enrollment in first level education	per cent
	STUD	enrollment in higher level education	per 10 thousand
	NEWS	newspaper circulation	per 100 thousand
	PHYS	number of physicians	per 100 thousand
	CALO	per capita calory intake per day	10 calory
	EDUU*	per capita educational expenditure	US dollar
Social and Demographic Sector	BIRT	birth rate	per thousand
	DETH	death rate	per thousand
	INFM	infant mortality	per birth
	URBN	share of population living in locations of 100 thousand or more	per cent
	IGIN	income inequality (Gini index)	–
	ETHA*	racial & linguistic ununification	per cent
	LGIN*	inequality in land held (Gini index)	–
Political Sector	VOTE	voting rate to population over 20 years old	per cent
	DEMO	number of demonstrations during 1950–1965	per 100 thousand
	RIOT	number of riots during 1950–1965	per 100 thousand
	GSAN	government sanctions during 1950–1965	per 100 thousand
	ADJT	number of changes in gov't cabinet	
	MEAL*	number of affiliation to international organizations	
	MILW*	number of soldiers	
	EXIN*	number of interventions from foreign countries	

Note: * attached to some variables shows to be policy or exogeneous variables.

Data Sources:

(1) Taylor, C.L., and M.C. Hudson, *World Handbook of Political & Social Indicators,* 2nd ed., Cambridge, Mass., Yale Univ. Press, 1972

(2) Banks, A.S., and R. Textor, *A Crosspolity Survey,* Cambridge, Mass., MIT Press, 1963

(3) Banks, A.S., et.al., *Crosspolity Time Series,* Cambridge, Mass., MIT Press, 1971

1.2 Notation and Results of Estimation

Our social model consists of 28 variables: 22 endogenous and 6 exogenous ones. Notation of the variables and their units are shown in Table 1.

Results of estimation of the social model are shown in the following. $\bar{R}$ stands for the coefficient of determination after modification of the degree of the freedom, $\bar{S}$ for the standard deviation of equation, F for F ratio, and figures in parentheses under each coefficient (parameters) for t values.

Economic Sector

(1) per capita GDP (level of production and economic welfare)

$$GDP = -18.37 + 0.541\ ELCT + 0.756\ ELMT + 1.950\ URBN$$
$$\quad\quad (2.5) \quad (7.7) \quad\quad (4.1) \quad\quad (5.6)$$
$$\bar{R} = 0.871 \quad\quad \bar{S} = 36.82 \quad\quad F = 102.7$$

(2) per capita private consumption

$$CONS = 2.546 + 0.818\ GDP$$
$$\quad\quad (1.1) \quad (37.7)$$
$$\bar{R} = 0.968 \quad\quad \bar{S} = 16.03 \quad\quad F = 1241.9$$

(3) Share of manufacturing to GDP (industrialization)

$$INDP = 14.66 + 0.200\ ELMT + 0.294\ ENGC$$
$$\quad\quad (8.7) \quad (3.8) \quad\quad (3.9)$$
$$\bar{R} = 0.719 \quad\quad \bar{S} = 9.60 \quad\quad F = 52.9$$

(4) per capita energy consumption

$$ENGC = -2.706 + 0.204\ GDP + 0.139\ URBN$$
$$\quad\quad (1.8) \quad (13.3) \quad\quad (1.6)$$
$$\bar{R} = 0.896 \quad\quad \bar{S} = 8.24 \quad\quad F = 198.1$$

(5) per capita capacity of electric power generation

$$ELCT = 6.762 + 2.209\ ENGC$$
$$\quad\quad (1.1) \quad (8.35)$$
$$\bar{R} = 0.644 \quad\quad \bar{S} = 48.31 \quad\quad F = 69.8$$

Social Sector

(6) Birth Rate

$$BIRT = 37.68 + 0.021\ INFM - 0.184\ LITE + 0.339\ IGIN - 0.030\ GDP$$
$$(11.5)\quad (1.5)\quad (6.2)\quad (6.7)\quad (3.1)$$

$\bar{R} = 0.922$ $\bar{S} = 4.90$ $F = 139.4$

(7) Death Rate

$$DETH = 23.32 - 0.028\ PHYS - 0.123\ FIST$$
$$(19.1)\quad (3.1)\quad (5.3)$$

$\bar{R} = 0.744$ $\bar{S} = 3.73$ $F = 69.1$

(8) Infant Mortality

$$INFM = 134.6 - 1.234\ ELMT - 0.181\ PHYS$$
$$(20.0)\quad (4.8)\quad (1.6)$$

$\bar{R} = 0.732$ $\bar{S} = 38.38$ $F = 56.9$

(9) Urbanization

$$URBN = 15.83 + 0.279\ NEWS + 0.068\ GDP - 0.091\ ETHA$$
$$(7.5)\quad (2.1)\quad (2.9)\quad (2.6)$$

$\bar{R} = 0.734$ $\bar{S} = 9.11$ $F = 38.8$

(10) Income Inequality (Gini Index)

$$IGIN = 23.78 - 0.188\ VOTE - 0.232\ INDP + 0.119\ LGIN + 0.375\ BIRT$$
$$(2.9)\quad (3.2)\quad (3.1)\quad (1.9)\quad (4.3)$$

$\bar{R} = 0.821$ $\bar{S} = 7.22$ $F = 51.3$

Cultural and Educational Sector

(11) Literacy

$$LITE = 38.47 + 0.716\ ELMT + 0.512\ NEWS - 0.243\ ETHA$$
$$(9.8)\quad (7.9)\quad (2.9)\quad (4.3)$$

$\bar{R} = 0.891$ $\bar{S} = 14.63$ $F = 125.8$

(12) Newspaper Circulation (Informatization)

$$NEWS = -5.97 + 0.142\ LITE + 0.107\ GDP + 0.089\ URBN$$
$$(4.6)\quad (8.0)\quad (1.2)$$

$\bar{R} = 0.889$ $\bar{S} = 6.47$ $F = 122.6$

(13) Elementary School Graduates (Educational Stock)

$$ELMT = -2.483 + 0.420\ FIST + 1.003\ NEWS$$
$$(0.5)\quad (4.5)\qquad (6.5)$$

$\bar{R} = 0.825$ $\bar{S} = 15.10$ $F = 104.5$

(14) Enrollment in First Level Education

$$FIST = 54.93 + 0.179\ EDUU + 0.619\ URBN - 0.215\ ETHA$$
$$(11.9)\quad (3.5)\qquad (3.9)\qquad (3.5)$$

$\bar{R} = 0.732$ $\bar{S} = 15.86$ $F = 38.2$

(15) Enrollment in Higher Education

$$STUD = 14.10 + 0.341\ GDP + 0.598\ FIST$$
$$(1.3)\quad (5.4)\qquad (3.0)$$

$\bar{R} = 0.713$ $\bar{S} = 35.17$ $F = 51.2$

(16) Number of Pysicians (Medical Level)

$$PHYS = -18.91 + 0.986\ LITE + 0.313\ STUD + 0.145\ GDP$$
$$(2.8)\quad (6.7)\qquad (3.5)\qquad (2.3)$$

$\bar{R} = 0.864$ $\bar{S} = 29.6$ $F = 96.2$

(17) Calory Intake (Nutritive Condition)

$$CALO = 253.8 + 0.154\ GDP + 0.424\ LITE - 1.342\ IGIN$$
$$(20.8)\ (2.9)\qquad (3.4)\qquad (4.9)$$

$\bar{R} = 0.803$ $\bar{S} = 26.8$ $F = 59.7$

Political Sector

(18) Vote (Political Participation)

$$VOTE = 108.5 - 0.713\ IGIN - 0.267\ LGIN - 0.136\ ETHA$$
$$(17.5)\quad (6.5)\qquad (2.7)\qquad (3.2)$$

$\bar{R} = 0.728$ $\bar{S} = 11.68$ $F = 37.6$

(19) Riot

$$RIOT = -5.50 + 0.182\ DEMO + 0.507\ EXIN$$
$$(2.1)\quad (2.3)\qquad (17.2)$$

$\bar{R} = 0.912$ $\bar{S} = 23.3$ $F = 239.1$

(20) Demonstration

$$\begin{aligned} DEMO = {} & 5.26 + 0.322\ NEW + 0.107\ MEAL - 0.124\ GSAN \\ & \quad (1.3) \quad (0.9) \qquad (7.5) \qquad (2.6) \\ & -0.106\ GDP + 0.102\ MILW \\ & \quad (1.6) \qquad (1.0) \end{aligned}$$

$\bar{R} = 0.696$ $\bar{S} = 24.85$ $F = 19.2$

(21) Government Sanctions

$$\begin{aligned} GSAN = {} & 35.19 + 1.051\ RIOT \\ & \quad (5.2) \quad (9.2) \end{aligned}$$

$\bar{R} = 0.680$ $\bar{S} = 63.87$ $F = 84.2$

(22) Cabinet Alternation (Political Stability)

$$\begin{aligned} ADJT = {} & -6.05 + 2.274\ RIOT + 0.361\ VOTE \\ & \quad (0.2) \quad (18.8) \qquad (0.9) \end{aligned}$$

$\bar{R} = 0.887$ $\bar{S} = 67.16$ $F = 179.7$

2. DOES ECONOMIC DEVELOPMENT LEAD TO SOCIAL INJUSTICE?

2.1 Directions of Simulation Analysis

Social development will be considered as a multi-dimensional porcess of social change. Therefore, social development planning should be concerned in the pursuit and achievement of multidimensional values or goals. When we want to achieve several different goals at the same time, we shall readily find there are some complementary relations among certain goals and conflicting relations among others. Our concern in this study is to examine and measure the social influences of changes in policy variables under certain sets of social goals and constraints. We are also interested in considering the effects and restriction in goals due to existing social and political limitations. In this case, we shall be able to find the bottlenecks and also the social costs of achieving a given goal, by employing the concept of "shadow price" as used in linear programming.

We made two types of simulation analysis. One was the application of simple impact analysis in which we operated one core (key) variable at a time and estimated the effects of the resulting change (A series). The other was done by linear programming under multi-constraints in which some of the main (core) variables are fixed at certain levels, assuming there exist such social and Political limitations (B series).

Our simulation analysis is based on the following linear programming (LP). The social model described above was used as the structural equation of constraint. However, there were some difficulties in defining the objective function. If all variables could be measured in monetary terms then the objective function might be defined as, for example, maximization of the total

amount. In the case of the social model, the procedure is not so simple. This includes many variables of different units. There is also a serious problem of values among variables. It is extremely difficult or impossible to define a true objective function for either the individual or the entire society. We do not have any a priori value criterion for it. Therefore, we first set the following composite indicators for the purpose of calculating the social objective function.

In the economic sector, for instance, there are five variables, i.e. GDP, ENGC, ELCT, CONS, and INDP. Let the world averages and standard deviations of these variables be $\bar{X}_1, \bar{X}_2, \ldots \bar{X}_5$ and $\sigma_1, \sigma_2, \ldots, \sigma_5$, respectively. Thus, the indicator of the economic level (ECO. LEVEL) may be written as

$$(23)\quad \text{ECO. LEVEL} = \frac{1}{5}\left[\frac{1}{\sigma_1}(X_1 - \bar{X}_1) + \frac{1}{\sigma_2}(X_2 - \bar{X}_2) + \ldots \right.$$
$$\left. \ldots + \frac{1}{\sigma_5}(X_5 - \bar{X}_5)\right].$$

If the values of each variable are equal to the world averages, then ECO. LEVEL will be zero. If all variables are higher than the world averages by one standard deviation, then ECO. LEVEL = 1. Likewise we have difined such LEVEL indicators for each sector. The indicators we have defined include cultural level (CUL. LEVEL), basic standard of living (BASIC. LEVEL), social level (SOC. LEVEL), political situation (POL. LEVEL), and exogenous variables (EXO. VAR.).

Thus, we have defined our objective function of social LP model as

$$(24)\quad \text{AIM} = \text{ECO. LEVEL} + \text{CUL. LEVEL} + \text{BASIC. LEVEL}$$
$$+ \text{SOC. LEVEL} + \text{POL. LEVEL}$$

We did not use any weighting or value judgement for determining it. Our social LP model may be described as follows:

(25) Maximize AIM
Subject to Equations (1) to (22).

2.2 Social Impacts of Economic Growth

Let us first examine effects of the change in per capita GDP (or economic growth), based on results of Simulation Series A. For this purpose we made the following procedures.

(1) Set four exogenous variables, LGIN, MEAL, MILW, and EXIN, fixed to world averages.

(2) Limit the range of change of EDUU (per capita educational expenditure) and ETHA (racial and linguistic ununification) to $0 \leqq \text{EDUU} \leqq 150$ and $25 \leqq \text{ETHA} \leqq 100$.

(3) Take GDP (per capita GDP) as a policy variable and change the value from US$200, 400, 700, 1,300, to $1,600.

(4) Maximize AIM and solve.

Part of the results are shown in Table 2 and also illustrated the tendencies for some key variables in Figure 1.

From these results we may be able to quantitatively measure the effects of economic growth on the society. At the beginning, we consider a society with per capita GDP at the level of US$200. In this society, the literacy rate is 63 per cent, infant mortality is 76 per 1,000 births, newspaper circulation is about 5 per 100,000 persons, number of demonstration is 12 times per annum, on the average. And, the birth rate is 3.2 percent and death rate is 1.1 percent.

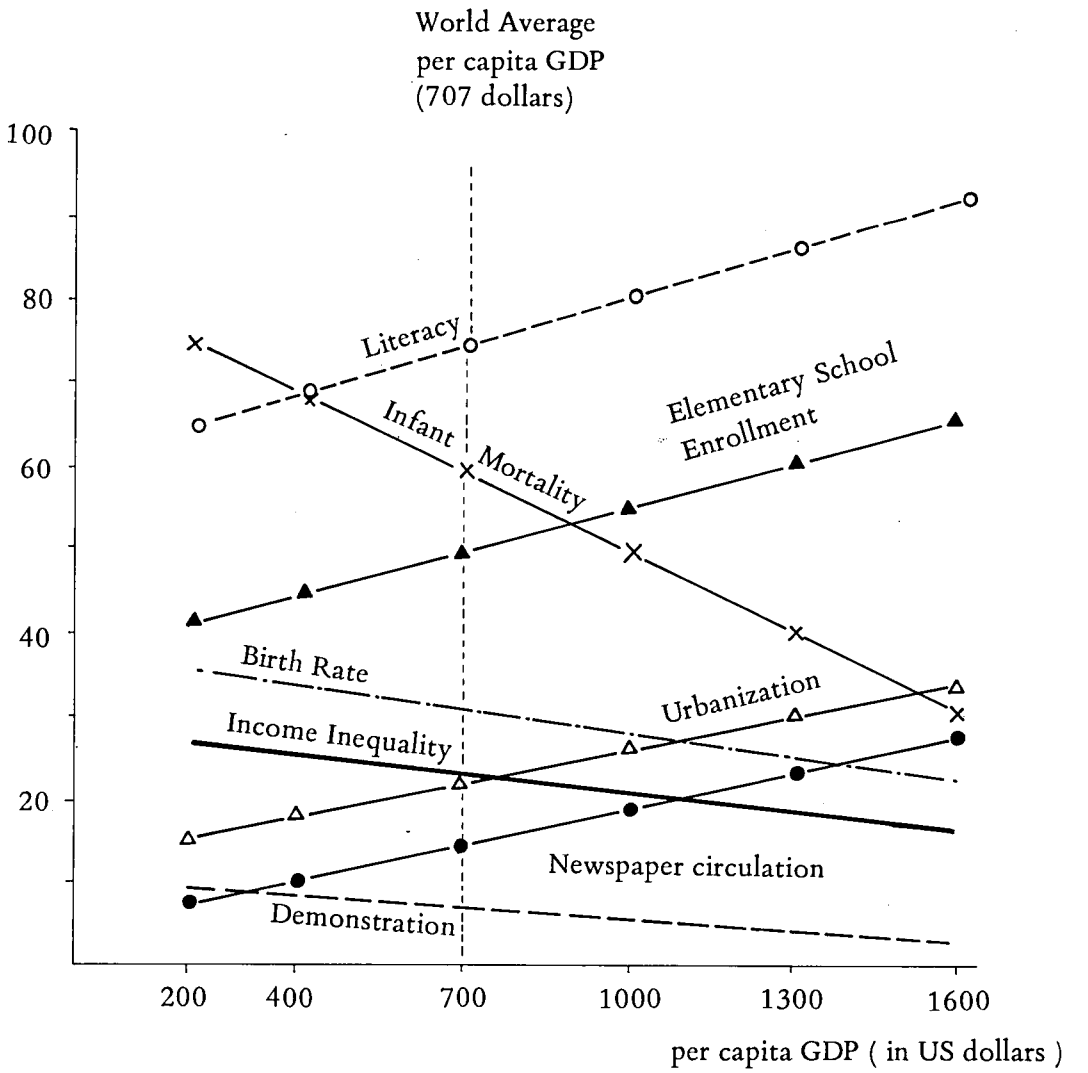
TABLE 2 SOCIAL IMPACTS OF ECONOMIC GROWTH

(LP Solution)

Case of Simulation / Variable	Per Capita GDP		
	US$ 400	1000	1600
ECO. LEVL	− 0. 328	0. 351	0. 937
CUL. LEVL	0. 235	0. 631	1. 112
BASIC. LEVL	0. 191	0. 552	0. 914
SOC. LEVL	0. 265	0. 427	0. 589
POL. LEVL	0. 031	0. 098	0. 147
EXO. VAR	0. 736	0. 680	0. 736
AIM	**0. 392**	**2. 057**	**3. 697**
GNP	40. 000	100. 000	160. 000
CONS	35. 260	84. 340	133. 420
ELCT	24. 567	53. 487	82. 407
ENGC	8. 094	21. 240	34. 385
INDP	25. 898	31. 851	37. 804
LITE	69. 294	81. 424	93. 553
ELMT	44. 453	55. 157	65. 860
NEWS	9. 845	18. 568	27. 290
FIST	87. 531	91. 563	95. 595
STUD	51. 844	74. 655	97. 466
PHYS	71. 451	99. 251	127. 050
URBN	18. 992	25. 506	32. 019
BIRT	33. 686	27. 879	22. 072
DETH	10. 554	9. 279	8. 005
INFM	67. 091	48. 894	30. 698
CALO	255. 429	275. 282	295. 135
VOTE	69. 625	72. 555	75. 485
DEMO	9. 150	4. 153	2. 208
RIOT	17. 764	16. 855	16. 500
GSAN	53. 852	52. 897	52. 525
ADJU	59. 408	58. 401	58. 655
IGIN	25. 153	21. 044	16. 934
ETHA	25. 000	25. 000	25. 000
EDUU	150. 000	150. 000	150. 000
GINI	65. 700	65. 700	65. 700
MEAL	120. 700	120. 700	120. 700
MILW	15. 300	0. 000	15. 300
EXIN	42. 600	42. 600	42. 600

Note: Units of the Figures in this table should be referred to Table 1 (p.4)

FIGURE 1 SOCIAL EFFECTS OF ECONOMIC GROWTH



Assumptions: (1) Exogeneous variables (LGIN, MEAL, MILW, and EXIN) are fixed at the world averages.

(2) $25 \leqq \text{ETHA} \leqq 100$

(3) $\text{EDUU} \leqq 150$

Note: Figures of world average were calculated for 1968.

Thus, the rate of population growth is 2.1 percent per annum.

We are interested in how the society would change if per capita GDP increased from $200 to the level of $1,600. As shown in Table 2, literacy rate becomes 93.6 percent and infant mortality decreases to the level of 30 per 1,000 births. Newspaper circulation will multiply 5 times of the level of the $200 society to 24 per 100 thousand persons. The number of demonstrations shows a marked decrease to only 2 times per annum. This result depends on the specification of demonstration function (20). Since the coefficient of GDP is minus, demonstrations decrease when GDP increases. In this case the minus effect of GDP is far stronger than the plus effect of NEWS and two exogenous variables, MEAL and MILW. We may need to reexamine this specification.

The birth rate becomes 2.2 percent which shows a decrease of 1.0 percent compared with that of the $200 society. The death rate also falls to 0.8 percent. As a result, the rate of population growth becomes 1.4 percent per annum in the $1,600 society, compared with 2.1 percent in the $200 society.

We may make some general comments on the results as follows: variables which were considerably improved by the increase of income are literacy, newspaper circulation, education enrollment, medical care, and infant mortality (decrease), besides the economic variables (CONS, ELCT, and ENGC); other variables which were comparatively improved are enrollment of first level education, birth rate (decrease), death rate (decrease), coalory intake, voting rate, and income inequality. Many of the political variables are not so affected by income growth as might expected. This may be caused by the weak connection between economic and political variables in our model.

It was also ascertained that urbanization advanced with economic growth. But, we cannot unconditionally say whether urbanization is in fact social advancement. It may depend upon the development stage of the society and the value judgements of the people.

By the way, the world average of per capita GDP in 1968 was US 707 dollars (simple average from our data). In this average society, literacy rate would be 61.8 percent, infant mortality 58 per 1,000 birth, birth rate 2.6 percent, death rate 0.9 percent, and at that time the rate of population growth was 1.7 percent.

We also made a similar impact analysis for considering the effects of changes in the following variables: literacy, urbanization, income inequality, education expenditure, primary school enrollment, land holding inequality and lack of racial and linguistic uniformity. These results have been reported in other journals in Japanese mentioned before.

2.3 Social Development Leads to Social Justice in the Long Run

As shown in Figure 1, most of the variables are improved by an increase in per capita GDP. Such undesirable variables, income inequality, infant mortality, birth rate and death rate all show declining tendencies with economic growth. Desirable variables such as the literacy rate and newspaper circulation are improved by an income increase. Although we cannot judge only from this examination whether or not economic growth leads to equality or enhances social values, our results show some of the directions of socio-economic development.

According to this framework and our results, we cannot find any evidence

to prove Prof. Isard 'and Liossators' hypothesis, 'development leads to social injustice', Instead, our results show 'social development leads to social justice'. Furthermore, this result will be considered as total effects of interrelated social processes through the working of our socio-economic model. However, our study has been done on the basis of the cross-national data in a single year. We should mention here that the results have not been derived from the study of the historical process of a certain country. We need to apply this kind of framework to one specific country, utilizing time series socio-economic data.

3. SOCIAL AND POLITICAL CONSTRAINTS

This examination is based on the results of Series B of our simulation analysis. In this series we have taken into account some social and political variables as the unremovable constraints in the society. The method of this simulation is a linear programming one, i.e. maximization of specific social objective function, by supposing that there exist certain social and political conditions which limit some social variables or activities to their critical levels.

For this simulation, we first set upper *and* lower limits for all exogenous and one-sided free (upper *or* lower) limits for some endogenous variables. We made 53 cases of LP simulations for different combinations of objective functions and constraints. In this section, we shall only examine two experiments of this: one is the case where the upper boundary of the literacy rate was limited to just 70 percent; the other is the case where the birth rate could not be decreased below 2.8 percent. Other results and examinations have partly been reported in the Japanese Journal *Azia Keizai* (Asian Economy) in August issue of 1974.

3.1 If Literacy Rate Could Not Be Improved More Than 70 Percent?

If the upper bound of the literacy rate was limited to 70 percent, then what level of social life will the society be able to enjoy? The 70 percent literacy rate is roughly equal to those of such Asian countries as Thailand, South Korea, and Hong Kong or those of Ecuador and Paraguay in South America in 1968. The world simple average of this rate was 61.8 percent in 1968. We took 70 percent as the maximum literacy rate which is higher 0.25 o (one-fourth of standard deviation) than the world average.

We made eight cases of LP simulation for this examination, supposing

there existed such social and political restraints which depressed the literacy rate to 70 percent. The results are shown for five cases in the following Table 3.

TABLE 3 LP SOLUTIONS WHEN THE UPPER LIMIT OF LITERACY RATE IS 70 PERCENT

Objective Function	Max. or Min. Values of Objective Function	Shadow Price Under GDP Limitation	Shadow Price Exogenous Variables		
			ETHA	EDUU	LGIN
Infant Mortality	63 per 1000 birth	1.00	0	0.07	0
Per Capita GDP	850 dollars	1.60	0	0.018	0
Income Inequality	21	0.26	0	0.002	0.23
Death Rate	1.12%	0.113	0	0.017	0
Political Level	0.22	0.005	0	0.001	0.006

For the purpose of comparing these results with actual figures, the concerned values of the above four countries are shown in Table 4, respectively.

TABLE 4 ACTUAL FIGURES OF FOUR COUNTRIES

Country	Per Capita GDP	Infant Mortality Per 1000 Birth	Death Per 1000	Income Inequality (Gine Index)
Thailand	129	38	14	43
South Korea	105	–	12	17.7
Hong Kong	425	24	5	–
Equador	216	90	12	29.3

According to our results shown in Table 3, the highest per capita GDP to be achieved would be 850 dollars, in case of the literacy rate is limited to 70 percent. But, we may also be able to interpret this result in other ways. Per capita GDP of those countries, where the literacy rates are around 70%, are less than 500 dollars or as low as 100 dollars for some countries. Therefore, these countries may be able to increase their per capita GDP up to 850 dollars without any improvement of literacy rate.

Infant mortality, in this case, results in 60 per 1,000 births. Of course, this figure is on a world average. In actually, there are regional variations. As shown in Table 4, concerned Asian countries have already achieved such an average level long age showing rather low figures such as 24 for Hong Kong and 38 for Thailand, per 1,000 Births. On the other hand, Equador shows higher infant mortality at 90 per 1,000 births.

Now, let us examine the effects of an increase in the literacy rate of 1 point (percent). This can be judged by just looking at the shadow prices shown in Table 3. The shadow price of GDP in this case is 1.6. This means that a one per cent increase in the literacy rate creates additional 16 dollars of per capita GDP. The shadow price of infant mortality is 1. That is, a one percent increase in the literacy rate results in a decrease of infant mortality by one per 1,000 births. Likewise, we can examine effects of the changes in the literacy rate on other social variables by just calculating shadow prices.

For the record, we shall show the achievable values of other main variables, when the literacy rate is limited to 70 percent as follows: Newspaper circulation = 15 per 10 thousand persons; calory intake = 2,600 calories; university students = 62 per 10 thousand; industrialization (the share of manu-

facturing to GDP) = 29 percent; number of physicians = 81.9 per 100 thousand; urbanization = 22 percent, etc.

3.2 If the Birth Rate Cannot Be Lowered than 2.8 Percent?

The world average of birth rate shows 3.45 percent according to our data. We took the value of 2.8 percent for the society's limit of birth rate which is lower than the world average by half of standard deviations (0.5 σ). That is, this is an examination of the society's achievable levels in socio-economic indicators when the birth rate cannot be lowered beyond 2.8 percent. Some religious reasons may prevent family planning, resulting in this kind of situation in some underdeveloped countries. Results of LP simulation are shown in Table 5. We can read the results as before.

TABLE 5 LP SOLUTIONS WHEN LOWER LIMIT OF BIRTH RATE IS 2.8 PERCENT

Objective Function	Max. or Min. Values of Objective Function	Shadow Price	Shadow Price Exogenous Variables		
			ETHA	EDUU	LGIN
Death Rate	8.8%	0.33	0	.017	.026
Infant Mortality	44 per 1,000 Births	2.95	0	.07	.229
Per Capita GDP	1,110 dollars	4.60	0	.01	.36
Cultural Level	0.75	0.073	0	.002	.006

In the birth rate could not be lowered beyond 2.8 percent then the society can increase per capita GDP up to a maximum of 1,110 dollars. The death rate will fall to 0.88 percent; infant mortality will become 44 per 1,000 births.

The shadow price of per capita GDP shows 4.6. This means that a one percent decrease in birth rate results in an increase of per capita GDP by 46 dollars. Similarly, the shadow price of infant mortality is also high, 2.95. This shows that, if the society could decrease the birth rate by one percent, they can reduce nearly 3 infant deaths per 1,000 births.

4. SOME IMPLICATIONS

The Specifications and estimations of a socio-economic model have been examined in this paper. Also, parts of the results of simulation analyses have been explained. This study, however, has not aimed at direct analysis of peace, but it has just suggested some directions of study in this field.

Concerning to our results, there may be many shortcomings. Our study has been based on cross-sectional (-national) socio-economic data. We may have employed time-series data for the study, especially for examining a long term process of development. In this connection, we have already studied socio-economic development in Japan, making use of time-series data from 1890 to 1940. Parts of the results have been published in the Japanese Journal, *Azia Keizai* (*Asian Economy*), in July 1975.

Results of simulation analysis may just show an average trend and may not be applicable to every country as a norm. In this sense it is more meaningful to study this kind of socio-economic interrelationships for each country rather than by a cross-sectional analysis like ours.

There are some other questions relating to our examinations. Some of the specifications of our model should be reconsidered. We have not obtained any value system yet. There may be so many important variables which are not included here and not so easy to measure quantitatively.

However, our analysis may have contributed somewhat in the area in which social and peace scientists are interested. Problem of peace may not be considered only ideologically. Ideological disputes sometimes cause new conflicts and make them sharper when discuss peace or some objectives of peace, we would rather be convinced by theoretical *and* quantitative results which have been processed in scientific manners.

We have mainly aimed at making clear the whirlpool of social variables in socio-economic development, or in other words, the structure of socio-economic development. Thus, our model is an interlocking simultaneous equation system which consists of political, economic, social, and cultural variables. This model is unique from others which introduce only one or two non-economic variables into the usual economic models. Therefore, we could quantitatively estimate wider effects of social policies, taking into account such interlocking social processes.

The operationality of our model should also be evaluated. Based on the above framework of social systems we built a social model and estimated it statistically. We believe that we shall be able to quantitatively measure non-economic factors. Even though we could not take these figures other than "one to ten" scores, A.B.C. ranking, or just zero or one judgement which is usually used for computer programming, we can conduct such quantitative analysis which derives more operational policy implications.