



## Life quality index revisited

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### Abstract

The derivation of the life quality index (LQI) is revisited for a revision. This revision takes into account the unpaid but necessary work time needed to stay alive in clean and healthy conditions to be fit for effective wealth producing work and to enjoyable free time. Dimension analysis consistency problems with the standard power function expression of the LQI are pointed out. It is emphasized that the combination coefficient in the convex differential combination between the relative differential of the gross domestic product per capita and the relative differential of the expected life at birth should not vary between countries. Finally the distributional assumptions are relaxed as compared to the assumptions made in an earlier work by the author. These assumptions concern the calculation of the life expectancy change due to the removal of an accident source. Moreover a simple public acceptance criterion is compared to the LQI criterion.

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*Keywords:* Implied cost of averting a fatality; Life expectancy calculation; Life quality index; Public acceptance criterion

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### 1. Introduction

The life quality index (LQI) is a social indicator suggested by Nathwani et al. [1] to reflect the expected length of “good” life, in particular the enhancement of the quality of life by good health and wealth. The LQI is extensively studied by Rackwitz for its possible role as a mean to obtain the societal affordable level of safety of technical facilities including building structures [2]. The estimation of societal willingness-to-pay for safety is the topic of [3] in which the original derivation of the LQI is given.

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In the context of a paper by the author on decision modeling and acceptance criteria [4], the life quality index was defined in a slightly more general way than in [1,3], in particular focusing on the convex combination coefficient between the contribution to the relative differential of the LQI from the relative differential of the gross domestic product per person and the relative differential of the life expectancy at birth. The author questioned the convenience of the low weight on the money side as compared to the life expectancy side that is advocated both in [1,2]. Herein the definition of the LQI is reconsidered to include the unpaid work time in a more rational way than in [4].

Moreover it is pointed out that an unreasonable dimension property of the standard closed form expressions for the LQI makes the expression inconvenient by giving incorrect comparisons of the LQIs for different countries. The conclusion of the analysis is that the combination coefficient in the differential form should not be a function of the work time ratio valid in any given country, but should be fixed at the same value for all countries. An optimality argument points at a reasonable value of the combination coefficient. It is emphasized that the LQI defined in this paper is an *extension* of the definition used in [1–3]. The notation deviates from the notation in these references.

Finally the calculation of the effect on the life expectancy of removing an accident source is generalized from the exponential distribution to an arbitrary distribution of the waiting time to the occurrence of the accident.

## 2. General definition of the LQI

The definitions in the following relate to the concept of a societal economy, a concept invented as a terminology for this paper. A societal economy has members. The members are all human beings that live and for a part of their life make productive work within a geographical region in which there is statistical homogeneity of wealth and expected life at birth. A societal economy can be thought of as a part of a country, an entire country or a suitably selected group of countries of similar standard of living of their populations. When talking about “average” it relates to average over a considered social economy.

Following the derivation in [4] the LQI is denoted by  $Q$  and is defined in terms of the wealth  $G$  (= gross domestic product (GDP) per person), the life expectancy  $E$  (= mean life time of a person assessed at birth), and the work time ratio

$$w = \frac{T_{\text{work}}}{T_{\text{work}} + T_{\text{free}}} = \frac{T_{\text{work}}}{\text{active day time}}, \quad (1)$$

where  $T_{\text{work}}$  is the average total paid or unpaid work time and  $T_{\text{free}}$  is the free time per day adding up to “active day time” = 16 h. The revision of the LQI comes in here by defining work free time not only as the time in which the person does not contribute to  $G$ , but more generally as the time where the person enjoys life without doing either the  $G$  producing work or the necessary unpaid work needed to stay in life in good healthy and clean condition. Since sleep time in general is necessary time for all persons in order both to do work and to enjoy life, the relevant total time is set to 16 h per day and not as in the present literature set to 24 h per day.

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