AN EMPIRICAL STUDY ON REGIONAL WELFARE INEQUALITIES AND NATIONAL EXPENDITURE PRIORITIES

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Introduction

The allocation of public funds among regions has been one of the most important decisions made by the national governments of many countries. In particular, the question of whether such allocations actually contribute to the reduction of inter-regional welfare inequalities has been of great interest among regional scientists. To address this empirical question, however, we must answer the fundamental question of how to define a national government's perceptions of both the relative levels of regional welfare disparities and the relative effectiveness of various expenditures in reducing such inequalities. For example, how does the national government implicitly assign relative weights to economic factors such as income and employment in comparison to other socio-environmental factors such as public safety, education, housing and air pollution when making regional welfare comparisons? Similarly, how does the national government implicitly weigh the relative effectiveness of public works projects against revenue sharing programs in reducing perceived welfare disparities?[1]

To our knowledge, there have been no empirical attempts to measure such governmental tradeoffs, mainly due to the absence of an appropriate method. Recently, however, an interesting programming approach that can deal with this dual measurement problem has been proposed by Smith (1981). Although his approach is in essence an indirect one, it is very appealing, particularly from the empirical point of view since all computations can be easily done in a linear programming framework. In spite of the attractiveness of the Smith method, it has not yet been applied empirically.

This paper is a first attempt aimed at measuring such implicit governmental tradeoffs based on the Smith approach. A hypothesis relating regional welfare inequalities with the regional allocation pattern of government expenditures is established in the next section. Also, the method suggested by Smith (1982) to test this hypothesis will be briefly introduced. The following sections will then describe the data used in this analysis, and present the empirical results and their implications. Finally some concluding remarks are made.

The Hypothesis and Testing Method

Let us assume a nation consisting of R political regions. We then define a set of *regional indicators* s^i $(i = 1,...,N)$ reflecting the socio-economic and environmental characteristics of each region. It is further assumed that the national government perceives the welfare level of region r by a set of such regional indicators

$$(1) \quad S_r = (s^1_r,...,s^1_r,...,s^N_r) \quad (r=1,...,R)$$

where s^1_r denotes a regional indicator i in region r such as income level, unemployment rate, indices of education and health, air pollution emission, or welfare facilities.

Although this set can describe the various welfare aspects of each region reasonably well, it is clear that tradeoffs arise among regional indicators when making interregional comparisons of welfare due to the multidimensional nature of such a set[2]. As an attempt to avoid such a problem, let us assume that the inter-regional welfare comparisons by the national government can be represented by means of a linear *regional-welfare function:*

$$(2) \quad W(Sr) = \sum_{i=1}^{N} \alpha^i \, s^i_r = \alpha' S_r \quad r = 1,...,R$$

where the welfare weight vector $\alpha = \{\alpha^1...,\alpha^N\}$ consists of positive weights α^1 which reflect the national government's implicit valuations of the relative welfare implications of each regional indicators s^1. In terms of this representation, we then assume that whenever $W(S_r) \geq W(S_u)$, the national government regards the overall welfare level in region r to be at least as high as that in region u. Needless to say the implicit weights α are seldom made explicit, and can only be revealed indirectly in terms of observed governmental decision behavior.

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On the other hand, in responding to perceived regional welfare inequalities, it is assumed that the national government has a number of policy variables by which it can stimulate relative regional growth, and hence can control the relative levels of the regional indicators. For simplicity, assume that such policy variables can be characterized in terms of a set of government expenditure variables g_j. In addition, it is assumed that the regional policy of the national government toward each region 4 can be characterized by means of an expenditure set

$$(3) \quad Gr = \{g^1{}_r,...,g^j{}_r,...g^M{}_r\} \qquad r = 1,...,R$$

where $g^j{}_r$ denotes the level of government expenditure variable j in region r such as federally funded public works projects, urban or community development programs, and direct revenue transfers to regional governments.[3]

Under this definition of an expenditure set, it is clear that comparisons among possible expenditure sets for a given region will generally involve tradeoffs among the levels of one or more expenditure variables. Hence it is assumed, as in the case of regional welfare comparisons, that the government's comparisons of the relative effectiveness of each expenditure set G_r can be represented by some implicit linear effective expenditure function:

$$(4) \quad E(G_r) = \sum_{i=1}^{N} \beta^j g^j{}_r = \beta' G_r \qquad r = 1,...,R$$

where the positive expenditure weight vector $\beta = \{\beta^1,...,\beta^M\}$ reflects the national government's implicit evaluations of the relative effectiveness of each expenditure variable j in improving regional welfare levels. The implicit weights e^j are also seldom made explicit, and can be revealed only in terms of observed governmental decision behavior.

If the national government does in fact seek to reduce perceived disparities in regional welfare levels, it is reasonable to hypothesize that higher effective expenditures $E(G_r)$ will be allocated to regions r with lower welfare levels $W(S_r)$. Let us call this the hypothesis for *regional allocation pattern of government expenditures* (RAPGE). In terms of equations (2) and (4), this hypothesis can be stated that, given sets of regional indicators $\{S_1,..,S_R\}$ and sets of expenditure variables $\{G^1,...,G_R\}$, there exist positive vectors,α and β, such that for all pairs of regions r and u

$$(5) \quad \alpha' S_r \geq \alpha\ni S_u \iff \beta\ni G_u \leq \beta' G_u$$

In this context, it is clear that testing RAPGE is logically equivalent to finding positive vectors α and β satisfying (5) for the given data S and G.

Smith (1982) has proposed a programming *method* to compute such weights. To see his approach, let us define R^N, $R^N{}_o$, and $R^N{}_+$ as n-dimensional euclidian space, the non-negative orthant, and the positive orthant, respectively. Since (5) holds for a pair of regions (r,u) if and only if it also holds for the pair (u,r), it is enough to consider only those pairs of regions (r,u) with r < u. Furthermore, since there are exactly R(R-1)/2 such pairs, we relabel these pairs as (r_i,u_i) with an index i E I ={1,...,R(R-1)/2}. We also define the associated *residual vectors* X_i and Z_i for each i in I as $X_i = S_{ui}-S_{ri}$ and $Z_i = G_{ri}-G_{ui}$, respectively. Then (5) can be stated more compactly in terms of *residual vectors*

$$(6) \quad \alpha' X_i \geq O \iff \beta' Z_i \geq O \quad (i \text{ E } I)$$

Smith then showed that if a solution set (μ*, α*, β*) satisfies the following two linear programs simultaneously, and furthermore μ* is positive, then the resulting vectors α* and β* always satisfy the relation (6)[4].

Linear Program (A)

$$(7) \quad \underset{(\mu,\beta)}{\text{maximize:}} \quad \mu$$

$$(8) \quad \text{subject to: } \mu - (\alpha' X_i) Z'_i \beta \leq O \quad (i \text{ E } I)$$

$$(9) \quad \beta \text{ E } C_M = \{ \beta E R^M{}_o \mid M \leq \sigma'_M \beta < M+1 \}$$

where $\sigma^M = (1,...,1)$ is the *unit vector* in R^M and the value of α is fixed.

Linear Program (B)

$$(10) \quad \underset{(\mu,\alpha)}{\text{mazimize:}} \quad \mu$$

$$(11) \quad \text{subject to: } \mu - (\beta' Z_i) X'_i \alpha \leq O \quad (i \text{ E } I)$$

$$(12) \quad \alpha \text{ E } C_N = \{\alpha \text{ E } R^N{}_o \mid N \leq \alpha \leq N+1\}$$

where $\sigma'_N = (1,...,1)$ is the *unit vector* in R^N and the value of β is fixed.

Furthermore Smith showed that these simultaneous programs can be effectively solved by an iterative procedure[5]. In addition, since such iterative computations are usually very costly, Smith proposed an approximation procedure which is simpler to solve and at least gives good starting values for such iterations.

Note that if we can find some α and β such that α' X_i=β' Z_i for all i in I, then (6) would be automatically satisfied. Hence one approximation approach to satisfying (6) is to find α and β such that the sum of squared differences between α' x_i and β' Z_i are as small as possible. In other words, find α and β satisfying the following minimization problem

(13) $$\text{mimize: } \sum_{i \in I} (\alpha' X_i - \beta' Z_i)^2$$

Hence if we solve this problem subject to the two positivity constraints (9) and (12), then this becomes a standard quadratic program. This quadratic problem can be solved by a linear programming technique such as a simplex method. If the resulting α and β by this square approximation procedure satisfy (6) for all i in I, then the HRAPGE is verified. If not, these vectors can serve by construction, as good starting values for solving the above simultaneous linear programs.

More simply, if we ignore the positivity constraint for the present and impose some constraints such as (15) to avoid the inherent scale problem in (13), then the above minimization problem will be the following maximization problem:

(14) $$\text{maximize: } \alpha' X Z' \beta$$

(15) $$\text{subject to: } \alpha' X X' \alpha = 1 = \beta' Z Z' \beta$$

where $X = \{X_i' \mid i \in I\}$ and $Z = \{Z_i' \mid i \in I\}$

Note that this is computationally equivalent to the well-known canonical correlation problem. Consequently, the weight vectors satisfying this maximization problem can be obtained by the standard eigenvalue technique.

If the resulting α and β by this least square approximation procedure satisfy (6) for all i in I, and in addition are positive, then the HRAPGE is verified. If not, these vectors again can serve, by construction, as good starting values for solving the above simultaneous linear programs.

The Data

There appears to be no generally acceptable way of representing the data S_r and G_r. We assume in this study that regional welfare can be represented as a function of six broadly defined regional factors: economics, education, environment, health, political and social factors. Then, instead of using surrogates to represent these factors[6] as in conventional studies, we construct six corresponding aggregated indices known as *quality of life (QOL) indices* from 75 variables ranging from individual income and wealth, income distribution, political participation, pollution, educational attainment, and individual equality, to economic structure, government performance, environmental protection, transportation, and crime. Selection of the data and calculation of the associated indices mainly follow Smith (1973) and Liu (1976). The composition and the associated data sources for these six QOL indices are presented in Appendix 1.

In addition, since the computed results are likely to be sensitive to the method of constructing the QOL indices, another set of 8 QOL indices[7] is also constructed based on 20 variables to investigate such a sensitivity problem.

The data G_{rb} are supposed to represent, by definition, the expenditure categories which can be regarded as regional polices aimed at stimulating regional growth. It is difficult, however, to decide what expenditure programs should be perceived as regional policy expenditures since it has been argued that the United States does not currently have a set of strong, explicit regional policies. Moreover some federal government studies show that not only were the impacts of most explicit regional policy programs insignificant, but they also accounted for only a small proportion of total federal expenditures (Richardson, 1978).

On the other hand, there is no doubt that many government expenditures aimed at achieving nonspatial objectives in fact discriminate in favor of some regions and against others. Hence some regional scientists such as Alonso have called such nonspatial expenditures *implicit* regional policies. Since such implicit policies usually occupy larger budgets and discriminate heavily among regions, their impacts are quantitavely more significant[8].

To reflect all these implicit and explicit regional policy expenditures, we use the total flow of federal funds as the data for G_r. The flow of federal funds consists of eight categories: five expenditure categories (Direct Payments to Individuals, Procurement, Federal Aid to States, Salaries and Wages, and Other Expenditures) and three tax categories (Corporate Income Tax, Individual Income Tax, and Other Taxes).

All statistics are mainly collected for the 48 contiguous states[9] for the year 1982 based on various government periodicals. Then the 48 states are aggregated into nine census regions[10] (New England, Mid Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific regions) to reduce the associated computational burdens. As a result, the suffix i in the above equations runs from 1 to 36.

Testing Results

We first compute the weight vectors α and β by the two least square approximation procedures, the quadratic programs and the eigenvalue techniques, for the six Quality of Life (QOL) indices. Table 1 presents the results. While all parameters from the quadratic program are positive, some estimates from the eigenvalue procedure are negative. Moreover, when we substitute all these computed weights into (6), the parameters from the quadratic program turn out to satisfy (6) for all i while those from the eigenvalue technique result in *three* reversals. In the above least square appoximation framework, this implies that for the given data of six QOL indices and the flow of federal funds, the RAPGE hypothesis is verified by the quadratic programming procedure, but not by the eigenvalue procedure. The computed weights from the quadratic program then automatically reflect by definition the implicit governmental perceptions of the relative importance of each regional welfare variable in making regional welfare comparisons, and of the relative effectiveness of each expenditure program in reducing perceived welfare disparities among the regions.

The relative magnitude of welfare in the third column of Table 1 suggests that, in comparing regional welfare disparities among regions, the federal government attaches relatively higher weights to the social index (4.826) and the economic index (1.021), but relatively lower weights to the educational index (O.O.), health index (O.O) and political index ((0.046). Since the importance of economic factors in regional welfare has been well known, their high values are not surprising. The fact, however, that the social index has a considerably greater value than the economic index is an interesting result. Note that most of the existing studies on interregional disparities have paid attention to economic factors, especially to income, based on the conventional belief that these factors are the most important policy variables (for example, Biehl, 1980). Our result, however, does not support such an argument. It supports, rather, those who have argued that such a justification is too weak an excuse to neglect other aspects of regional welfare (Richardson, 1976, and Reiner, 1974).

On the other hand, the ranking among expenditure weights indicates that the expenditure category "Grant in Aid" is perceived as the most effective program in reducing regional welfare inequalities. This result is durable because it includes many distributive expenditure programs such as public works programs and community development programs. Also the higher effectiveness of the category "Individual Income Tax" is reasonable due to its progressive nature, whereas it is difficult to explain why the expenditure category, "Wages & Salaries," is perceived to be more effective than the category "Procurement" or "Direct Payments to Individuals".

As explained before, other tests are done for the eight QOL indexes so as to investigate the sensitivity of the computed results to the type of data used. The results are presented in Table 2. Not surprisingly, the computed results in this case are quite different, and furthermore, the resulting weights by both approximation procedures fail to satisfy (6). For example, the computed weights by the quadratic program and by the eigenvalue technique have resulted in 9 reversals and 15 reversals when substituted into (6), respectively.

Since the approximation procedures have failed to verify the hypothesis for the case of eight QOL indices, the simultaneous linear programs (7) - (11) have been solved by the suggested iterative method with starting values based on the two approximation procedures as well as on a unitary value. Table 3 summarizes the results. First note that the iterative method results in a quick convergence. For example, a convergence occurred after 3 iterations when the starting values are provided by the quadratic program, and after 7 iterations when the initial values are given by the eigenvalue technique. This result suggests that the simultaneous program is also operationally durable. Note also that all objective values at converging points (μ^*) are *positive*. In our context, this implies that all three sets of weight vectors satisfy relation (6), and hence the RAPGE hypothesis for the given data.

Let us investigate the properties of the computed weights. The rankings of the computed welfare weights and the expenditure weights are quite different among the three sets. For example, the weight of the education index is ranked fourth in the third column, sixth in the fifth column and third in the last column. This conflicting result is essentially caused by the inherent non-uniqueness problem of the simultaneous program. Hence we must be cautious in interpreting the results. One way to avoid such a conflict is to consider only those properties which are common to all three weights in Table 3. By this way, we can observe two interesting properties here: i) both the *public safety index* and the *air pollution index* have greater values than the *employment index* or the *income index, and* ii) the weights of *individual income and employment tax* are higher than that of any other tax categories. In particular, note that the first property is consistent with previous results in Table 1 in the sense that there are other social or environmental factors which are perceived more importantly than economic factors in regional welfare comparisons. Hence this result also supports our previous assertion that noneconomic factors, in the study of regional inequalities, have been too often neglected without any sound empirical evidence.

Concluding Remarks

As an attempt to study the implicit governmental tradeoffs arising both in making regional welfare comparisons and in evaluating the effectiveness of various expenditure programs on reducing the perceived regional inequalities, a hypothesis describing the relation between regional welfare inequalities and the regional pattern of federal expenditures has been tested using the new methodological framework proposed by Smith. The important findings of our study can be summarized as follows.

First, the observed data strongly support the main hypothesis: the federal government allocates relatively more effective expenditures to regions with relatively lower welfare levels.

Second, in spite of the high weights attached, economic factors are perceived as relatively less important variables than certain noneconomic factors such as environmental quality in making interregional welfare comparisons.

Finally, it is difficult to find any consistent patterns in national expenditure priorities due to the sensitivity of the results to the type of data.

It must be born in mind, however, that this study still has several shortcomings associated with the data and the testing method. In particular,

i) the sensitivity of the results to the degree of spatial disaggregation has not been investigated;

ii) the interregional feedback effects of government expenditures are neglected for simplicity, which may be difficult to justify in a system as open as a region of a nation, and;

iii) since the requirement of strict ordering in Smith's method is in general unrealistic, it is desirable to extend it to a statistical method which can allow an ordering failure. In this respect, it is hoped that the results of this paper are interpreted as *tentative* rather than *conclusive*.

FOOTNOTES

[1]Most existing studies on the relationship between regional welfare inequalities and the regional allocation pattern of national expenditures have avoided these tradeoff problems both by representing regional welfare in terms of a single indicator such as income and by assuming that a unit of expenditure in each expenditure category is equally effective (see for example, Cameron, 1970, Catsambas, 1975, Pack, 1980, 1982, and Greytak et al. 1978).

[2]For example, in comparing the sets $S_r = \{s^1_r,...,s^N_r\}$ and $S_u = \{s^1_r,...,s^N_r\}$ for two regions r and u, if the condition $s^1_r \geq s^1_u$ were to hold for all i = 1,...,N then it is reasonable to assume that the national government perceives the welfare level of region r to be at least as high as that in region u. However, if neither $S_r \geq S_u$ nor $S_u \geq S_r$ were true, then any overall comparison of regional welfare levels must necessarily involve implicit tradeoffs between the levels of two or more regional indicators.

[3]Federal revenues withdrawn from each region (such as through tax) can be regarded as *negative* expenditure variables.

[4]Refer to Smith (1982) for a more technical discussion.

[5]The iterative procedure adopted in this study was i) with some candidate expenditure weight vector βo, solve the Linear Program (B) and get (μ_{BO}, α_o), ii) by starting α_o, solve the Linear Program (A) and find (μ_{A1}, β_1), iii) if $\mu_{A1} = \mu_{BO} > O$, then finished, otherwise keep doing this process.

[6]For example, using income as a surrogate for the economic factors and air pollution emission for the environmental factors.

[7]These are 1) health index, 2) public safety index, 3) education index, 4) employment index, 5)income index, 6) housing index, 7) leisure and outdoor recreation index and 8) pollution index. The composition of these indices is given in Appendix 2.

[8]A good example is defense expenditures. It is widely known that the defense spending in the United States has heavily favored the South and West. To some extent, the defense contracts were a stimulus to regional growth and hence partially accounted for the relatively high income growth rate of the South and West.

[9]Hawaii, Alaska, and the District of Columbia are not included because of their special place in the federal budget.

[10]There have been two different sets of macro regions used in regional data analysis in the United States. The first set is eight regional classifications developed by the Regional Economics Devision of the U.S. Department of Commerce. The second set is nine regions adopted by the Bureau of the Census. In this dissertation, the second set will be mainly used.

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TABLE 1

Results of Least Square Approximation Procedures
(6 Quality of Life Indexes)

Variable Name	Coefficient Estimates Quadratic[a]	Eigenvalue[b]
Welfare Variable		
economic index	1.021	0.324
education index	0.000	-0.377
environmental index	0.108	-0.110
health index	0.000	0.051
political index	0.046	0.091
social index	4.826	0.716
Expenditure Variable		
direct payments to individuals	0.000	0.048
procurements	0.000	0.040
grant in aid	4.832	0.043
salaries and wages	1.822	-0.045
other expenditures	0.000	-7.260
corporate income tax	0.000	-0.374
individual income tax	1.304	0.250
other tax revenue	0.000	-0.041

[a]Minimize: $S_i\ (a' X_i - b' Z_i)2$ subject to: i) $6 \leq S_k\ a^k \leq 7$ ($ak \geq O$), and ii) $8 \leq S_j\ b_j \leq 9$ ($b^j \geq O$).
[b]Maximize: $a' X Z' b$ subject to: $a X X' a = 1 = b' Z Z' b$

TABLE 2

Results of the Least Square Approximation Procedures
(8 Quality Of Life Indexes)

Variable Name	Coefficient Estimates Quadratic[a]	Eigenvalue[b]
<u>Welfare Variable</u>		
health index	0.000	-0.040
public safety index	1.918	-0.102
education index	0.000	0.154
employment index	1.374	0.270
income index	0.000	0.318
housing index	0.000	0.248
leisure and recreation index	0.060	-0.009
air pollution index	4.648	-0.166
<u>Expenditure Variable</u>		
direct payments to individuals	0.000	-0.118
procurements	0.000	0.043
grant in aid	2.788	-0.425
salaries and wages	1.867	0.075
other expenditures	0.000	-0.098
corporate income tax	1.216	0.089
individual income tax	2.129	-0.479
other tax revenue	0.000	0.006

[a]Minimize: $S_i\ (a'X_i - b'Z_i)2$ subject to: i) $6 \leq S_k\ a^k \leq 7\ (a^k \geq O)$, and ii) $8 \leq S_j\ b^j \leq 9\ (b^j \geq O)$.

[b]Maximize: $a'XZ'B$ subject to: $a'XX'a = 1 = b'ZZ'b$

TABLE 3

Results of the Bilinear Programming Procedure
(8 Quality of Life Indexes)

Variable Name	Coefficient Estimates		
	Quadratic[a]	Eigenvalue[b]	Unitary[c]
Welfare Variable			
health index	0.000	0.000	0.272
public safety index	2.362	1.956	2.117
education index	0.213	0.000	0.962
employment index	0.333	1.680	0.616
income index	0.900	0.390	0.000
housing index	0.000	0.016	0.000
leisure and recreation index	0.000	0.000	0.000
air pollution index	5.192	4.958	5.033
Expenditure Variable			
direct payments to individuals	0.000	0.000	0.000
procurements	0.000	1.155	0.153
grant in aid	0.000	0.000	0.000
salaries and wages	3.612	4.651	0.000
other expenditures	0.000	0.755	0.000
corporate income tax	0.119	0.000	1.627
individual income tax	5.269	2.440	6.956
other tax revenue	0.000	0.000	0.264
Number of iterations	3	15	7
Object Value (m^*)	0.02	0.0002	0.005

[a]Starting values are taken from the results of the quadratic program (i.e., values of the third column in Table 2).
[b]Starting values are taken from the results of the eigenvalue procedure (i.e., values of the last column in Table 2).
[c]All starting values are given as one.

Appendix 1

Composition of 6 Quality of Life Indices

I. Components of the Economic Index
1) Individual Economic Well-being
A. Income
1. personal income per capita (No. 751, SA, 1984)
2. median income of 4-person families (No. 751, SA, 1984)
B. Wealth
1. savings per capita (No. 833, SA, 1985)
2. percent of owner-occupied housing units (No. 1341, SA, 1984)
3. asset per capita (No. 773, SA, 1985)
2) Community Economic Health
A. Income Distribution
1. percent of persons below poverty level (No. 783, SA, 1984)
2. ratio of highest percentile to lowest (No. 751, SA, 1984)
B. Employment
1. unemployment rate (No. 686, SA, 1985)
2. labor force participation rate (No. 673, SA, 1984)
3. female participation rate (No. 673, SA, 1984)
4. wage rate (No. 714, SA, 1984)
5. percent of insured unemployed (No. 703, SA, 1984)
C. Degree of Economic Concentration
1. concentration rate (calculated by author)
D. Productivity
1. value added in manufacturing (No. 1341, SA, 1985)
2. value added in retail (No. 1407, SA, 1985)
3. value added in wholesale (No. 1416, SA, 1985)
4. value added in services (No. 1423, SA, 1985)
E. Capital Availability
1. total bank deposits per capita (No. 826, SA, 1985)

II. Components of the Education Index
1) Individual Condition
1. median school years completed by persons 25 years old and over (Table 23, COP, 1984)
2. educational expenditure per pupil (No. 239, SA, 1984)
3. average teacher's salary in public schools (No. 245, SA, 1983)
4. percent of population enrolled in higher education (Table 71, DES, 1984)
5. ratio of per capita education expenditure to per capita income (Table 11, DES, 1984)

III. Components of the Environmental Index
1) Air pollution
1. tons of particulate emissions per year per acre (NER, 1983)
2. tons of sulfur oxide emissions per year per acre (NER, 1983)
3. tons of carbon monoxide emissions per year per acre (NER, 1983)
4. tons of nitrogen oxide emissions per year per acre (NER, 1983)
5. tons of volatile compounds emissions per year per acre (NER, 1983)
2) Noise
1. population density (No. 11, SA, 1984)
2. registered motor vehicles per 1000 population (No. 1035, SA, 1985)
3. registered cycles per 1000 population (No. 1035, SA, 1985)
3) Water
1. clean water consumption per day (No. 1062, SA, 1984)

IV. Components of Health Index
1) Individual Conditions
1. infant mortality rate (No. 109, SA, 1985)
2. death rate (No. 107, SA,1985)
3. personal health care expenditure (No. 150, SA, 1984)
2) Community Conditions
1. dentists per 1000 population (No. 159, SA, 1985)
2. physicians per 1000 population (No. 159, SA, 1985)
3. hospital beds per 1000 population (No. 167, SA, 1985)
4. hospital occupancy rates (No. 167, SA, 1985)
5. daily room charge (No. 171, SA, 1984)
6. nursing beds per 1000 population (No. 167, SA, 1985)
7. state and local government health expenditure (No. 167, SA, 1985)
8. mental patients per 1000 population (No. 182, SA 1984)

V. Components of the Political Index
1) Individual Participation
1. presidential election voting rate (No. 423, SA, 1985)
2) State Local Government
A. Professionalism
1. total municipal employment per 1000 population (No. 492, SA, 1984)
2. police and fire protection employment per 1000 population (No. 492, SA, 1984)
3. public welfare employment per 1000 population (No. 492, SA, 1984)
B. Performance
1. revenue per capita (No. 454, SA, 1984)
2. percent of federal government aid in total revenue (No. 454, SA, 1984)
3. debt outstanding per capita (No. 454, SA, 1984)
4. tax base (approximate market value of locally assessed ordinary realty per capita) (No. 465, SA, 1984)
C. Welfare Assistance
1. per capita welfare expenditure (No. 454, SA, 1984)
2. monthly benefits of retired workers (No. 523, SA, 1984)
3. monthly benefits of disabled workers (No. 523, SA, 1984)
4. monthly benefits of widows and widowers (No. 523, SA, 1984)

VI. Components of the Social Index
1) Individual Concerns
A. Family Life
1. divorce rate (No. 122, SA, 1985)
2. marriage rate (Table A, CCDB, 1983)
B. Information
1. newspaper circulations per 100 population (No. 940, SA, 1985)
C. Others
1. suicide rate (No. 112, SA, 1985)
2. labor union rate (No. 709, SA, 1985)
2) Community Living Condition
A. Public Safety and Law Enforcement
1. crime rates (No. 277, SA, 1984)
2. number of policemen per 1000 population (No. 492, SA, 1984)
3. population-lawyer ratio (No. 301, SA, 1985)
B. Housing Condition
1. housing units with 1.01 or more persons per room (No. 1312, SA, 1984)
2. housing units lacking complete plumbing (Table A, CCDB, 1984)
3. monthly owner cost of specified housing (No. 1312, SA 1984)
4. median values of specified housing (No. 1312, SA, 1984)

C. Leisure and Recreation
1. park areas per 1000 population (No. 390, SA, 1984)
2. average working hours per week in manufacturing industry (No. 714, SA, 1984)

D. Transportation Condition
1. highway mileage per car (No. 1025, SA, 1984)
2. public transportation utilization rate (Table A, CCDB, 1983)
3. state highway maintenance cost per highway mileage (No. 1030, SA, 1984)

Note: The sources of these data appear in parenthesis

Abbreviation:

SA:	Statistical Abstract of United States
COP:	Census of Population
DES:	Digest of Education Statistics
NER:	National Emission Report
CCDB:	County and City Data Book

APPENDIX 2

Composition of 8 Quality of Life Indexes

I. Health Index
1. long life (death rate)
2. disability (resident patients per 1000 residents in mental care hospital)
3. access to medical care (per capita health expenditure)

II. Public Safety Index
1. crime (crime rate)
2. security (number of policement per 1000 resident)

III. Education Index
1. attainment (percent of persons 25 years and over, who completed 4 years of high school or more)
2. achievement (education expenditure per pupil)
3. higher and continuing education (percent of population enrolled in higher education)

IV. Employment Index
1. employment opportunity (unemployment rate, female labor participation rate)
2. working conditions (average weekly wage rate)

V. Income Index
1. level of income (personal income per capita)
2. expenditure of income (asset per capita)
3. lower income population (poverty level)

VI. Housing Index
1. living space (percent of housing with 1.01 or more persons per room)
2. housing unit (percent of housing lacking complete plumbing facility)

VII. Leisure and Recreation Index
1. leisure time (average working hours per week)
2. outdoor recreation (park areas per 1000 residents)

VIII. Air Pollution & Noise Index
1. air quality (sulfur oxide emissions per year per acre)
2. congestion (population density)