SOCIO-PSYCHOLOGICAL MEASURES OF RURAL QUALITY OF LIFE: A PROXY FOR MEASURING THE MARGINAL UTILITY OF INCOME

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Economics has been defined as the science of allocating scarce means among competing ends. Ultimate ends to be achieved in so far as possible may be defined as well-being, satisfaction, utility, or quality of life. It has become fashionable to divaricate economics into dimensions of efficiency and equity. Defined as increasing the size of the "pie" of goods and services, efficiency has received the lion's share of attention by economists--its study has been viewed as objective, precise and respectable.

Economists have relied heavily on perfect competition as a norm of efficiency, but perfect competition results only in a Pareto optimum. Using the Edgeworth Box as an example, two individuals or groups can be at a Pareto optimum on a contract curve, yet one individual or group can be in misery from starvation while the other individual or group can be satiated with goods and services. To move along the contract curve to a point of global welfare maximization requires knowledge of the marginal utility of additional goods and services (income). If individual or group A's marginal utility from sacrifice of income is less than the marginal utility gained by individual or group B, then total utility can be increased by moving along the contract curve. Utility is maximized at the point where marginal utility of income is equal for A (gainers) and B (losers). Suggestions for such movement along the contract curve have been eschewed by positive economists, in part because subjective, normative, interpersonal comparisons of utility were required and

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in part because, even if accurate estimates of marginal utility were unavailable, a normative judgment is implied that such movement is appropriate.

It is time to begin merging equity and efficiency in economic science, the nexus being the marginal utility of income. Given that economics is concerned with increasing well-being of people, the study of conventional measures of efficiency is neither objective nor precise because it conveniently assumes away too much by implicitly employing the premise that the marginal utility of income is equal for all income levels and all people. Neither is it appropriate to label the study of equity as unsuitably subjective and imprecise in view of advances in methodology which can provide useful comparisons of quality of life among populations defined by income, age, education, etc. Although methods for estimating marginal utility may yet be too imprecise to make interpersonal comparisons of the marginal utility of income, the methodology appears to be sufficiently advanced to make useful intergroup comparisons of utility for formulating public policies that impact unevenly on different groups.

If the marginal utility of income is less for gainers than for losers, then it is possible that some public programs implemented on the basis of favorable conventional benefit-cost ratios may in fact reduce well-being. To promote a nexus between equity and efficiency, an efficacious start is to replace the concept of economic efficiency implicit in benefit per unit of cost (B-C ratio) with the concept of social efficiency defined as satisfaction per unit of sacrifice. Social efficiency is similar in concept to economic efficiency except that dollar benefits are weighted by marginal utilities among gainers to indicate satisfaction, and dollar costs are weighted by marginal utilities among those paying the cost to arrive at total sacrifice.

One goal of public policy is to fund projects with greatest social efficiency. Provision of satisfaction-sacrifice (S-S) ratios by no means rids the policymaker of his need to make judgments. The S-S ratio (or, alternatively, net social benefit defined as satisfaction minus sacrifice) from a project is but one of several positivistic pieces of information presented to him. The decision to allocate funds requires that the policymaker balance the S-S ratio against other information such as the outcome variation, the ethical soundness, and the political feasibility of increased well-being for society as a whole but requiring sacrifice by some members of society.

An advantage of the S-S over the B-C ratio is its ability to measure the social efficiency of a wide range of programs including transfer payments. If the marginal utility of income is sufficiently great for low versus high income groups, then greater social efficiency gains (based on S-S ratio) may be obtained by redistribution of income than by some investment projects with conventional B-C ratios greater than 1.0.

If economics is indeed the science of allocating scarce resources among competing ends to improve well-being of society, then social efficiency measures seem appropriate. This study shows one method of developing weights for benefits and costs among income groups for use in S-S analysis. The perceived quality of life index (QLI) is put forth as a measure of individual satisfaction and a proxy measure for utility.

Given knowledge of income flow over a period of time, economic theory holds that the rational consumption unit will choose that combination of goods and services which maximizes the satisfaction derived from the income stream. Well-being is assumed to be enhanced by having more options--greater income increases the options for purchasing goods and services or accumulating wealth which contributes to power and prestige. Given the basic economic assumption that more is preferred to less and the fact that income of the individual is finite, perceived quality of life is constrained by income. It follows that the quality of life which the individual perceives is, at least in part, a function of income.

Since Srole's development of a social indicator scale for anomie, social scientists have attempted to measure the relationship between social indicators and income. An inverse or negative relationship has been demonstrated between anomie and level of income (McDill; Mier and Bell; Bell; and Bradburn and Caplovitz). A positive relationship between income and self-esteem has been established (Crain and Weisman; Heiss and Owens; and Yancy, Rigsby and McCarthy), but the aggregation of income into too few segments (e.g. "high" and "low") precludes determination of the rate of change in self-esteem as income varies. Scales measuring "level of happiness" or "life satisfaction" perceived by the individual have been found to have a positive relationship with income (Easterlin; Bradburn and Caplovitz).

The Rural Income Maintenance Experiment (RIME) conducted in Iowa and North Carolina during the period 1969-72, was a major effort "to test the behavioral consequences of a universal income-conditioned cash transfer program" (Bawden, et al.). The extensive socio-psychological data collected as part of the Experiment included items which were modifications and adaptations of established social indicator scales. These items and the accompanying income and demographic items form the data base for this analysis. Data on attitudes were complete only for quarters 2 and 10 of RIME (Bawden, et al.).

The objective of this analysis is to construct a measure of individual perceived quality of life and to relate this measure, using ordinary least squares, to income, age, education, and other explanatory variables. Data were available for both household head and spouse, but taken as separate data sets, each group produced statistical results less satisfactory than those from the pooled data set reported herein. The coefficient for a dummy variable for spouse inserted into the general model was not significant at the 0.05 probability level. The family was taken as the relevant data set for QLI development and analysis; when logically consistent, independent variables were aggregated into family units and related to attitudes of the head and spouse.

QLI Construction and Analytic Framework

The quality of life index (QLI) is conceptualized as the weighted summation of three socio-psychological subindices: Alienation (A), Worry (W), and Self-Esteem (SE). The subindices were constructed from established social indicator scales. To verify the a priori conceptual grouping of the scale components into the subindices, principal axis factor analysis was performed on the entire set of scale items with the number of factors restricted to three--the number of subindices. The resulting loadings of individual items upon the three factors substantiated the grouping of the scales into the proposed subindices.

Factor analysis was also used to identify factors (hypothetical constructs) which explain the variation observed within the individual scales. The following criteria were used to determine the maximum number of factors incorporated into each scale: the factors retained had eigenvalues greater than or equal to one and/or the addition of another factor would result in the grouping of the scale items into a less plausible configuration of the scale items. To assure internal consistency and a QLI directly related to positive and negative perceptions, the factor loadings for negative construct factors within each scale were "reflected" by changing the algebraic signs. Individual responses to each item were standardized by dividing deviations from the mean item score by the standard deviation. Individual scale values were then calculated by the following functional relationship:

$$M_i = \sum_{k=1}^{m} E_k \left(\sum_{j=1}^{n} f_{kj} R_{ij} \right)$$

where: M_i = scale value for the i-th individual,

m = number of factors extracted for the scale,

n = number of items in the j-th scale,

E_k = the eigenvalue for the k-th factor,

f_{kj} = the factor loading for the j-th item on the k-th factor,

R_{ij} = the standardized response of the i-th individual to the j-th item on the scale.

The subindices of the QLI were then calculated as:

$$A_i = An_i + P_i + NA_i$$

$$SE_i = SS_i + LS_i + PA_i$$

where: An_i = Anomie Scale for the i-th individual ($m = 1$),

P_i = Powerlessness Scale for the i-th individual ($m = 1$),

NA_i = Negative Affect Scale for the i-th individual ($m = 2$),

SS_i = Self Satisfaction Scale for the i-th individual ($m = 2$),

LS_i = Life Satisfaction Scale for the i-th individual ($m = 2$),

PA_i = Positive Affect Scale for the i-th individual ($m = 1$).

The Worry Subindex (W) consisted of only one scale with $m = 1$.

The final step in the QLI construction was the weighted summation of the three subindices. In the verification of the a priori subindex composition, each of the three factors received the loadings of the majority of the items of one of the subindices. The results of this analysis were used for the final weighting, and QLI_i was calculated as

$$QLI_i = E_a A_i + E_w W_i + E_{se} SE_i$$

where E_a, E_w, and E_{se} are respectively the eigenvalues of the factor containing the majority of the items making up that subindex.

Theoretical QLI Model

The nuclear model for the QLI analysis was judged a priori to be of the following form:

$$QLI_i = f(Y_i^*, ED_i, AGE_i, N_i, L_i, R_i, S_i, PERFARMY_i, NW_i, QTR, T_i, E_i)$$

where QLI_i = the quality of life index for the i-th individual. The independent variables (and, where appropriate, studies suggesting their relevance) are:

Y_i^* = expected net income in current quarter, including transfer payments of the i-th family unit,

ED_i = educational level (last grade completed) of the i-th individual (Katona; Smith and Haythorn),

AGE_i = age of the i-th individual (Katona),

N_i = number of individuals in the i-th family unit (Smith and Haythorn),

L_i = geographical location of the residence of the i-th family unit (L_i = 1 if Iowa; L_i = 0 if North Carolina),

R_i = race of the i-th individual (Yancy, Rigsby and McCarthy; Heiss and Owens; Tweeten and Lu),

S_i = sex of the i-th individual,

$PERFARMY_i$ = farm income-total income ratio for the i-th family unit (Tweeten and Lu),

NW_i = net worth of the i-th family unit (Ackley),

QTR = time variable (QTR = 0 for quarter 2; QTR = 1 for quarter 10),

T_i = negative income tax treatment of the i-th family unit,

E_i = error term for the i-th individual.

Interaction among the independent variables was also considered theoretically germane to the model.

Four algebraic forms were selected as potentially appropriate for the functional form of the general QLI model: logarithm, square root, quadratic, and cubic.

<u>Empirical QLI Model</u>

Criteria for selecting a functional form were R^2 and coefficient signs and significance. The quadratic form of the QLI model was selected, and certain of the theoretically admissible variables were rejected from the model on the basis of statistically insignificant coefficients (see Table 1). The nine independent variables account for 82 percent of the variation in QLI and each coefficient is significant at the .04 probability level or better.

In the empirical model education (ED^2) is positively related to the individual QLI, but for any given level of education, increasing age diminishes the contribution of education. Age (AGE) initially exhibits a positive contribution to QLI, reaches a maximum, and declines thereafter. Based upon average level of education (see Table 1), the contribution of AGE to QLI reaches a maximum at 39.43 years and becomes zero at 78.87 years. The marginal contribution of AGE to QLI is linear and declines throughout. Interaction of age with education (AGEED) causes a change in the responses of QLI to age with each level of education. The positive relationship of location (L) to the QLI may arise from superior public services and other "environmental" factors in Iowa. The possibility that income contributes to the variation explained by L is discussed later with the income specific analysis.

A preference within the study group for farm derived income is shown by PERFARMY. The data do not permit a determination of the reason for this preference, but two potential sources are immediately apparent. Individuals may experience a positive influence from farming as a way of life; underreporting a farm income may also make a dollar of reported farm income preferable to a dollar of nonfarm income. The time trend variable (QTR) accounts for considerable observed variation in QLI, but without additional observations for the QLI scale items, the data are not sufficient for an evaluation of the source of the variation explained by QTR. The "washing out" of an experimental payments effect over time, a decline in a "Hawthorn" or participation effect, or changes in the social environment and national mood of the U. S. are all potential sources of the observed QTR variation.

The failure of the theoretically admissible NW variable to enter the model may be due to inadequate data on net worth coupled with the fact that a large portion of the sample consists of low income individuals with little net worth.

Based upon an analysis of the general model containing Y_t and Y_{t-1} (t = quarter) as separate variables, income was aggregated into Y^* (expected income). Coefficients for the linear terms Y_t and Y_{t-1} were significant at the 0.05 probability level, but the coefficient for Y_{t-1} was much smaller. Y^* was calculated as:

$$Y^* = \frac{b_{yt}}{b_{yt} + b_{yt-1}} Y_t + \frac{b_{yt-1}}{b_{yt} + b_{yt-1}} Y_{t-1}$$

The term Y^{*2} in Table 1 is the square of Y^*. The decline in the relative size of the coefficients of Y_t (0.00229796) and Y_{t-1} (0.00123586) indicates that Y^* should not be seriously biased by the lack of additional lagged income periods. QLI reaches a maximum (marginal QLI reaches zero) at $40,942 of expected income Y^* per year which is outside the range of the data; the point must, therefore, be interpreted with caution. The marginal contribution of Y^* is linear and declines throughout.

Income Related Hypotheses

Having established a general QLI model in which expected income (Y^*) is one of the variables, we now appraise in more detail the specific impact of income on the QLI.

Relative versus Absolute Hypothesis

The relative versus absolute hypothesis tests the proposition that the variation observed in the QLI depends upon the relative as well as the absolute level of income. A dummy variable PI (PI = 1 if $Y^* > \overline{Y^*}$) was used to separate the regional data sets into subsets where Y^* is above the mean ($\overline{Y^*}$) or less than or equal to the mean of the respective state sample. The relevant test statistics are:

Variable	Coefficient	Prob > |T|	T for H_0: B=0
PI	5.85138590	0.557	0.58761

Given the lack of significance of T for the coefficient of PI, the Chow Test (Chow) was used to test the structural stability of two equations estimated with data for individuals respectively above and below the mean of Y^*. The F statistic (F = 2.20) rejects at the 0.05 probability level the null hypothesis that the regression coefficients estimated by the respective subsets belong to the same structure, and the two structures are inferred to be different at the chosen level of significance. The difference need not arise from different responses to income, however. The regression coefficients 0.01650283 (Y^*), -0.00000080 (Y^{*2}) for data set $Y^* > \overline{Y^*}$ and 0.002261761 (Y^*), -0.00000108 (Y^{*2}) for data set $Y^* \leq \overline{Y^*}$ suggest that the marginal response of QLI with respect to Y^* is greater for the subset $Y^* \leq \overline{Y^*}$ than for the subset $Y^* > \overline{Y^*}$ over all relevant ranges of Y^*. A crude test for difference between the paired coefficients is $t = \frac{\hat{b} - c}{s_b}$ where c is the coefficient of the linear (squared) income variable and b is the corresponding coefficient of the linear (squared) variable in the equation of income above (below) the mean. The difference is significant at the 0.10 probability level for only the coefficient c of linear term Y^* of the subset $Y^* > \overline{Y^*}$.

The coefficient of the variable L is significant at the 0.0001 probability level. L may also measure a part of the variation in QLI arising from a relative income phenomenon. If persons in North Carolina and Iowa judge their relative position based on a national rather than local perspective, then the coefficient of L could indicate a lower QLI experienced by persons in North Carolina as they perceive their relative deprivation. The place of relative versus absolute income in determining the quality of life needs further consideration when more comprehensive data become available.

Income Irreversibility Hypothesis

The income irreversibility hypothesis is that the marginal response of QLI is greater for falling income than for rising income. Two methods were used to test this hypothesis. First, the income variable was segmented into rising and falling components. No evidence was found to support the hypothesis that the marginal response of QLI with respect to Y^* is greater for falling than for rising income. Second, the Chow Test was used to evaluate the structural stability of the QLI model with the data set subdivided into observations for respondents whose income increased and for respondents whose income decreased during the past quarter. The F statistic ($F = 1.28$) failed to reject at the 0.05 probability level the null hypothesis that the regression coefficients estimated by the respective subsets belong to the same structure.

In estimating the impact of income on the quality of life, differentiating between rising and falling income does not appear to be necessary--the QLI index appears to be reversible.

Earned-Unearned Income Hypothesis

The earned-unearned income hypothesis tests the proposition that earned income (Y^*_e) and unearned income (Y^*_{tr}) have different influences on QLI. The income variable (Y^*) was segmented (other variables the same as in Table 1) with the following results:

Variable	Coefficient	Prob > $\|T\|$	T for H_0: B=0
Y_e^*	0.01647140	0.0001	4.10506
Y_e^{*2}	-0.00000095	0.0029	-2.97790
Y_{tr}^*	0.02452665	0.0005	3.50728
Y_{tr}^{*2}	-0.00000396	0.0251	-2.24208

The coefficients indicate that the marginal QLI response to Y_{tr}^* is initially greater than to Y_e^*, but it falls more rapidly for Y_{tr}^* and reaches zero at a much lower level than for Y_e^*.

Separate regressions taking the model with Y_e^* and Y_{tr}^* as the unrestricted model and the model with Y^* as the restricted model failed to yield an F statistic (F = 1.25) significant at the 0.10 probability level.

In a test of the equality of the paired coefficients (H_0: $B_{ye} = B_{ytr}$), the analysis failed to reject H_0 at the 0.05 probability level for both pairs of coefficients, but the analysis rejected H_0 at the 0.10 probability level for the squared terms. In short, the results provide modest and mixed support for the proposition that QLI responds differently to earned than to unearned income.

Implications and Potential Uses

The QLI function and the accompanying hypotheses of this analysis apply to some of the central issues of economic policy. These results if substantiated by further experimentation have profound implications for equity issues and suggest substantial welfare gains from a more nearly even distribution of income. Supplemented by findings extended to other geographic, temporal, and income conditions, results such as those shown above would allow the computation of a more nearly optimal distribution of income. These results can provide a foundation for revision of income tax scheduled to provide equal marginal sacrifice or to redistribute income (see Harper). Benefit-cost ratios for public projects could be constructed by weighting benefits and costs among income groups according to the marginal impact on quality of life. The QLI results could enable the determination of an appropriate mix of transfer payments versus earnings-generating programs to maximize QLI. Findings can also be used to compute welfare losses from an unstable economy as well as benefits from programs to reduce instability. Given the declining marginal response of QLI to income, it follows that a greater quality of life may be derived from a given stable income than from the same income received on the average but with variability. Education appears to have an impact on quality of life independent of income--this finding could alter the procedures for computing returns to schooling. Amplification of the data base to additional geographic areas, income levels, sectors, and time periods should be accompanied by a reconsideration of the variables rejected from the general model.

The QLI model of this analysis reflects the environmental aspects of quality of life only as they influence individual responses. It would *a priori* appear that a more adequate explanation of quality of life would entail a larger set of independent variables including the institutional structure of the environment.

Table 1. Statistical Results of Ordinary Least Squares Equation Relating the Quality of Life Index (QLI) to Selected Independent Variables

Variable	Coefficient	Prob > |T|	T for H_0: B=0	Standard Coefficient
Intercept	-236.14916910	0.0001	-6.17425	---
Y^*	0.01923246	0.0001	5.80810	0.13045
Y^{*2}	-0.00000094	0.0001	-3.89588	-0.08238
ED^2	0.99464418	0.0001	5.77013	0.15973
PERFARMY	31.15025446	0.0025	3.02201	0.03336
L	26.34498185	0.0005	3.49683	0.04108
AGE	4.28721617	0.0067	2.71663	0.17013
AGE^2	-0.03179832	0.0352	-2.10702	-0.11707
AGEED	-0.19949018	0.0006	-3.44485	-0.09170
QTR	-563.33453861	0.0001	-91.00945	-0.89993

N = 2014 R^2 = 0.82   F Statistic = 987.90

$\overline{QLI}$ = -330.35[1/]   s = 134.5683   Sig of F = 0.0001

$\overline{Y}^*$ = $2193.41 per quarter $\overline{PERFARMY}$ = .02 (proportion)

$\overline{ED}$ = 9.62 years $\overline{AGE}$ = 43.21 years

[1/] The coefficient of the independent variables are invariant to addition of a constant to the scale. Negative predicted values may be avoided by an arbitrary addition to the scale--adding a constant would affect only the intercept.

FOOTNOTES

*Respectively, Graduate Assistant and Regents Professor, Department of Agricultural Economics, Oklahoma State University, Stillwater. Journal article J-3357 of the Oklahoma Agricultural Experiment Station.

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