United Nations University

WIDER

World Institute for Development Economics Research

Research Paper No. 2005/06

Measuring the Quality of Life across Countries

A Sensitivity Analysis of Well-being Indices

Tauhidur Rahman,[1] Ron C. Mittelhammer,[2] and Philip Wandschneider[2]

January 2005

Abstract

This paper attempts to provide a comprehensive analysis of interrelationships among the determinants of the quality of life (QOL). We show that various measures of well-being are highly sensitive to domains of QOL that are considered in the construction of comparative indices, and how measurable well-being indicators are aggregated and weighted to arrive at composite measures of QOL. We present a picture of conditions among the 43 countries of the world with respect to such interrelated domains of QOL as the relationship with family and friends, emotional well-being, health, work and productivity, material well-being, feeling part of one's community, personal safety, and the quality of environment. On the basis of Borda rule and the principal components approach, we search for factor-indices that may function as QOL indices across countries. Comparing and analysing well-being conditions among countries in this way aim to facilitate the discovery of problems with government policies impacting QOL.

Keywords: quality of life, domains of quality of life, Borda rule, principal components analysis, well-being indices

JEL classification: I31, D60, D63

[1] Corresponding author: Department of Agricultural and Resource Economics, The University of Arizona, Tucson, AZ 85721-0023, USA: tauhid@Ag.arizona.edu; [2] Washington State University, Pullman, WA 99164, USA.

This is a revised version of the paper originally prepared for the UNU-WIDER Conference on Inequality, Poverty and Human Well-Being, 30-31 May 2003, Helsinki.

UNU-WIDER acknowledges the financial contributions to the research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Finland (Ministry for Foreign Affairs), Norway (Royal Ministry of Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida) and the United Kingdom (Department for International Development).

ISSN 1810-2611 ISBN 92-9190-673-5 (internet version)

Acknowledgements

This paper is a revision of the paper presented at the UNU-WIDER conference on Inequality, Poverty and Human Well-being, 30-31 May 2003, Helsinki, Finland. We would like to thank the participants and, in particular, Ruut Veenhoven, Eric Neumayer, Ram Pillarisetti, Farhad Noorbakhsh, Mina Baliamoune, Esfandar Maasoumi for their comments and suggestions. We are especially indebted to Mark McGillivary and A. L. Nagar for their encouragement. The usual disclaimer applies.

Tables and figures appear at the end of the paper.

UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Camera-ready typescript prepared by Liisa Roponen at UNU-WIDER

1 Introduction

Given that improving the quality of life (QOL) is now a common aim of international development, the long-term future of humanity lies in a better understanding of factors that may have had or will have an impact on the QOL. For a better understanding and the long-term survivability of humanity during the coming millennia, the following seven distinct issues must be addressed: first, what do we mean by the term 'quality of life'; second, how to measure QOL; third, what are the domains of well-being that should be included in the measurement; fourth, at what scale to measure the QOL; fifth, how various domains of well-being are related; sixth, how these factors affect various subgroups of populations; and seventh, how to provide outcomes that have practical policy implications by allowing comparisons across countries, individuals, groups, and over a period of time.

In the presence of overwhelming consensus that per capita income or related measures of income are substantially insufficient measures of well-being, the emphasis has now shifted to the identification of alternative measures. Quality of life (QOL), social indicators and basic needs are alternative approaches that are being discussed.[1] All these approaches are related to the concept of the standard of living. Sen (1985, 1987) has made a thorough investigation of the concept of standard of living. Improving QOL is now a common aim of international development. However, identifying robust QOL indicators, or providing a coherent and robust definition of the concept, remains problematic (Bloom, Craig, and Malaney 2001).

Historically, life expectancy, literacy rates, per capita income, mortality and morbidity statistics have been widely employed to construct various indices of well-being. Probably the best-known composite indices of well-being are the human development index (HDI), developed by the United Nations Development Programme (UNDP), and the physical quality of life index (PQLI) developed by Morris (1979). These new approaches are recognized improvements in terms of capturing various dimensions of QOL, but they are still substantially limited by their inability to capture diverse domains of QOL, arbitrary assignment of weights, data used not being subjected to empirical testing, arbitrary selection of variables, non-comparability of measures over time and space, measurement errors in variables, and estimation biases due to omission of feedback effects with various indicators as environmental quality and political and civil liberties.

In this paper, we make an attempt to provide a comprehensive analysis of interrelationships among the determinants of QOL. We show that the various measures of well-being are highly sensitive to domains of QOL that are considered in the construction of comparative indices, and how measurable inputs into the well-being indicators are aggregated and weighted to arrive at composite measures of well-being. We also reexamine some policy relevant questions that have been addressed previously in the growth economics literature in light of the sensitivity findings.

---

[1] See for example, Hicks and Streeten (1979), Hicks (1979), Drenowski (1974), Morris (1979), Sen (1973), Streeten (1979), Dasgupta (1990), Dasgupta and Weale (1992), Kakwani (1993), Ram (1982) and Slottje (1991).

We present an assessment of conditions among 43 countries of the world with respect to such interrelated domains of QOL as the relationship with family and friends, emotional well-being, health, work and productive activity, material well-being, feeling part of one's community, personal safety, and the quality of environment. We make an attempt to measure the various domains of QOL as comprehensively as possible given the constraint of non-availability of comparable and reliable data on a large set of countries for our present exercise. Empirical results are illustrated on the basis of data collected on well-being indicators from various sources, including *Human Development Reports* (UNDP) and *World Development Indicators* (the World Bank) for the year 1999 for 43 countries of the world (Annexes A and B).

This paper is organized as follows. Section 2 briefly reviews the literature on well-being indices. In section 3 we discuss on our conceptual framework and the data to be used in the analysis of sensitivity of well-being measures with respect to the various domains of QOL and with respect to alternative aggregation rules to arrive at composite measures of well-being. Section 4 describes three alternative aggregation rules to compute a QOL index. In particular, we derive the rankings of countries on the basis of the Borda rule, and the principal components approach, and compare these results with the rankings of human development index (UNDP 1999). The results are discussed in section 4. We provide concluding remarks in section 5.

2 Literature review

Traditionally, per capita gross domestic product (GDP) was considered as the sole and reliable measure of well-being and economic development. However, in the presence of overwhelming consensus that as the GDP increases, well-being does not necessarily increase along with it, there is agreement among economists that per capita GDP or related measures of income are substantially insufficient measures of well-being. Thus, the emphasis now has shifted to the identification of alternative measures. QOL, social indicators and basic needs are new approaches that are being discussed (see Hicks 1979; Morris 1979; Sen 1973; Dasgupta and Weale 1992). As early as the year 1967, Adelman and Morris examined numerous indicators of socioeconomic and political change. Morris (1979) proposed the physical quality of life index (PQLI) as an alternative to per capita GDP for measuring the well-being of people. The PQLI is a function of life expectancy at age one, infant mortality rate, and literacy rate. Dasgupta and Weale (1992) constructed a measure of QOL that included per capita income, life expectancy at birth, adult literacy rate, and indices of political rights and civil liberties. However, probably the best known and the most controversial measure of well-being (the human development index) has been published by UNDP in their *Human Development Reports* since 1990 to date. The human development index is based on the assumption that economic development does not necessarily equate to human development or improvement in well-being. The HDI is based on three indicators: life expectancy at birth, educational attainment and real GDP per capita.

The HDI is obtained by a procedure where each individual country is first placed on a scale of 0 to 100 (0 representing the worst performance and 100 the best) with respect to any indicator; and then it is obtained by a simple arithmetic average of the scale indicators.

More recently, Osberg and Sharpe have developed the index of economic well-being (IEWB) (see Osberg and Sharpe 1998, 1999 and 2000). Their index is based on the view that the economic well-being of society depends on the level of consumption flows, accumulation of productive stocks, and inequality in the distribution of income and insecurity in the anticipation of future incomes. The weights attached to each of their IEWB component vary depending on the values of different observers. They argue that the public debate would be improved if there is an explicit consideration of the aspects of economic well-being obscured by average income trends and if weights attached to these aspects were explicitly open for discussion.

The American demographic index (ADI) of well-being for the United States from February 1996 to December 1998 was published by *American Demographics*. It was a monthly composite of five indicators developed, maintained, and reported by Elia Kacapyr. He selected the items on the basis of an economist's perception of well-being, free of any paradigm or QOL theory.

These new approaches are recognized improvements in terms of capturing various dimensions of QOL, but they are still substantially limited by their inability to capture diverse domains of QOL, arbitrary weights, data used not being subjected to empirical testing and arbitrary selection of variables. One weakness (among others) with indices of general well-being currently in use in such institutions as the World Bank and the UNDP (e.g., UNDP 1990) is that they are restricted to the socioeconomic aspects of life; the political and civil aspects are for the part kept separate. When the latter are mentioned at all, they are dealt with perfunctorily (Dasgupta and Weale 1992). Table 1 shows an overview of the various domains of QOL that are measured or captured by the various well-being indices discussed in the preceding review. From Table 1, we can easily notice that existing indices of well-being are severely limited by their inability to capture the multidimensional nature of QOL. The HDI, which is the most well-known and widely used index of well-being, captures only three domains of the QOL. It is quite remarkable that the HDI ignores the domains of relationship with family and friends, emotional well-being, work and productivity, personal safety, and the quality of environment. In fact, none of the indices of current well-being captures the domain of the quality of environment despite the fact that it is well documented that the environmental quality has direct effect on the QOL.[2] Consequently, different indices of well-being give different rankings of countries, and can lead to potentially misleading policy recommendations.

In the next section, we discuss the conceptual framework and data sources of the indicators of the QOL employed to compute the QOL rankings of countries in our study.

3 Conceptual framework for the QOL

In behavioural sciences it is generally assumed that individuals' behaviour is guided by the goal of seeking a higher level of the QOL and that actual behaviour should be seen as the reflection of that. However, economists often use the concept of utility instead of

2 For more discussion on this, see Perrings (1998).

QOL, while psychologists use the term satisfaction or happiness. Literature on well-being is massive and diverse. There are many terms that are used to represent *well-being*. Commonly used terms are QOL, standards of living, human well-being, and welfare. However, there are several problems with these terms. One of the problems is that these terms do not have an unequivocal meaning (Veenhoven 2000). For instance, the term well-being can refer to any evaluation of person's situation, or, perhaps more fittingly, any such evaluation which is focused on the person's 'being' (Gasper 2002). The term 'welfare' can refer to how well people live, or what actions are taken by others to help the needy. Some define welfare as well-being; happiness; health and prosperity. Even the term QOL has been defined differently by various scholars. Philosophers have never agreed on one final definition of QOL. McCall (1975) defines QOL as 'necessary conditions for happiness', while Terhune (1973) defines it as subjective satisfaction itself.[3] QOL can inevitably be conceived in different ways according to viewpoint, and the term is likely to remain controversial. This imprecision is compounded by the fact that QOL is more than a synonym for well-being, it is intended as a *measure* of it, allowing organizations to quantify how well-off people are and to track changes in levels of happiness over time (Bloom, Craig and Malaney 2001: 14). However, in this paper we shall use the terms QOL, standard of living, human well-being, and welfare interchangeably and argue that while a coherent and robust definition of the term QOL will remain problematic, the concept of QOL is at best seen as an abstraction for referring to many aspects of life and is essentially determined by variety of interacting factors.

In consumer theory, the utility function, $u(x)$ defined on the commodity space X is a device to describe a preference ordering among commodity bundles. Indifference curves are described by the equation $u(x) = k$ where k is constant. The function $u(x)$ can never be completely identified, but it may be estimated by observing consumer choice behaviour, i.e. via revealed preferences. In principle any monotonic transformation $g(u(x))$ will describe the same indifference curves and the maximization of $g(u(x))$ will result in the same choice behaviour as the maximization of $u(x)$. This is the idea of viewing utility as an ordinal concept, describing a preference ordering only.[4] If individuals or public policymakers on the behalf of people are driven by the achievement of a higher standard of living, understanding and analysing the determinants of QOL over a population, society or a country seems a necessary condition to understand human behaviour. In order to accomplish comparisons, achievements of different societies or population would have to be interpersonally comparable, and societies producing similar results need to enjoy similar standard of living. Is this plausible? The answer is yes in light of arguments that the satisfaction level or the level of standard of living are predictive in the sense that individuals or societies will not choose to continue activities which produce low satisfaction levels or the low levels of the standards of living.[5]

---

3 See Veenhoven (1984: 16-7) for detailed account on definitions of happiness, and Noll (1999) for many meanings of QOL in nations.

4 See, for example, Robbins (1932), Samuelson (1945) and Debreu (1959).

5 See for detailed arguments and justification Kahneman *et al.* (1993), Clark (1998) and Frijters (2000).

Life expectancy, literacy rates, mortality and the like are usually considered as 'indicators' of QOL of people and these statistics have been used by many researchers over the years to construct various indices of well-being. It is now well recognized that none of these indicators is singly adequate to measure the QOL (see Sen 1981). The QOL is, in fact, a composite variable, which is determined by the interactions of several dimensions of well-being. Changes in the income level of people, their living conditions, health status, environment, safety, stress, leisure, and the satisfaction with family life, social contacts, and many other such variables interact in complex ways and determine the QOL and its changes.

In the present study, we interpret the QOL of people as an 'unobservable or a latent conceptual variable', which cannot be directly observed, but is jointly determined by changes in several causal variables. The causal variables are supposed to be measured with a reasonable degree of accuracy. Conceptualization of QOL as a 'latent' variable is also more suitable for modelling preferences, outcomes and for that matter concepts like 'well-being' that are ambiguous. In this paper, we focus on factors that may affect the QOL by identifying the following eight domains of QOL that have been emphasized at different times by different researchers depending on what were considered to be the major elements of well-being:[6]

- Relationship with family and friends
- Emotional well-being
- Health
- Work and productive activity
- Material well-being
- Feeling part of one's local community
- Personal safety, and
- Quality of environment.

The QOL is a multidimensional concept, which has many distinct domains (Hirschberg *et al*. 2001). Therefore, besides a composite measure of the QOL, we may distinguish also specific *domains* such as the eight domains mentioned above. We speak of domains of the QOL, $D_1,\ldots,D_J$ where J stands for the number of different domains. Then the QOL must be a composite of the various domains, say

$$QOL = QOL(D_1,\ldots,D_J), \text{ where } J = 8 \qquad (1)$$

---

6 These eight domains of QOL have been identified based on our review of current and historical literature on well-being indices. However, we note that these eight domains are not mutually exclusive of each other, as we don't expect zero correlation among them. Many readers might question our classification of domains, but we emphasize that it is not an *ad hoc* classification, as we will provide justifications in the subsequent discussions. For more detailed discussions on the domains of life satisfaction, see also Cummins (1996).

Moreover, each domain J has its own indicators, which are observable, say a vector of observable indicators $x^j = (x_1{}^j, \ldots, x_K{}^j)$, (where $j = 1 \ldots 8$), will determine the achievements in the respective domains. Hence, our basic conceptualization of QOL will be:

$$QOL = QOL((D_1(x^1), \ldots, D_J(x^J)) \tag{2}$$

In this paper our aim is to compute a composite QOL index (say, QOLI) based on the general conceptualization in equation (2). If the QOL could be numerically measured and related to the causal variables (indicator variables in each domain), it would be straight forward to determine, say, a least squares regression of QOL on the causal variables. In that case, the partial derivative of QOL with respect to the one of the causal variables would measure the marginal rate of change of QOL for a small change in the causal variable, holding other causal variables fixed; and an estimator of QOL would be obtained as the estimator of the mean of the conditional distribution of QOL when causal variables are held fixed. Since QOL is not directly observable, some rules are needed to aggregate its various domains (eight, in the present case) and corresponding indicators to arrive at a composite measure of the QOL, and that we discuss in the next section.

Figure 1 contains the schematic presentation of the conceptual framework relating to domains of QOL. Here we attempt to draw as broad a picture as possible of QOL. Some links are direct and easy to understand, but indirect links can also have a substantial effect. Policymakers often neglect indirect effects, where they need to be aware of both unanticipated consequences and positive feedback when they assess the actual effects of changes in any components of QOL. Figure 1 shows both direct and indirect links between the QOL and its various domains. As can be seen, the QOL has direct links with its eight domains, which are indicated by bold arrows. In addition, it indicates the links between domains of QOL, and shows possible indirect effects, represented by the dotted arrows. These eight domains of QOL have therefore driven the choice of indicators in the present study for the 43 countries of the world for which comparable data on various indicators of the QOL are available.

To complete the schematic presentation of the conceptual framework for the analysis of the QOL, we now briefly discuss the domains and data sources of QOL.

Domain 1: Relationship with family and friends

Satisfaction with family life is an important element of an individual's well-being. It is quite reasonable to argue that, in most cases, an individual with strong family ties will be a happier person than someone without having any family relations. Therefore, relationship with family and friends should be considered in any measure of QOL. While there can be many other variables that could be argued as representing the domain of *relationship with family and friends*, it is extremely difficult to find many objective and quantitative indicators, which are necessary for cross-country comparisons. Therefore due to the limitation of data availability, we consider only one indicator to characterize this domain, namely, incidence of divorce rates. Increasing divorce rate is an indication of failing marriages and eroded relationship with family and

relatives.[7] The data for this variable have been obtained from Gulnar Nugman (2002) of the Heritage Foundation. The data are for the year 1999, or the nearest available date. The divorce rate is reported as the number of divorces per thousand people.

Domain 2: Emotional well-being

Although measures such as crime statistics, health status, and indicators of wealth are surely related to QOL, these indicators cannot capture what it means to be 'happy'. How happy an individual is not only depends on his/her income, and consumption, but is also affected by intensity of stress, depression, and psychology. Emotional well-being, like physical health, can be judged on a variety of dimensions. Yet in both realms, it is difficult to say which of these dimensions are essential for overall well-being. We use estimates of both male and female suicide rates to focus on emotional well-being. Teenage suicide rates were used in the construction of the index of social health (ISH) by Miringoff of the Fordham Institute for Innovation in Social Policy (1999). Jungeilges and Kirchgasser (2002) examined the link between suicide rates, and economic welfare (economic growth and per capita income) and civil liberties. They found a positive relationship between suicide rates and economic welfare, and a negative relationship between suicide rates and civil liberty. Thus we assume that economic welfare does not guarantee a better emotional well-being, and a higher incidence of suicide rates by either gender is an indication of weaker emotional well-being. We have obtained data for both male and female suicide rates from the *Mental Health Data* of the World Health Organization (WHO) (2002).

Domain 3: Health

Good health should result in a better QOL. Health has both direct and indirect positive effects on QOL. Improvement in health has an immediate impact on a person's QOL, but may also indirectly increase it by acting on other variables that in turn also have a beneficial effect. One of the most studied relationships is between health and income. Higher income leads to better health, but better health also leads to higher income because of better productivity and labour force participation.[8] To focus on the domain of health, a balance has to be struck among various components of a healthy society: demography, longevity, mortality, morbidity, and health infrastructure. Thus, we use population growth rate (representing demographic pressure); life expectancy at birth

---

7 It can be argued that the incidence of divorce rate is not a good indicator of relationship with family and friends. One can dispute it on the ground that a marriage not ending in divorce does not mean that people in the marriage are happy. For instance, many researchers have argued it that low rate of divorce in countries like India and Islamic countries can be partly explained by the low status of women in the society where women are traditionally supposed to be playing the role of homemaker. However, we strongly emphasize that in these countries people attach higher importance to joint family system, social status, and that marriage is considered as a *social value* rather than a *contract*, and divorce is viewed as the social *taboo*. Thus, we argue that low divorce rates in these countries are not only a result of the low status of women in the society, but also a reflection of a strong joint family system and relationship with family and friends.

8 See, for example, Lee (1982), Ettner (1996), Pritchett and Summers (1996), Luft (1975), Grossman and Benham (1980), Bloom and Malaney (1998), Bloom and Sachs (1998), Bloom and Williamson (1998) and Bloom and Canning (1999).

(longevity); infant mortality rate (mortality); the number of AIDS cases and tuberculosis cases (representing morbidity); government expenditure on health as a percentage of GDP, and doctor/population ratio (representing health facilities) to capture the domain of health in our measure of the QOL. The data on these indicators have been obtained from UNDP (1999).

Domain 4: Material well-being

The elements of material well-being have both direct and indirect positive and negative impact on a person's QOL. For instance, rising national income due to industrialization raises QOL on the one hand, but on the other hand decreases it for those living in polluted areas. The latter may suffer further indirect effects if increased pollution raises the incidence of disease and chronic illness. Aspects of material well-being have been most widely used to construct various indices of well-being. One of the main reasons for its use is the availability of good data on various indicators. Traditionally measures of income or related measures of material well-being were considered adequate indicators of standards of living. To capture the extent of material well-being in our QOL we use per capita GDP (at purchasing power parity), daily per capita supply of calories, the commercial use of energy, and telephone lines per thousand people (both representing infrastructure).[9] The data for these indicators have been obtained from the UNDP (1999).

Domain 5: Feeling part of one's local community

Feeling part of one's local community and society in general depends on the factors like educational attainments, political rights, and civil liberties, among others. Many people in different countries of the world are systematically denied political liberty and basic civil rights. It is sometimes claimed that the denial of these rights helps to stimulate economic growth and is 'good' for rapid economic development. However, comprehensive intercountry comparisons have not provided any confirmation of this thesis, and there is little evidence that authoritarian politics actually helps economic growth. As Sen (1999: 16-17) argued:

> political liberty and civil freedoms are directly important on their own, and do not have to be justified indirectly in terms of their effects on economy. Even when people without political liberty or civil rights do not lack adequate economic security (and happen to enjoy favourable economic circumstances), they are deprived of important freedoms in leading their lives and denied the opportunity to take part in crucial decisions regarding public affairs. These deprivations restrict social and political lives, and must be seen as repressive even without their leading to other afflictions. Since political and civil freedoms are constitutive elements of human freedom, their denial is a handicap in itself.

---

9 Since daily per capita supply of calorie is much influenced by income, one can argue we will be counting income twice. However, we note that the quality of consumption depends not only on the level of income, but also on how income is being used by the individual, which in turn depends on his/her level of education. Moreover, it is an easy matter to redo our computations by deleting data on either of our material well-being indices.

Concurrent with this realization, economists who previously assumed that measures of income are the sole and reliable indicators of human well-being finally have begun to understand that political liberties and civil freedoms are as important elements of QOL as any other elements of QOL. Moreover, Jungeilges' and Kirchgasser (2002) finding of a negative relationship between suicide rates and civil liberty reinforces the assertion that dimensions of freedom are very important for human well-being. Thus we emphasize that any measure of current well-being that does not include political and civil spheres of life, will be incomplete and misleading for intercountry comparisons of QOL. Here we use indices of political and civil liberties along with both male and female adult literacy rates to capture this domain of QOL. The indices of political rights and civil liberties are taken from Gastil (1982) (for definition see Taylor and Jodice 1983). It is also available from various human development reports of UNDP. Right to political liberty measures citizens' right to play a part in determining their government, and what laws are and will be. Countries are ranked with scores ranging from one (highest degree of liberty) to seven (lowest degree of liberty). On the other hand, the index of civil liberties measures the extent of people's access to an impartial judiciary, access to free press, and liberty to express their opinion. Countries are ranked with scores ranging from one (highest civil liberty) to seven (lowest degree civil liberty).

Domain 6: Work and productive activity

Estimates of unemployment rate, combined first, second and third level school gross enrolment ratio; and female economic activity rate are used to capture the 'extent of work and productive activity' that exists in countries included in our sample. At any point of time, citizens of a country can be productively engaged either in work employment, or be engaged in the process of learning in school. The female economic activity rate is used to capture the intensity of gender equality in productive activity.

Domain 7: Personal safety

For the well-being of people, personal safety is as important as any other QOL domains. In a society where incidence of crimes is less, people can enjoy their way of living more than in a society where criminal offences are high and common. An individual derives utility not only from the commodity bundles he or she purchases, but also from her/his ability to move about freely, and by being free from crimes and material theft, and enjoy law and order in neighbourhoods. To characterize this domain of well-being, we use two different indicators, namely, the total number of offences per 100,000 inhabitants as indicated by the national crime statistics, and expenditure on military as percentage of GDP. Total number of offences includes cases of murder, sex offences, serious assaults, theft, fraud, counterfeit currency offences, and drug offences. We believe that the higher the total number of offences per 100,000 inhabitants, the lower the well-being of people will be. Similarly, we argue that the expenditure on military is an unproductive expenditure, and therefore it has indirect adverse effect on the QOL. We have obtained data on total offences from the International Crime Statistics of the Interpol. The data refer to the year 1997. Data on military expenditures were obtained from UNDP (1999).

Domain 8: Quality of environment

Most indices of human well-being have ignored the interrelationships between the QOL and environmental changes. Quality of environment has direct and indirect long-term effects on the health status of the citizens, and consequently affects the quality of life of people in the region. As we can see from Figure 1, the elements of material well-being have impact on quality of environment; the quality of environment has direct and an immediate effect on QOL, and an indirect effect on QOL through its effect on health. To capture the extent of the quality of environment, we use a measure of greenhouse gas emissions/carbon dioxide (CO2); a measure of water pollution/access to safe water supplies (ACH2O); and a measure of the depletion of environmental resources/deforestation. Emissions of CO2 are primarily a by-product of industrialization, and attract more attention in middle and upper-income countries. Deforestation and depletion of local water supplies attract the most attention in low-income countries. Water pollution is of the major concern because of its immediate effects on human health and productivity. Deforestation is important because it affects the hydrological cycle, and is linked with the depletion and pollution of water supplies. We have obtained data on these variables from the World Bank (1999) and UNDP (1999).

Our overall aim is to conduct a number of exercises with data on the preceding eight domains of the QOL. The method is to select and test domains which may function as the QOL indices on their own. In the next section, we describe three aggregation methods to arrive at a composite measure of the QOL index. First, we briefly describe the computation of QOL based on the principal component approach. Second, we make use of the well-known Borda rule as the aggregator of set of variables in each domain of the QOL. Third, we examine UNDP's approach to human development index (HDI).

4 Computation of quality of life index (QOLI)

We postulate a latent variable model where the QOL is linearly determined by a set of observable indicators (or a set of causal variables) plus a disturbance term capturing error.

Let the general model in equation (2) can be written as

$$QOL = \alpha + \beta_1 D_1(x^1) + \beta_2 D_2(x^2) + ... + \beta_8 D_8(x^8) + \varepsilon \qquad (3)$$

where $D_1, \ldots, D_8$ are set of indicators in each domain of the QOL used to capture the 'quality of life index', and $\beta_1, \ldots, \beta_8$ are the corresponding vectors of parameters in each domain. Thus the total variation in the QOL is composed of: (i) the variation due to sets of indicators, and (ii) the variation due to error. If the model (3) is well specified, including an adequate number of indicators in each domain, so that the mean of the probability distribution of ε is zero, ($E(\varepsilon) = 0$), and error variance is small relative to the total variance of the latent variable *QOL***,** we can reasonably assume that the total variation in *QOL* is largely explained by the variation in the indicator variables in each domain included for the computation of this composite index.

Since the number of indicators variables included in the model (3) may be large and the indicator variables may be mutually linearly related, we propose to replace the set of indicators by an adequate number of their principal components (PC). The principal components are normalized linear functions of the indicator variables and they are mutually orthogonal. The first principal component accounts for the largest proportion of total variation (trace of the covariance matrix) of all indicator variables. The second principal component accounts for the second largest proportion and so on. In practice, it is adequate to replace the whole set of indicator variables by only the first few components, which account for a substantial proportion of the total variation in all indicator variables. However, if the number of causal variables is not very large, we may, as well, compute as many principal components so that 100 per cent of the variation in indicators is accounted for by their PCs (see Anderson 1984). To compute PCs, we proceed as follows.

Step 1: Transform the indicators into their standardized form, i.e.

$$X_k = \frac{X_k - \overline{X_k}}{std(X_k)}$$

Step 2: Then solve the determinental equation

$$|R - \lambda I| = 0 \text{ for } \lambda$$

where R is a $K \times K$ correlation matrix of the standardized vector of indicator variables; this provides Kth degree polynomial equation in λ and hence K roots. These roots are called the eigenvalues of R. Now let us arrange λ in the descending order of magnitude, as

$$\lambda_1 > \lambda_2 > \ldots > \lambda_k$$

Step 3: Corresponding to each value of λ, we solve the matrix equation

$$(R - \lambda \mathrm{I})\alpha = 0 \text{ For the } K \times 1 \text{ eigenvectors } \alpha, \text{ subject to the condition that } \alpha'\alpha = 1.$$

Let us write the characteristic vectors as

$$\alpha_1 = \begin{pmatrix} \alpha_{11} \\ . \\ . \\ . \\ \alpha_{1k} \end{pmatrix}, \ldots, \alpha_k = \begin{pmatrix} \alpha_{k1} \\ . \\ . \\ . \\ \alpha_{kk} \end{pmatrix}$$

which correspond to $\lambda = \lambda_1, \ldots, \lambda_k$ respectively.

Step 4: The principal components are obtained as

$$P_1 = \alpha_{11}X_1 + \ldots + \alpha_{1K}X_K$$
$$P_2 = \alpha_{21}X_1 + \ldots + \alpha_{2K}X_K$$
.
.
$$P_K = \alpha_{K1}X_1 + \ldots + \alpha_{KK}X_K$$

Thus we compute all these principal components using elements of successive eigenvectors corresponding to respective eigenvalues.

Step 5: We define the weighted average of the principal components as an estimator of the quality of life index (QOLI), thus:[10]

$$QOLI = \frac{P_1\lambda_1 + P_2\lambda_2 + \ldots P_K\lambda_K}{\lambda_1 + \lambda_2 + \ldots \lambda_K}$$

where the weights are $\lambda_1,\ldots,\lambda_K$ are variances of successive principal components. We assign the largest weight λ_1 to the first principal component, as it accounts for the largest proportion of variation in all causal variables. Similarly, the second principal component has the second largest weight and so on.

Step 6: Finally, we normalize the QOLI value by the following procedure,

$$QOLI^i = \frac{QOL^i - Minimum(QOLI^i)}{Maximum(QOLI^i) - Minimum(QOLI^i)}$$

where i = 1, 2 … n (= 43 countries). Then on the basis of estimated value of QOLI we rank 43 countries of the world where the value of 0 indicates the worst-performing country and therefore it gets the rank of 43. Similarly, the value of 1 indicates the best-performing country, and hence it is assigned the rank of 1 (highest rank).

Advantages of the above procedure are the following. First, it minimizes the problem of assigning arbitrary weights since weights are based on information contained in the date set. That is, we assign weights to successive principal components based on their relative contribution in accounting the total variation in all indicator variables. Second, it overcomes the difficulties associated with the maximum likelihood method for the estimation of multiple indicators and multiple causes (MIMIC) model. For instance, the maximum likelihood method requires that the number of causal variables to be included in the model does not exceed the number of observations and none of the causal variables is linearly related with others. In fact, the method requires that the matrix of sum of squares and products of observations on causal variables is non-singular (see Goldberger 1974; Joreskog and Goldberger 1975). Thus, the usefulness of the principal

10 This methodology was originally proposed by Nagar and Rahman (1999), has been subsequently used by many researchers including Nagar and Basu (2002).

component approach lies in its simplicity and its wide scope in providing flexibility for exploratory statistical analyses to be conducted on various domains of the quality of life.

Of the many alternative aggregation methods, the most well known and most studied is the Borda rule. This rule provides a method of rank-order score, the procedure being to award each alternative (say, a country) points equal to its rank in each criterion of ranking (the criteria being per capita income, life expectancy, and the like), adding each alternative's scores to obtain its aggregate score, and then ranking alternatives on the basis of their aggregate scores. To illustrate, suppose a country has the ranks i, j, k, l, and m, respectively, for the five criteria. Then it's Borda score is i + j + k + l + m. The rule invariably yields a complete ordering of alternatives. We note that the Borda rule suffers from various limitations (Goodman and Markowitz 1952 and Fine and Fine 1974 have investigated the strengths and limitations of the Borda rule). The fact that Borda rule is simple, and its strengths and weaknesses are transparent, provides a good justification for using it (Dasgupta and Weale 1992). Moreover, it provides a very simple tool to analyse the sensitivity of QOL rankings across countries contingent on inclusion or exclusion of a particular domain of the QOL.

UNDP in its first *Human Development Report* (1990) introduced a new way of measuring well-being by combining indicators of life expectancy, educational attainment and income into a composite human development index (HDI). Although, over the years some changes have been made in the construction of HDIs, the methodology has remained the same. The HDI is based on three indicators: (i) longevity, as measured by life expectancy at birth; (ii) educational attainment, measured as a weighted average of adult literacy rate with two-third weight, and combined gross primary, secondary and tertiary enrolment with one-third weight; (iii) standard of living, as measured by real gross domestic product (GDP) per capita (PPPS). The HDI sets a minimum and maximum for each dimension and then shows where each country stands in relation to this scale, expressed as value between 0 and 1. Since the minimum adult literacy rate is 0 per cent and the maximum is 100 per cent, the literacy component of knowledge for a country where literacy rate is 75 per cent would be 0.75. Similarly, HDI uses the minimum of life expectancy as 25 years and the maximum of 85 years, so the longevity component for a country where life expectancy is 55 years would be 0.50. For income, the minimum is US$100 (PPP) and the maximum is US$40,000 (PPP). Then the scores for the three dimensions are averaged in an overall index.

4 Discussion of results

We consider 43 countries from around the world for which comparable data on eight domains of QOL and corresponding indicators were available in the year 1999. Our set of countries includes both developed and developing economies. In total we make use of 26 indicators of the QOL. Table 2 summarizes the data. The first column of Table 2 represents domain 1, the relationships with family and friends. Its indicator is the divorce rate (DR). Columns 2 and 3 represent domain 2, emotional well-being. Its two indicators are female suicide rate (FS) and male suicide rate (MS). Columns 4 to 10 represent domain 3, health. It has in total seven indicators: population growth rate (PGR), infant mortality rate (IMR), life expectancy at birth (LE), cases of AIDS (AIDS), cases of tuberculosis (TC), health expenditure by the government as the

percentage of GDP (HE), and doctor population ratio (DPR). Columns 11 to 14 represent domain 4, material well-being. It includes per capita GDP (at PPP), commercial energy use (CEU), daily per capita supplies of calories (CS), and phone lines available per 1000 population (PH). Columns 15 to 18 describe domain 5, feeling part of one's local community: political rights index (PR), civil liberties index (CL), female adult literacy rate (FALR), and the male adult literacy rate (MALR). Columns 19 to 21 represent domain 6, work and productive activity where unemployment rate (UR), combined enrolment ratio in school (CER), and female economic activity rates (FEA) are its indicators. Columns 22 and 23 show domain 7, in which the total number of offences (TTF) and expenditure on military as a percent of GDP (ME) are its two indicators. Finally, columns 24 to 26 represent the domain of the quality of environment. Its three indicators are emissions of carbon dioxide (CO2), rate of deforestation (DEF), and the access to safe water (ACH20).

Table 3 presents the rankings of QOL indicators data. The HDI rank is the rankings of countries provided by *Human Development Report* 1999, and the rankings of the countries have been re-assigned in accordance with countries in our set. We note that rank of 1 represents the best-performing country, and the rank of 43 represents the worst-performing country. Even a glance at these rankings in Table 3 tells us that well-being rankings are highly sensitive to its' domain and corresponding indicators. Also rankings of eight domains indicate that they do not quite follow the rankings provided by HDI, which uses different weighting criterion, and very limited numbers of QOL indicators. Thus, rankings in Table 3 suggest that not only the measures of well-being are sensitive to its coverage of the various domains, but also how different well-being inputs are aggregated to arrive at a composite measure of the QOL. Developed countries like Canada, USA, Japan, and Sweden perform the best in the domains of material well-being, and feeling part of one's local community, but they do not perform as good in the domains of personal safety, and the quality of environment, relationships with family and friends, and emotional well-being. The other low ranked countries, on the basis of HDI, do better in the domains of relationships with family and friends, emotional well-being, and personal safety. These exploratory and tentative results may be an indicative of differences between advanced industrial societies with nucleus family, and developing countries with traditional societies and strong family ties.

Table 4 presents a comparison of QOL indices based on each of eight domains, an overall QOLI* based on both Borda rule and principal components approach, and the HDI ranks. However, two major questions arise. First, do we need an indicator (similar to HDI) that measures QOL and summarizes the result in one *composite* index (such as QOLI*) or a set indicators (indices, e.g., domain indices) that could be more useful in understanding QOL in different countries, and which we could use to do some sort of country ranking? Second, can we combine the measurement of environmental quality with that of other domains of QOL to arrive at one single indicator (index) of well-being? Most certainly we sometimes have justifiable reasons to aggregate; not because this reveals a shared essence such as utility, but because we are required to make choices, and this is one way. The rationale behind an aggregated HDI was to provide a contrast to the ruling aggregate, GNP; to show how it misleads us on well-being, not to claim that it was itself a perfect indicator of overall well-being. Aggregation is unlikely to ever give a great overall indicator of well-being; any appropriate weights may be far from being non-arbitrary and fixed. Moreover, another

good reason for having an aggregated and composite indicator of well-being is that it facilitates easy rankings of countries in the sample in overall sense. Neumayer (1999; 2001; 2004) argues that fully integrated indicators of current well-being and sustainability encounter a fundamental conceptual problem. What affects current well-being need not affect sustainability at all or not in the same way and vice versa. Fully integrated indicators therefore tend to conflate the measurement of two items that should be kept conceptually different. However, here we emphasize that quality of environment and sustainability are not the same concepts. In a limited sense, quality of environment can be viewed as an indicator of sustainability but it cannot be the complete picture. There is no dispute on whether QOL is related with the quality of environment, and disagreement is on whether we can fully integrate them in one composite measure. Thus in Table 4 we present respective domain indices as well as overall QOL indices. Our aim is to test whether respective domain indices can function as indicators of QOL on their own and how different domains affect an overall QOL. We do not claim that such index is inclusive. Rather, it is hoped that the present approach serves as a framework that can be expanded and further used to understand how different dimensions of well-being interact with each other and determine the QOL. Domain indices have been computed by using Borda rule. Looking at the five best-performing countries on the basis of HDI, we observe Canada, USA, Japan, Belgium, and Sweden. On the other hand, the five best countries on the basis of QOLI*(Borda rule) are Spain, Austria, Sweden, Switzerland, and Canada. That is, there are only two countries, Canada, and Sweden, which figure in these two schemes of aggregation. Similarly, if we look at the five worst-performing countries on the HDI rankings, they are El Salvador (43), Moldova (42), Azerbaijan (41), Albania (40), and Jordan (39). On the other hand, the five worst countries on the basis of QOLI*(Borda) rankings are Russia (43), Sri Lanka (42), Ecuador (40), Kazakhstan (40), and South Korea (39). It is quite chilling to note that there is not even single country common between two sets of five worst-performing countries based on HDI and QOLI*. Now let us look at the rankings based on the QOLI*(Borda rule) and QOLI*(principal components (PC) approach). We can clearly note from Table 4 that these two methods of weighting of well-being indicators do not produce quite similar rankings. From Table 5, we observe that the rank correlation coefficient between HDI and QOLI*(Borda) is 0.624, between HDI and QOLI*(PC) is 0.813, and between QOLI*(Borda) and QOLI*(PC) is 0.544. Thus we can say that the rankings based on the principal component approach follows more closely with the HDI rankings than with the rankings based on the Borda rule. Since these two rankings are based on all eight domains of QOL, we conclude that there is sufficient evidence that the well-being rankings are sensitive to aggregation rules.

Table 5 presents rank correlation matrix of indices of QOL domains, the HDI, and QOLI* itself. First, let us look at the correlation coefficients between QOLI*(Borda) and its eight domains. We notice that QOLI* has statistically significant correlation with only five domains of the QOL: health (0.696), material well-being (0.560), feeling part of one's local community (0.598), work and productive activity (0.371), and the quality of environment (0.668). QOLI* has the highest correlation (0.696) with the domain of health. We were not expecting this. We did not have any reason to expect that health would be the closest to our measure of the quality of life. Nevertheless, our findings support the results obtained by Dasgupta and Weale (1992) where they found that life expectancy (an indicator of health) was closest to the measure of the QOL. Thus, if we had to choose a single ordinal domain of aggregate well-being, the domain

of health would seem to be the best when the aggregation method is the Borda rule. Moreover, if we really had to choose one indicator instead of a domain, it would be most appropriate to choose the life expectancy at birth as the indicator of the quality of life. This is also corroborated from the correlation between QOLI*(Borda) and LE, which is (0.745) from Table 6. The QOLI*(Borda) has the second highest correlation with the domain of the quality of environment. This supports our postulation that the quality of environment is very important for human well-being, and it has direct and positive impact on the QOL. Since QOLI* is highly correlated with quality of environment, any alternative index of well-being in the development literature that ignores the domain of the quality of environment, would give misleading rankings of countries and consequently misleading policy recommendations.

Moreover, QOLI*(Borda) has statistically insignificant correlation with the domains of relationship with family and friends, emotional well-being, and the personal safety. The statistically insignificant correlation of QOLI*(Borda) with the domains of relationship with family and friends, emotional well-being, and the personal safety, might mislead readers that these domains are not critical to any measures of the QOL. But we caution that this is not the case at all. First, these domains have statistically significant correlations with the QOLI*(PC). Second, as mentioned in the previous section, divorce rate is a crude indicator of relationship with family and friends, and therefore cannot singly and adequately capture the domain of relationship with family and friends. Similarly, emotional well-being is a much more diverse domain than is being captured by suicides rates. Due to the non-availability of data we limited ourselves to the choice of divorce statistics.[11] Thus we emphasize only the exploratory nature of our inquiry because the matter is a sensitive one, and a great deal remains to be done and examined in this field. The correlation coefficient of 0.824 between the domains of material well-being and feeling a part of one's local community means that the claim, asserting that poverty-inducing circumstances are the same which make it necessary for a government to deny citizens their political and civil liberties, is simply false. In the sample there are low-income countries which enjoy relatively high levels of civil and political liberties. Now let us look at correlation coefficients between HDI and domain indices. The HDI has the lowest rank correlation coefficient with the domain of the quality of environment (0.142). This is expected because HDI does not include any measure of environmental quality. Moreover, we emphasize that since correlation coefficient between HDI and quality of environment is low, it also means that they are two distinct dimensions of well-being and inclusion of environmental indicators in the measurement of well-being will bring additional statistical information. Thus, domain of quality of environment is not redundant for the measurement of well-being (statistically).

---

[11] Some can argue that *emotional well-being* and *relationship with family and friends* are subjective domains of the QOL, and therefore it would be difficult to find many indicators in these domains, which will be reliable enough to perform intercountry comparisons. However, we note that people always attach higher weights to emotional well-being and relationships with family and friends in direct surveys when they are asked to rank the elements of their well-being.

5 Concluding remarks

This paper introduced a multidimensional approach to measuring the QOL across countries. We operationalized Sen's concept that other factors besides measures of per capita income and mortality rates should be included in any analysis of QOL. Using information on eight domains of the QOL we showed that the various measures of well-being are *highly sensitive* to domains of QOL that are considered in the construction of comparative indices, and how measurable inputs into the well-being indicators are aggregated and weighted to arrive at composite measures of QOL. We presented a picture of conditions among the 43 countries of the world with respect to interrelated domains of QOL such as the relationship with family and friends, emotional well-being, health, work and productivity, material well-being, feeling part of one's community, personal safety, and the quality of environment. On the basis of Borda rule and the principal components approach, we searched for factor-indices that may function as QOL indices comparatively across countries. Our results suggest that the well-being rankings are not robust to the various aggregation methods and the domains of the QOL. Our findings support the result obtained by Dasgupta and Weale (1992) where they found that life expectancy (an indicator of health) was closest to the measure of the QOL. Thus, if we had to choose a single ordinal domain of aggregate well-being, the domain of health would seem to be the best when the aggregation method is the Borda rule. Moreover, if we had to choose one indicator instead of a domain, the most appropriate choice would be life expectancy at birth to indicate the quality of life. However, if aggregation method is the principal component approach, domain 5 (feeling a part of one's local community) is the closest to the measure of QOL. Similarly, HDI is most closely related with the domain of material well-being. Thus we conclude that well-being results are not robust to alternative aggregation rules and various dimensions of well-being. Our most robust conclusion for policy implication (across all aggregation methods) is proving false the claim that the circumstances which cause poverty are also the same which makes it necessary for governments to deny citizens their political and civil liberties. Potentials for future research lie in finding optimal and robust aggregation methods to derive appropriate weights for the well-being attributes, improving the quality of data available and collecting comparable cross-country data on various dimensions of well-being including relationship with family and friends, emotional well-being, and the quality of environment.

References

Adelman, I. and C. T. Morris (1967). *Society, Politics and Economic Development.* Baltimore, MD: Johns Hopkins University Press.

Bloom, D. E. and D. Canning (2000). 'The Health and Wealth of Nations'. *Science,* 287: 1207-09.

Bloom, D. E. and J. Sachs (1998). 'Geography, Demography, and Economic Growth in Africa'. *Brookings Papers on Economic Activity*, 2: 207-95.

Bloom, D. E. and J. Williamson (1998). 'Demographic Transitions and Economic Miracles in Emerging Asia'. *World Bank Economic Review*, 12 (3): 419-55.

Bloom, D. E. and P. N. Malaney (1998). 'Macroeconomic Consequences of the Russian Mortality Crisis'. *World Development*, 26 (11): 2073-85.

Bloom, D. E., P. H. Craig and P. N. Malaney (2001). *The Quality of Life in Rural Asia.* Hong Kong: Oxford University Press.

Cark, A. E. (1998). 'Comparison-Concave utility and Following Behavior in Social and Economic Setting'. *Journal of Public Economics*, 70 (1): 133-55.

Dasgupta, P. (1990). 'Well-being and the Extent of its Realization in Poor Countries'. *Economic Journal*, 100 (Supplement): 1-32.

Dasgupta, P. and M. Weale (1992). 'On Measuring the Quality of Life'. *World Development*, 20 (1): 119-31.

Debreu, G. (1959). *Theory of Value*. New Haven: Yale University Press.

Drenowski, J. (1974). *On Measuring and Planning the Quality of Life*. The Hague: Mouton.

Ettner, S. L. (1996). 'New Evidence on the Relationship between Income and Health'. *Journal of Health Economics*, 15: 67-85.

Fine, B. and K. Fine (1974). 'Social Choice and Individual Rankings, I and II'. *Review of Economic Studies*, 44 (3): 303-22, and (4): 459-76.

Frijters, P. (2000). 'Do Individuals try to Maximize General Satisfaction?'. *Journal of Economic Psychology*, 21 (3): 281-304.

Gasper, D. (2002). 'Is Sen's Capability Approach an Adequate Basis for Considering Human Development?'. *Review of Political Economy*, 14 (4): 435-61.

Gastil, R. D. (1982). *Freedom in the World: Political and Civil Lib*erties. New York: Freedom House.

Goldberger, A. S. (1974). 'Unobservable Variables in Econometrics', in P. Zarembka (ed.) *Frontiers of Econometrics*. New York: Academic Press: 193-213.

Goodman, L. A. and H. Markowitz (1952). 'Social Welfare Functions based on Individual Rankings'. *American Journal of Sociology*, 58 (3): 257-62.

Grossman, M. and L. Benham (1980). 'Health Hours and Wages', in P. Jacobs (ed.), *The Economics of Health and Medical Care: An Introduction.* Baltimore, MD: University Park Press.

Hicks, N. (1979). 'Growth vs. Basic Needs: Is There a Trade-off?'. *World Development*, 7: 985-94.

Hicks, N. and P. Streeten (1979). 'Indicators of Development: The Search for a Basic Needs Yardstick'. *World Development*, 7: 567-80.

Hirschberg, J. *et al*. (2001). 'Clusters of Attributes and Well-being in the USA'. *Journal of Applied Econometrics*, 16: 445-60.

Joreskog, K. and A. S. Goldberger (1975). 'Estimation of a Model with a Multiple Indicators and Multiple Causes of a Single Latent Variable'. *Journal of American Statistical Association*, 70: 631-9.

Jungeilges, J. and G. Kirchgasser (2002). 'Economic Welfare, Civil Liberty, and Suicide: An Empirical Investigation'. *Journal of Socio-Economics*, 31: 215-31.

Kacapyr, E. (1996). 'Are We Having Fun Yet?'. *American Demographics*, October: 28-9.

Kahneman, D., B. L. Fredrickson, C. A. Schreiber and D. A. Redelmeier (1993). 'When More Pain is Preferred to Less: Adding a Better End'. *Psychological Science*, 4: 401-5.

Kakwani, N. (1993). 'Performance in Living Standards: An International Comparison'. *Journal of Development Economics*, 41: 307-36.

Lee, Lung-Fei (1982). 'Health and Wage: A Simultaneous Equation Model with Multiple Discrete Indicators'. *International Economic Review*, 23: 199-219.

Luft, H. S. (1975). 'Impact of Poor Health on Earnings'. *Review of Economics and Statistics*, 75: 43-57.

McCall, S. (1975). 'Quality of Life'. *Social Indicators Research*, 16: 299-349.

Miringoff, M. L. and M. L. Miringoff (1999). *The Social Health of the Nation: How America is Really Doing*. New York: Oxford University Press.

Morris, D. (1979). *Measuring the Conditions of the World Poor, the Physical Quality of Life Index*. New York: Pergaman Press.

Nagar, A. L. and T. Rahman (1999). 'Measurement of Quality of Life'. Working Paper, National Institute of Public Finance and Policy, New Delhi.

Nagar, A. L. and S. R. Basu (2002). 'Weighting Socioeconomic Indicators of Human Development: A Latent Variable Approach'. In A. Ullah, A. T. K. Wan and C. Anoop (eds) *Handbook of Applied Econometrics and Statistical Inference*, 2003 New York: Marcer Dekker.

Neumayer, E. (1999). 'The ISEW: Not an Index of Sustainable Economic Welfare'. *Social Indicators Research*, 47: 77-101.

Neumayer, E. (2001). 'The Human Development Index and Sustainability—A Constructive Proposal'. *Ecological Economics*, 39: 101-14.

Neumayer, E. (2004). 'Sustainability and Well-being Indicators'. Research Paper 2004/23. Helsinki: UNU-WIDER.

Noll, H.-H. (1999). 'Konzepte der Wohlfahrtsentwicklung: Lebensqualitat und 'neue' WohlfahrtsKonzepte'. Euro-reporting paper 3, ZUMA: Mannheim.

Nugman, G. (2002). *World Divorce Rates*. Heritage Foundation.

Osberg, L. and A. Sharpe (1998). 'An Index of Economic Well-being for Canada'. Research Paper R-99-3E. Ottawa: Applied Research Branch, Human Resources Development.

Osberg, L. and A. Sharpe (1999). 'An Index of Economic Well-being for Canada and the United States'. Paper presented at the annual meeting of the American Economic Association, January, New York.

Osberg, L. and A. Sharpe (2000). 'International Comparisons of Trends in Economic Well-being'. Paper presented at the annual meeting of the American Economic Association, January, Boston.

Perrings, C. (1998). 'Income, Consumption and Human Development: Environmental Linkages', in *Background Papers, Human Development Report, 1998*: 151-212.

Pritchett, L. and L. H. Summers (1996). 'Wealthier is Healthier'. *Journal of Human Resources*, 31 (4): 841-68.

Ram, R. (1982). 'Composite Indices of Physical Quality of Life, Basic Needs Fulfillment, Income: A Principal Component Representation'. *Journal of Development Economics*, 11: 227-47.

Robbins, L. (1932). *An Essay on Nature and Significance of Economic Science*. London: Macmillan.

Samuelson, P. A. (1945). *Foundations of Economic Analysis*. Cambridge, MA: Harvard University Press.

Sen, A. K. (1973). 'On the Development of Basic Economic Indicators to Supplement GNP Measures'. *UN Economic Bulletin for Asia and the Far East*, 24 (2-3): 1-11.

Sen, A. K. (1981). 'Public Action and the Quality of Life in Developing Countries'. *Oxford Bulletin of Economics and Statistics*, 43: 287-319.

Sen, A. K. (1985). *Commodities and Capabilities*. Amsterdam: North-Holland.

Sen, A. K. (1987). *Standard of Living*. New York: Cambridge University Press.

Sen, A. K. (1999). *Development as Freedom*. New York: Alfred A. Knopf.

Slottje, D. (1991). 'Measuring the Quality of Life across Countries'. *Review of Economics and Statistics*, 73: 684-93.

Taylor, C. L. and D. A. Jodice (1983). *World Handbook of Political and Social Indicators*, Vol. 1. New Haven, CT: Yale University Press.

Terhune, K. W. (1973). 'Probing Policy Relevant Questions on the Quality of Life', in: *The Quality of Life Concept*. Washington, DC: Environmental Protection Agency.

UNDP (United Nations Development Programme) (various years). *Human Development Report*.

Veenhoven, R. (1984). *Conditions of Happiness*. Dordrecht: Kluwer.

Veenhoven, R. (2000). 'The Four Qualities of Life: Ordering Concepts and Measures of Good Life'. *Journal of Happiness Studies*, 1: 1-39.

WHO (2002). *Mental Health Data*. World Health Organization.

World Bank (various years). *World Development Indicators.* Washington, DC: World Bank.

Figure 1
Schematic presentation of conceptual framework

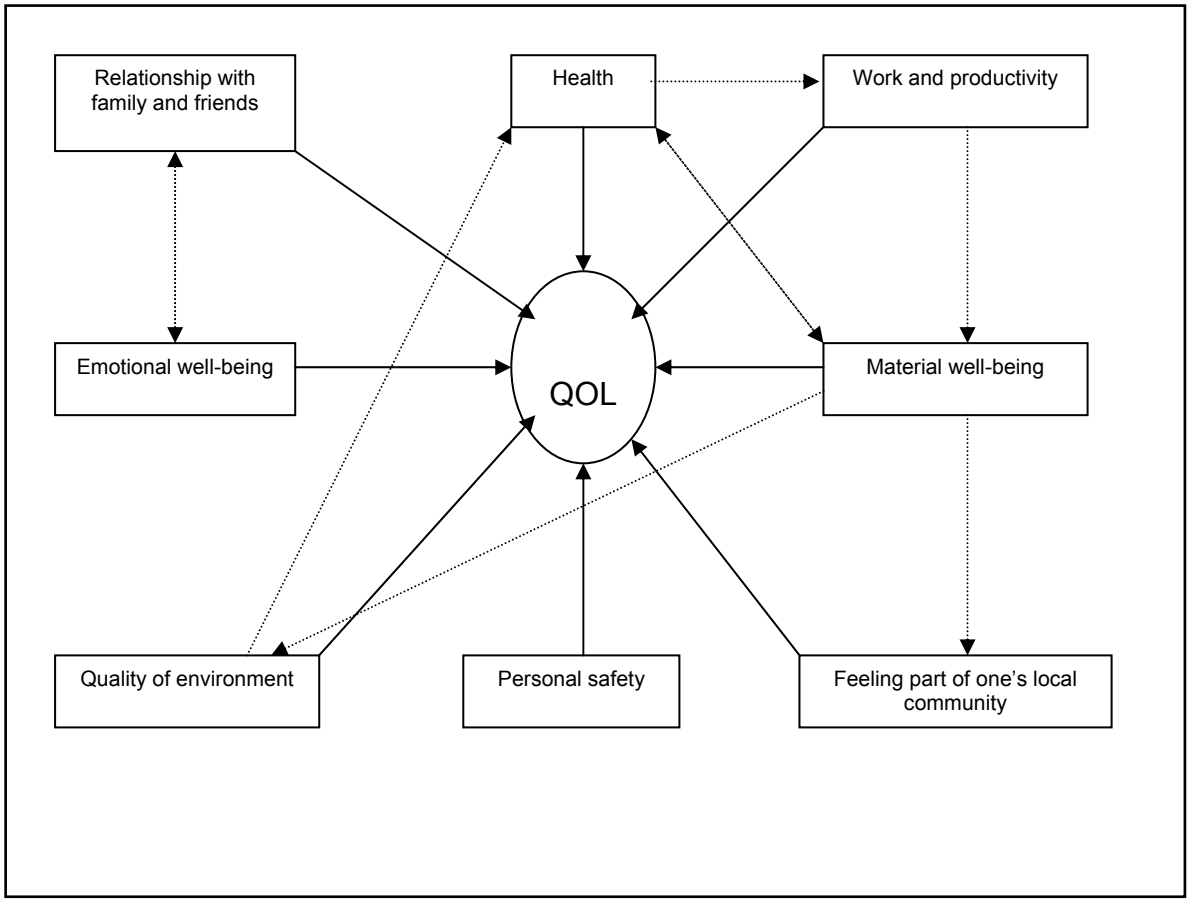

Table 1
Domains of QOL measured by some indexes

Domains of QOL	Human development index (UNDP)	Physical quality of life index (Morris)	Index of economic well-being	American demographic index	Dasgupta and Weale (1992)
Relationship with family and friends	×	×	×	√	×
Emotional well-being	×	×	×	×	×
Health	√	√	×	×	√
Material well-being	√	×	√	√	√
Work and productivity	×	×	√	×	×
Feeling a part of one's local community	√	√	×	√	√
Personal safety	×	×	√	√	×
Quality of environment	×	×	×	×	×

Note: × indicates that it does not cover; √ indicates that it covers.

Table 2
Domains of quality of life and corresponding indicators in 1999

		Domain 1	Domain 2		Domain 3						
	HDI rank	DR 1	FS 2	MS 3	PGR 4	IMR 5	LE 6	AIDS 7	TC 8	HE 9	DPR 10
Canada	1	2.28	5.4	21.5	1.2	6	79.0	50.4	6.5	6.9	221
United States	2	4.1	4.5	19.8	1.0	7	76.7	225.3	7.9	6.5	245
Japan	3	1.92	14.1	36.5	0.6	4	80.0	1.2	33.5	5.6	177
Belgium	4	2.6	11.6	26.8	0.2	6	77.2	23.7	13.3	6.9	365
Sweden	5	2.4	9.2	21.5	0.4	4	78.5	17.6	5.6	7.1	299
United Kingdom	6	2.6	3.2	11.7	0.2	6	77.2	25.9	10.7	5.9	164
France	7	2.0	10.7	31.5	0.5	5	78.1	81.0	13.1	8.0	280
Switzerland	8	2.8	11.6	29.2	0.6	5	78.6	83.8	10.6	6.9	301
Finland	9	2.7	11.8	43.4	0.4	4	76.8	5.2	12.6	5.8	269
Germany	10	2.3	8.7	23.2	0.2	5	77.2	20.7	14.4	8.1	319
Denmark	11	2.7	11.2	24.2	0.2	6	75.7	40.1	9.2	6.9	283
Austria	12	2.4	11.0	34.2	0.3	5	77.0	21.7	17.1	5.9	327
New Zealand	13	2.65	6.9	23.7	0.9	7	76.9	17.1	8.7	5.7	210
Spain	14	0.9	3.7	12.7	0.5	5	78.0	123.3	21	5.8	400
Portugal	15	1.9	4.4	12.2	0.4	7	75.3	48.0	53.2	5.0	291
Korea, Rep. of	16	2.12	6.7	14.5	1.2	6	72.4	0.2	68.7	1.9	127
Slovenia	17	1.1	12.6	45.3	0.6	5	74.4	3.2	28.2	7.1	219
Chile	18	0.42	1.4	10.2	1.6	11	74.9	13.4	28.0	2.3	108
Kuwait	19	1.58	1.6	1.6	2.5	12	75.9	1.4	23.7	3.5	178
Czech Republic	20	2.9	8.5	25.6	0.1	6	73.9	1.1	19.1	6.9	293
Uruguay	21	2.01	4.2	16.6	0.7	18	73.9	28.7	21.6	1.9	309
Slovakia	22	1.7	4.6	23.4	0.6	10	73.0	0.3	28.0	6.1	325
Hungary	23	2.4	16.7	50.6	-0.2	10	70.9	2.8	43.2	4.9	337
Venezuela	24	0.79	1.9	8.3	2.7	21	72.4	30.4	25.0	1.0	194
Panama	25	0.65	1.9	5.6	2.1	18	73.6	52.5	41.1	4.7	119
Croatia	26	0.8	9.8	29.7	0.2	8	72.6	2.6	48.4	8.5	201
Belarus	27	4.3	10.0	61.1	0.5	14	68.0	0.2	53.9	5.3	379
Lithuania	28	2.9	15.6	79.1	0.5	13	69.9	0.3	70.2	5.1	399
Bulgaria	29	1.3	8.1	24.1	-0.2	16	71.1	0.6	36.8	3.6	333
Thailand	30	0.9	2.4	5.6	1.7	31	68.8	101.1	67.4	2.0	24
Romania	31	1.4	4.6	20.3	0.3	22	69.9	22.8	106.9	3.6	176
Russian Fed.	32	4.3	13.7	72.9	0.4	20	66.6	0.2	75.1	4.3	380
Ecuador	33	0.73	3.2	6.4	2.5	30	69.5	5.2	54.1	2.0	111
Kazakhstan	34	2.35	9.4	48.9	0.7	37	67.6	0.1	84.8	2.2	360
Brazil	35	0.6	1.8	6.6	1.9	37	66.8	69.4	54.0	1.9	134
Armenia	36	0.3	0.7	2.5	1.0	25	70.5	0.2	26.0	3.1	312
Dominican Rep.	37	1.17	0.0	0.0	2.2	44	70.6	48.7	75.4	1.8	77
Sri Lanka	38	0.15	16.8	44.6	1.4	17	73.1	0.4	30.1	1.4	23
Jordan	39	1.22	0.0	0.0	4.0	20	70.1	0.9	8.0	3.7	158
Albania	40	0.6	3.6	6.3	1.2	34	72.8	0.3	23.4	2.5	141
Azerbaijan	41	0.7	0.2	1.1	1.4	34	69.9	0.1	32.6	1.1	390
Moldova, Rep. of	42	2.7	8.3	29.7	0.6	25	67.5	0.4	66.8	5.8	356
El Salvador	43	0.49	5.5	10.4	1.7	31	69.1	34.1	29.1	2.4	91

Table 2 continues

Notes: Domain 1 = Relationship with family and friends
Domain 2 = Emotional well-being
Domain 3 = Health
Domain 4 = Material well-being
Domain 5 = Feel part of one's local community
Domain 6 = Work and productivity
Domain 7 = Personal safety
Domain 8 = Quality of environment
See section 4 (first paragraph) for variable definitions.

Table 2 (con't)
Domains of quality of life and corresponding indicators in 1999

	Domain 4				Domain 5			
	Y	CEU	CS	PH	PR	CL	FALR	MALR
	11	12	13	14	15	16	17	18
Canada	22,480	7,880	3,056	602	1	1	99.0	99.0
United States	29,010	8,051	3,642	640	1	1	99.0	99.0
Japan	24,070	4,058	2,905	489	1	2	99.0	99.0
Belgium	22,750	5,552	3,543	465	1	2	99.0	99.0
Sweden	19,790	5,944	3,160	682	1	1	99.0	99.0
United Kingdom	20,730	3,992	3,237	528	1	2	99.0	99.0
France	22,030	4,355	3,551	564	1	2	99.0	99.0
Switzerland	25,240	3,622	3,280	640	1	1	99.0	99.0
Finland	20,150	6,143	2,916	549	1	1	99.0	99.0
Germany	21,260	4,267	3,330	538	1	2	99.0	99.0
Denmark	23,690	4,346	3,808	618	1	1	99.0	99.0
Austria	22,070	3,373	3,343	469	1	1	99.0	99.0
New Zealand	17,410	4,388	3,405	499	1	1	99.0	99.0
Spain	15,930	2,583	3,295	392	1	2	96.2	98.4
Portugal	14,270	1,928	3,658	375	1	1	88.3	93.7
Korea, Rep. of	13,590	3,576	3,336	430	2	2	95.5	98.9
Slovenia	11,800	3,098	3,117	333	1	2	99.0	99.0
Chile	12,730	1,419	2,810	156	2	2	94.9	95.4
Kuwait	25,314	8,167	3,075	232	5	5	77.5	83.1
Czech Republic	10,510	3,917	3,177	273	1	2	99.0	99.0
Uruguay	9,200	912	2,830	209	1	2	97.8	97.0
Slovakia	7,910	3,266	3,030	232	2	4	99.0	99.0
Hungary	7,200	2,499	3,402	261	1	2	99.0	99.0
Venezuela	8,860	2,463	2,398	117	2	3	91.6	92.5
Panama	7,168	853	2,556	122	2	3	90.4	91.7
Croatia	4,895	1,418	2,458	309	4	4	96.4	99.0
Belarus	4,850	2,386	3,101	208	6	6	98.5	99.0
Lithuania	4,220	2,414	2,805	268	1	2	99.0	99.0
Bulgaria	4,010	2,705	2,756	313	2	3	97.6	98.8
Thailand	6,690	1,333	2,334	70	3	3	92.8	96.7
Romania	4,310	2,027	2,943	140	2	2	96.7	98.9
Russian Fed.	4,370	4,169	2,704	175	3	4	98.8	99.0
Ecuador	4,940	731	2,592	73	3	3	88.8	92.7
Kazakhstan	3,560	2,724	3,007	116	6	5	99.0	99.0
Brazil	6,480	1,012	2,938	96	3	4	83.9	84.1
Armenia	2,360	474	2,147	154	5	4	98.8	98.8
Dominican Rep.	4,820	652	2,316	83	3	3	82.3	82.8
Sri Lanka	2,490	371	2,263	14	3	4	87.6	94.0
Jordan	3,450	1,040	2,681	60	4	4	81.8	92.2
Albania	2,120	362	2,523	17	4	4	85.0	85.0
Azerbaijan	1,550	1,570	2,139	85	6	4	96.3	96.3
Moldova, Rep. of	1,500	1,064	2,562	140	3	4	97.4	99.0
El Salvador	2,880	700	2,515	56	2	3	74.2	80.1

Table 2 continues

Table 2 (con't)
Domains of quality of life and corresponding indicators in 1999

	Domain 6			Domain 7		Domain 8		
	UR 19	CER 20	FEA 21	TTF 22	ME 23	CO2 24	DEF 25	ACH2O 26
Canada	6.8	99	47.9	8,690.81	1.4	13.8	-0.1	100
United States	4.0	94	45.7	4,922.74	3.6	19.7	-0.3	100
Japan	4.7	85	43.3	1,570.05	1.0	9.3	0.1	96
Belgium	8.4	100	32.9	8,072.12	1.6	10.5	0.2	100
Sweden	6.0	100	51.2	1,3520.9	2.4	6.2	0.0	100
United Kingdom	5.5	100	42.6	8,576.46	3.0	9.5	-0.5	100
France	9.7	92	39.1	5,972.32	3.0	6.2	-1.1	100
Switzerland	1.9	79	42.5	5,460.56	1.5	6.1	0.0	100
Finland	9.8	99	47.3	1,4026.7	1.6	11.6	0.1	96
Germany	9.9	88	41.1	8,030.71	1.7	10.5	0.0	100
Denmark	5.3	89	51.2	1,0068.3	1.8	10.8	0.0	100
Austria	5.4	86	37.0	5,975.01	0.9	7.3	0.0	100
New Zealand	6.3	95	43.6	12,586.6	1.2	8.3	-0.6	97
Spain	14.0	92	31.1	2,344.16	1.5	5.9	0.0	100
Portugal	4.3	91	42.4	760.78	2.4	4.9	-0.9	92
Korea, Rep. of	4.1	90	41.2	1,195.96	3.2	9.0	0.2	93
Slovenia	7.1	76	45.4	1,890.81	1.6	6.8	0.0	100
Chile	9.0	77	25.9	1,309.38	1.6	3.4	0.4	87
Kuwait	1.8	57	24.8	1,326.71	11.9	25.3	0.0	90
Czech Republic	8.7	74	51.3	3,913.27	1.8	12.4	0.0	95
Uruguay	14.0	77	36.2	3,382.93	1.5	1.8	0.0	95
Slovakia	17.0	75	49.9	1,714.94	2.3	7.4	-0.1	100
Hungary	9.4	74	40.5	5,056.05	1.6	6.0	-0.5	98
Venezuela	14.0	67	27.2	1,107.44	1.0	6.5	1.1	92
Panama	13.0	73	28.8	726.64	1.2	2.5	2.2	84
Croatia	22.0	67	39.9	1,151.38	14.5	3.9	0.0	95
Belarus	2.1	80	47.8	1,254.58	1.2	6.0	-1.0	100
Lithuania	10.8	75	46.9	1,995.16	0.5	3.7	-0.6	67
Bulgaria	17.7	70	47.8	2,891.21	1.8	6.5	-0.57	99
Thailand	3.7	59	55.5	212.16	1.9	3.5	2.6	77
Romania	11.5	68	41.5	1,597.08	3.5	5.3	-0.23	95
Russian Fed.	10.5	77	48.1	1,629.3	3.7	10.7	0.0	99
Ecuador	13.0	73	20.7	569.45	3.4	2.1	1.6	54
Kazakhstan	6.0	76	43.7	1,038.82	1.5	10.4	-1.9	91
Brazil	7.1	80	32.1	1,403.5	1.9	1.7	0.5	87
Armenia	20.0	72	46.0	325.89	4.0	1.0	-2.7	86
Dominican Rep.	20.0	66	26.1	862.16	1.1	1.6	1.6	68
Sri Lanka	8.8	66	30.5	392.48	6.0	0.4	1.1	60
Jordan	15.0	66	13.6	474.63	8.8	2.5	2.5	99
Albania	16.0	68	41.5	192.33	1.5	0.6	0.0	97
Azerbaijan	20.0	71	37.9	214.92	2.6	4.0	0.0	90
Moldova, Rep. of	1.9	70	45.9	1,042.22	0.8	2.7	0.0	100
El Salvador	10.0	64	28.9	878.99	0.9	0.7	3.3	47

Table 3
Rankings of quality of life indicators data

	Domain 1	Domain 2		Domain 3							Domain 4				Domain 5				Domain 6			Domain 7		Domain 8		
	HDI	DR	FS	MS	PGR	IMR	LE	AIDS	TC	HE	DPR	Y	CEU	CS	PH	Y	CEU	CS	PH	UR	CER	FEA	TTF	ME	CO2	DEF	ACH2O
	rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Canada	1	26	20	21	29	10	2	36	2	6	24	7	3	19	5	1	1	1	1	16	4	7	39	11	41	13	1
United States	2	41	17	19	27	16	13	43	3	11	23	1	2	3	2	1	1	1	1	6	7	14	31	34	42	11	1
Japan	3	22	40	35	19	1	1	15	27	19	30	4	12	25	11	1	10	1	1	9	15	18	21	5	32	30	21
Belgium	4	32	35	29	4	10	7	28	11	6	6	6	6	5	13	1	10	1	1	19	1	31	37	16	35	32	1
Sweden	5	29	28	21	11	1	4	24	1	4	17	13	5	15	1	1	1	1	1	13	1	3	42	28	23	15	1
United Kingdom	6	32	11	14	4	10	7	29	8	13	32	11	13	13	9	1	10	1	1	12	1	19	38	31	33	9	1
France	7	23	32	33	15	4	5	39	10	3	21	9	8	4	6	1	10	1	1	24	8	27	34	31	23	3	1
Switzerland	8	38	35	30	19	4	3	40	7	6	16	3	15	12	2	1	1	1	1	2	18	20	33	12	22	15	1
Finland	9	35	37	36	11	1	12	20	9	15	22	12	4	24	7	1	1	1	1	25	4	10	43	16	39	30	21
Germany	10	27	27	23	4	4	7	25	12	2	13	10	10	10	8	1	10	1	1	26	13	24	36	22	35	15	1
Denmark	11	35	34	27	4	10	15	33	6	6	20	5	9	1	4	1	1	1	1	10	12	3	40	21	38	15	1
Austria	12	29	33	34	9	4	10	26	13	13	11	8	17	8	12	1	1	1	1	11	14	29	35	3	28	15	1
New Zealand	13	34	23	25	26	16	11	23	5	18	26	14	7	6	10	1	1	1	1	15	6	17	41	8	30	6	19
Spain	14	12	14	16	15	4	6	42	15	15	1	15	22	11	15	1	10	27	28	33	8	33	27	12	19	15	1
Portugal	15	21	16	15	11	16	16	34	32	22	19	16	28	2	16	1	1	43	34	8	10	21	9	28	17	5	28
Korea, Rep. of	16	25	22	17	29	10	25	3	38	37	36	17	16	9	14	21	10	28	24	7	11	20	16	33	31	32	27
Slovenia	17	14	38	38	19	4	18	19	23	4	25	19	19	16	17	1	10	1	1	17	22	15	25	16	27	15	1
Chile	18	3	5	12	34	22	17	22	21	33	39	18	30	27	28	21	10	29	32	22	19	39	18	16	12	34	33
Kuwait	19	19	6	4	40	23	14	16	18	29	29	2	1	18	23	40	41	40	41	1	43	40	19	39	43	15	31
Czech Republic	20	39	26	28	3	10	19	14	14	6	18	20	14	14	20	1	10	1	1	20	26	2	30	21	40	15	23
Uruguay	21	24	15	18	24	28	19	30	16	37	15	21	36	26	25	1	10	21	29	33	19	30	29	12	7	15	23
Slovakia	22	20	18	24	19	20	23	7	21	12	12	23	18	20	23	21	31	1	1	38	24	5	24	27	29	13	1
Hungary	23	30	42	40	1	20	28	18	30	23	9	24	23	7	22	1	10	1	1	23	26	25	32	16	20	9	18
Venezuela	24	10	8	11	42	32	25	31	19	43	28	22	24	38	33	21	24	31	36	33	36	37	14	5	25	36	28
Panama	25	7	8	6	38	28	21	37	29	24	37	25	37	34	32	21	24	32	38	31	28	36	8	8	9	40	36
Croatia	26	11	30	31	4	19	24	17	31	1	27	29	31	37	19	37	31	25	1	43	36	26	15	40	15	15	23

Table 3 continues

Table 3 (con't)
Rankings of quality of life indicators data

		Domain 1	Domain 2		Domain 3							Domain 4				Domain 5				Domain 6			Domain 7		Domain 8		
	HDI rank	DR 1	FS 2	MS 3	PGR 4	IMR 5	LE 6	AIDS 7	TC 8	HE 9	DPR 10	Y 11	CEU 12	CS 13	PH 14	Y 15	CEU 16	CS 17	PH 18	UR 19	CER 20	FEA 21	TTF 22	ME 23	CO2 24	DEF 25	ACH2O 26
Belarus	27	42	31	41	15	25	38	3	33	20	5	30	26	17	26	42	43	22	1	4	16	8	17	8	20	4	1
Lithuania	28	39	41	43	15	24	32	7	39	21	2	34	25	28	21	1	10	1	1	29	24	11	26	1	14	6	39
Bulgaria	29	17	24	26	1	26	27	12	28	27	10	35	21	29	18	21	24	22	26	39	32	8	28	21	25	8	16
Thailand	30	12	10	6	35	37	37	41	37	35	42	26	32	39	39	29	24	30	30	5	42	1	2	25	13	42	37
Romania	31	18	18	20	9	33	34	27	43	27	31	33	27	22	30	21	10	24	24	30	34	22	22	35	18	12	23
Russian Fed.	32	42	39	42	11	30	42	3	40	25	4	32	11	30	27	29	31	20	1	28	19	6	23	36	37	15	16
Ecuador	33	9	11	9	40	36	35	20	35	35	38	28	38	32	38	29	24	33	35	31	28	41	7	33	8	38	41
Kazakhstan	34	28	29	39	24	41	39	1	42	34	7	36	20	21	34	42	41	1	1	13	22	16	12	12	34	2	30
Brazil	35	5	7	10	37	41	41	38	34	37	35	27	35	23	35	29	31	37	40	17	16	32	20	25	6	35	33
Armenia	36	2	4	5	27	34	30	3	20	30	14	40	41	42	29	40	31	20	26	40	30	12	4	36	4	1	35
Dominican Rep.	37	15	1	1	39	43	29	35	41	40	41	31	40	40	37	29	24	38	42	40	38	38	10	7	5	38	38
Sri Lanka	38	1	43	37	32	27	22	10	25	41	43	39	42	41	43	29	31	35	33	21	38	34	5	37	1	36	40
Jordan	39	16	1	1	43	30	31	13	4	26	33	37	34	31	40	37	31	39	37	36	38	42	6	38	9	41	16
Albania	40	5	13	8	30	39	24	7	17	31	34	41	43	35	42	37	31	36	39	37	34	22	1	12	2	15	19
Azerbaijan	41	8	3	3	32	39	32	1	26	42	3	42	29	43	36	42	31	26	31	41	31	28	3	30	16	15	31
Moldova, Rep. of	42	35	25	31	19	34	40	10	36	15	8	43	33	33	30	29	31	23	1	2	32	13	13	2	11	15	1
El Salvador	43	4	21	13	35	37	36	32	24	32	40	38	39	36	41	21	24	41	43	27	41	35	11	3	3	43	

Notes: See notes to Table 2.

Table 4
A Comparison of quality of life indices

	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5	Domain 6	Domain 7	Domain 8	HDI rank	QOLI* Borda	QOLI* PC-based
Canada	26	21	12	6	1	3	29	22	1	5	6
USA	41	18	20	1	1	3	40	20	2	18	1
Japan	22	38	13	14	9	12	9	35	3	17	17
Belgium	32	31	3	4	9	16	32	28	4	16	5
Sweden	29	24	1	6	1	1	43	7	5	3	3
United Kingdom	32	13	11	12	9	6	42	9	6	10	12
France	23	32	9	3	9	21	40	2	7	6	8
Switzerland	38	32	8	5	1	11	23	6	8	4	7
Finland	35	37	6	13	1	9	37	41	9	30	4
Germany	27	25	2	9	9	22	35	17	10	8	9
Denmark	35	29	7	2	1	2	39	20	11	13	2
Austria	29	34	5	11	1	19	15	12	12	2	10
New Zealand	34	23	17	8	1	7	26	22	13	12	11
Spain	12	14	10	17	20	26	16	4	14	1	20
Portugal	21	15	23	16	21	9	14	16	15	9	21
Korea, S	25	20	30	15	24	7	26	41	16	39	23
Slovenia	14	39	13	19	9	19	19	9	17	7	19
Chile	3	8	33	24	27	29	13	33	18	18	32
Kuwait	19	5	27	10	43	32	35	39	19	35	30
Czech Rep.	39	27	4	18	9	14	30	32	20	26	15
Uruguay	24	16	27	26	19	30	19	13	21	20	28
Slovakia	20	22	15	21	18	25	30	9	22	14	24
Hungary	30	42	18	20	9	26	25	14	23	25	16
Venezuela	10	10	38	31	31	41	6	39	24	28	35
Panama	7	6	37	33	33	36	4	36	25	24	36
Croatia	11	29	16	30	29	40	33	18	26	29	29
Belarus	42	36	21	22	30	5	8	1	27	27	14
Lithuania	39	43	22	26	9	23	10	24	28	31	18
Bulgaria	17	25	19	24	28	28	26	15	29	21	26
Thailand	12	7	42	34	32	14	10	43	30	38	34
Romania	18	19	36	29	21	33	34	18	31	32	27
Russian	42	41	24	23	23	18	37	28	32	43	13
Ecuador	9	11	40	34	35	37	17	37	33	40	40
Kazakhstan	28	35	33	28	26	16	7	26	34	40	22
Brazil	5	8	41	32	40	24	23	30	35	37	37
Armenia	2	4	25	40	34	30	17	8	36	11	31
Dominican Rep.	15	1	43	38	39	42	5	34	37	32	42
Sri Lanka	1	40	35	43	36	34	21	31	38	42	38
Jordan	16	1	31	37	42	42	22	26	39	32	41
Albania	5	12	32	42	41	34	1	5	40	15	39
Azerbaijan	8	3	29	39	38	37	12	25	41	21	33
Moldova, Rep. of	35	28	26	36	25	13	3	2	42	23	25
El Salvador	4	17	39	41	37	39	2	38	43	35	43

Notes: See notes to Table 2.

Table 5
Correlation matrix of domain indices of quality of life

	Dom 1	Dom 2	Dom 3	Dom 4	Dom 5	Dom 6	Dom 7	Dom 8
Dom 2	0.577							
	0.000							
Dom 3	-0.595	-0.530						
	0.000	0.000						
Dom 4	-0.660	-0.371	0.781					
	0.000	0.014	0.000					
Dom 5	-0.701	-0.585	0.813	0.824				
	0.000	0.000	0.000	0.000				
Dom 6	-0.723	-0.431	0.584	0.726	0.726			
	0.000	0.004	0.000	0.000	0.000			
Dom 7	0.419	0.218	-0.584	-0.664	-0.518	-0.398		
	0.005	0.160	0.000	0.000	0.000	0.008		
Dom 8	-0.242	-0.240	0.466	0.212	0.304	0.234	-0.135	
	0.118	0.122	0.002	0.172	0.048	0.132	0.387	
HDI	**-0.491**	**-0.288**	**0.748**	**0.930**	**0.818**	**0.662**	**-0.571**	**0.142**
	0.001	**0.061**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.365**
QOLI*Borda	**-0.165**	**-0.059**	**0.696**	**0.560**	**0.598**	**0.371**	**-0.202**	**0.668**
	0.290	**0.708**	**0.000**	**0.000**	**0.000**	**0.014**	**0.194**	**0.000**
QOLI*PC	**-0.806**	**-0.591**	**0.857**	**0.894**	**0.913**	**0.820**	**-0.621**	**0.359**
	0.000	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.018**
	HDI	**QOLI*Borda**						
QOLI*Borda	**0.624**							
	0.000							
QOLI*PC	**0.813**	**0.544**						
	0.000	**0.000**						

Table 6
Correlation matrix of quality of life indicators rankings

	DR	FS	MS	PGR	IMR	LE	AIDS	TC
FS	0.541							
MS	0.601	0.941						
PGR	-0.569	-0.638	-0.644					
IMR	0.465	-0.518	-0.432	0.564				
LE	-0.224	-0.213	-0.098	0.301	0.846			
AIDS	-0.044	-0.185	-0.271	0.066	-0.243	-0.433		
TC	-0.218	-0.014	0.072	0.125	0.598	0.752	-0.349	
HE	-0.543	-0.494	-0.466	0.665	0.773	0.609	-0.228	0.536
DPR	-0.544	-0.385	-0.504	0.583	0.231	0.039	0.297	0.055
Y	-0.426	-0.213	-0.132	0.260	0.793	0.829	-0.536	0.596
CEU	-0.676	-0.400	-0.382	0.443	0.729	0.624	-0.142	0.520
CS	-0.609	-0.367	-0.352	0.529	0.706	0.570	-0.318	0.433
PH	-0.628	-0.438	-0.394	0.599	0.885	0.781	-0.309	0.586
PR	-0.476	-0.445	-0.359	0.514	0.782	0.725	-0.511	0.517
CL	-0.395	-0.307	-0.200	0.414	0.727	0.699	-0.522	0.508
FALR	-0.670	-0.609	-0.631	0.613	0.659	0.512	-0.011	0.437
MALR	-0.777	-0.717	-0.777	0.704	0.626	0.362	0.118	0.280
UR	-0.500	-0.295	-0.270	0.090	0.364	0.247	-0.188	0.124
CER	-0.541	-0.321	-0.330	0.455	0.708	0.624	-0.265	0.488
FEA	-0.557	-0.416	-0.454	0.515	0.269	0.020	0.211	0.058
TTF	0.660	0.482	0.471	-0.624	-0.754	-0.647	0.312	-0.590
ME	-0.173	-0.197	-0.235	-0.006	0.041	0.080	-0.146	-0.020
CO2	0.662	0.352	0.374	-0.437	-0.609	-0.475	0.016	-0.376
DEF	-0.472	-0.286	-0.423	0.579	0.251	0.166	0.240	0.125
ACH2O	-0.563	-0.350	-0.382	0.559	0.649	0.526	-0.170	0.563
HDI Rank	**-0.491**	**-0.326**	**-0.269**	**0.424**	**0.883**	**0.877**	**-0.441**	**0.619**
QOLI*Borda	**-0.165**	**-0.081**	**-0.057**	**0.390**	**0.644**	**0.745**	**-0.341**	**0.652**
QOLI*PC	**-0.806**	**-0.597**	**-0.591**	**0.681**	**0.786**	**0.610**	**-0.167**	**0.510**

	HE	DPR	Y	CEU	CS	PH	PR	CL
DPR	0.361							
Y	0.566	0.020						
CEU	0.628	0.334	0.782					
CS	0.613	0.310	0.746	0.705				
PH	0.779	0.347	0.818	0.831	0.769			
PR	0.603	0.195	0.704	0.564	0.688	0.767		
CL	0.506	0.054	0.679	0.511	0.639	0.752	0.916	
FALR	0.702	0.479	0.517	0.700	0.567	0.737	0.652	0.549
MALR	0.774	0.547	0.410	0.666	0.538	0.703	0.506	0.401
UR	0.253	-0.018	0.523	0.465	0.540	0.407	0.272	0.271
CER	0.552	0.330	0.661	0.655	0.738	0.793	0.687	0.671
FEA	0.428	0.391	0.078	0.404	0.220	0.416	0.228	0.204
TTF	-0.694	-0.360	-0.708	-0.798	-0.720	-0.854	-0.792	-0.709
ME	0.024	0.184	0.028	-0.061	0.007	0.027	0.292	0.189
CO2	-0.531	-0.331	-0.686	-0.933	-0.626	-0.701	-0.435	-0.373
DEF	0.424	0.675	0.100	0.358	0.436	0.458	0.195	0.136
ACH2O	0.776	0.482	0.507	0.605	0.638	0.694	0.483	0.386
HDI Rank	**0.670**	**0.146**	**0.939**	**0.810**	**0.754**	**0.912**	**0.791**	**0.762**
QOLI*Borda	**0.639**	**0.340**	**0.515**	**0.366**	**0.508**	**0.662**	**0.606**	**0.585**
QOLI*PC	**0.768**	**0.521**	**0.697**	**0.852**	**0.771**	**0.905**	**0.704**	**0.656**

Table 6 continues

Table 6 (con't)
Correlation matrix of quality of life indicators rankings

	FALR	MALR	UR	CER	FEA	TTF	ME	CO2
MALR	0.905							
UR	0.259	0.346						
CER	0.626	0.583	0.368					
FEA	0.557	0.631	0.284	0.306				
TTF	-0.782	-0.696	-0.280	-0.743	-0.354			
ME	0.198	0.130	0.114	0.095	0.018	-0.155		
CO2	-0.647	-0.634	-0.428	-0.531	-0.437	0.669	0.068	
DEF	0.495	0.550	0.108	0.332	0.495	-0.371	-0.056	-0.341
ACH2O	0.620	0.682	0.303	0.602	0.378	-0.661	0.071	-0.524
HDI Rank	**0.662**	**0.568**	**0.444**	**0.798**	**0.240**	**-0.786**	**0.053**	**-0.697**
QOLI*Borda	**0.496**	**0.383**	**0.099**	**0.566**	**0.188**	**-0.517**	**0.221**	**-0.221**
QOLI*PC	**0.842**	**0.851**	**0.474**	**0.808**	**0.565**	**-0.856**	**0.079**	**-0.759**

	DEF	ACH2O	HDI rank	QOLI* Borda
ACH2O	0.459			
HDI Rank	**0.239**	**0.603**		
QOLI*Borda	**0.464**	**0.691**	**0.624**	
QOLI*PC	**0.531**	**0.741**	**0.813**	**0.544**

Annex A: The data sources and measurements of indicators

Domains/indicators	Units	Code	Sources
Divorce rates	per 1,000 people	DR	Nugman (2002)
Male suicide rates	per 100,000 people	MS	WHO (2002)
Female suicide rates	per 100,000 people	FS	WHO (2002)
Annual population growth rate	% (1995-97)	PGR	World Bank (1999)
Infant mortality rate	per 1,000 live births	IMR	World Bank (1999)
Life expectancy at birth	years	LE	World Bank (1999)
AIDS	cases per 100,000 (1997)	AIDS	World Bank (1999)
Tuberculosis	cases per 100,000 (1996)	TC	World Bank (1999)
Public health expenditure	% of GDP (1995)	HE	World Bank (1999)
Number of doctors	per 100,000 people (1993)	DPR	World Bank (1999)
Real GDP per capita	PPP US$ (1997)	Y	World Bank (1999)
Per capita commercial energy use (oil equivalent)	kg (1996)	CEU	World Bank (1999)
Daily per capita supply of calories		CS	World Bank (1999)
Telephone lines	per 1.000 people (1996)	PH	World Bank (1999)
Political rights index	On the scale of 1 to 7 (1 represents the most free, and 7 the least free)	PR	Freedom in the World, 1997-98
Civil liberties index		CL	Freedom in the World, 1997-98
Female adult literacy rate	%	FALR	World Bank (1999)
Male adult literacy rate	%	MALR	World Bank (1999)
Unemployment rate	%	UR	Globastat
Combined 1st, 2nd, and 3rd level gross enrolment ratio	% (1997)	CER	World Bank (1999)
Female economic activity rate (age 15+)	% (1997)	FEA	World Bank (1999)
Total number of offences	number (1997)	TTF	International Crime Statistics, INTERPOL
Military expenditure	% of GDP (1996)	ME	World Bank (1999)
CO2 emissions, per capita	metric tons (1996)	CO2	World Bank (1999)
Average annual rate of deforestation	% (1990-95)	DEF	World Bank (1999)
Population with access to safe water	%	ACH2O	World Bank (1999)

Annex B: Countries in the sample and classification*

Classification (by income group)	Countries in the sample
Low income (US$745 or less)	Armenia
	Azerbaijan
	Moldova
Lower middle income (US$746-US$2,975)	Albania
	Belarus
	Brazil
	Bulgaria
	Dominican Republic
	Ecuador
	El Salvador
	Jordan
	Kazakhstan
	Romania
	Russia
	Sri Lanka
	Thailand
Upper middle income (US$2,976-US$9,205)	Chile
	Croatia
	Czech Republic
	Hungary
	Lithuania
	Panama
	Slovakia
	Uruguay
	Venezuela
High income (US$9,206 or more)	Austria
	Belgium
	Canada
	Denmark
	Finland
	France
	Germany
	Japan
	Kuwait
	New Zealand
	Portugal
	Slovenia
	South Korea
	Spain
	Sweden
	Switzerland
	United Kingdom
	United States

Note: Economies are divided according to 2001 GNI per capita, calculated using the World Bank Atlas Method.

Source: World Bank (1999).