

# Comparing Countries' Life Satisfaction and Their Level Curve of Life Satisfaction over Time: An Analytical Framework

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**How to cite this paper:** Bouare, O. (2017). Comparing Countries' Life Satisfaction and Their Level Curve of Life Satisfaction over Time: An Analytical Framework. *Psychology*, 8, 2346-2376.  
<https://doi.org/10.4236/psych.2017.814148>

**Received:** August 8, 2017  
**Accepted:** December 5, 2017  
**Published:** December 8, 2017

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## Abstract

Life satisfaction or happiness is an elusive concept, making it difficult to aggregate, measure and compare at a country level. Therefore, we propose an analytical framework, which can determine life satisfaction and the level curve of life satisfaction over time in countries. We then address four countries as cases: the Netherlands, the UK, Belgium and France. The Netherlands has the highest ranking of life satisfaction by year and the level curve of life satisfaction over 1986-1995. This analytical framework allows for the direct intercession of a country's legislator on welfare issues, strengthening social cohesion that may foster country's economic development.

## Keywords

Life Satisfaction, Life Dissatisfaction, Level Curve of Satisfaction over Time, Unit of Measurement

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## 1. Introduction

In the 20<sup>th</sup> century, attempts of social reform influenced efforts to create welfare-states in order to provide a good life for everybody, particularly a good material standard of living. With the improvement of people's living standard, life satisfaction has become a hot topic. However, life satisfaction or happiness is an

elusive concept due to its subjective nature.<sup>1</sup> For many people it is an ultimate goal. Even in the United States of America's Declaration of Independence, there is a reference to "the pursuit of happiness". Life satisfaction however is never complete or constant because an individual's state of life satisfaction is relative to his or her subjective assessment, which depends on the evolving environment in which he or she lives. If the state of life satisfaction, happiness or pleasure was to be constant, life would become monotonous. In addition, as opposed to dissatisfaction, satisfaction is unimaginable without dissatisfaction, just as Paradise is unimaginable without Hell, because one loses meaning without the other. These features of life satisfaction make its construct and definition difficult.

However, since the state of life satisfaction may be at different degrees for different people, it needs to be defined. Defined simply, life satisfaction is "the degree of well-being experienced by individuals or aggregates of people under prevailing social and economic conditions" (Møller & Schlemmer, 1983). This makes the aggregation and cardinal measurement of life satisfaction problematic at a country level in general,<sup>2</sup> and a comparison of countries' life satisfaction even more problematic over time. This paper therefore proposes an analytical framework to aggregate, measure and compare countries' life satisfaction as well as their level curve of life satisfaction over time.

In the first part, we review the literature. Next, we discuss ways to compare countries' life satisfaction. We then suggest a means to compare countries' level curve of life satisfaction over time. This is followed by the section on discussion and conclusion. Finally, we present some limitations of the study and future research.

## 2. Literature Review

There is a voluminous literature on life satisfaction and happiness, including sociology, psychology and economics. The forerunners of the introduction of psychology into economics were Hume (Lyon, 1970), Bentham (Ekelund Jr &

<sup>1</sup>This paper is concerned with life satisfaction. However, we will refer to "happiness" from time to time because it is often used by researchers due to its close relationship with life satisfaction. According to Veenhoven, "The word 'happiness' ... is used interchangeably with terms like "well-being" or "quality of life" and denotes both individual and social welfare" (2012: p. 334). Happiness could be defined in the sense of Veenhoven as "the degree to which a person positively evaluates the overall quality of his/her life as-a-whole" (1996). According to Argyle (1987), "[h]appiness can be understood as a reflection on satisfaction with life, or as the frequency and intensity of positive emotions" (13). It follows that studies of "happiness" or "life satisfaction" will yield different results. Moreover, happiness can be a major factor affecting life satisfaction. For instance, one may be on balance unhappy but satisfied with life because of making contributions to advance the happiness of others (Ng, 2000). On empirical grounds, Di Tella et al. (2003) using *Eurobarometer Surveys* series reported that the correlation coefficient between happiness and life satisfaction is 0.56 for the period 1975-86 (4). In our study, we will use life satisfaction because the questionnaire administered to respondents was on life satisfaction. However, even if happiness were used, it would not undermine the generality of our analysis. This is so because the technique used to determine a unit of measurement for life satisfaction or happiness will remain the same although the percentage of respondents who are satisfied with life and that of those who are happy will be different.

<sup>2</sup>It should be noted that Ng proposed an interesting cardinal measurement of happiness based on a sophisticated survey of graduate students (Ng, 1996). However, due to the level of sophistication of the questionnaire, it may be difficult to use Ng's technique with people whose level of education is low.

Hébert, 1990) and Keynes with the concepts such as the propensity to consume, marginal efficiency of capital and liquidity preference (Keynes, 1936). More recently, these scholars were followed by Easterlin (2002, 1974), Kahneman et al. (1997), Frey & Stutzer (2000a, 2000b), Di Tella et al. (2003, 1998), Helliwell (2003) and Layard (2003).<sup>3</sup> We selected some of these for an overview before proceeding with the aggregation, measurement and comparison of countries' life satisfaction.

The scientific engagement with satisfaction vs. dissatisfaction or pleasure vs. pain can be traced back to Adam Smith and Jeremy Bentham's interpretation of the principle of utility or self-interest. Smith championed the idea of *the natural identity of interests*, which placed a great deal of confidence in natural order and harmony. He believed that the individual self-interests of human nature harmonize on their own accord in a free economy; consequently, his basic prescription essentially promoted a laissez faire policy (Ekelund Jr & Hébert, 1990) even if he stressed that when people in the same trade meet on social occasions they often conspire against the public interest.

Bentham, however, admitted that individuals are self-interested, although he denied any natural harmony of egoism. Crime, for example, provides a case of self-interested behaviour that violates public interests. The central tenet of Bentham's philosophy, therefore, was that the interest of each individual must be in line with the general interest, and that it is the business of the legislator to bring about this alignment through direct intercession. Thus, it was in the form of *the artificial identity of interests* framework that Bentham first adopted the utility principle. His doctrine is known as utilitarianism.<sup>4</sup>

Utilitarianism added to hedonism the ethical doctrine that human conduct should be directed towards maximizing the happiness of the greatest number of people: "the greatest happiness for the greatest number" was the catch phrase of the utilitarians.<sup>5</sup>

According to Bentham and the utilitarians, the general interest of the community is measured by the sum of the individual interests in the community.<sup>6</sup>

There are several analytical difficulties in Bentham's theory, among them "interpersonal comparisons" of utility. That is, one man's happiness may be another man's distress.<sup>7</sup> Another problem in Bentham's theory concerns the weighting

<sup>3</sup>This renewed interest is presumably due to the impact of economics on life satisfaction: the increase in demand and supply when consumers and producers' confidence is high concerning future prospects in life or life satisfaction, the availability of data, and a need for a better measurement of life satisfaction in order to more accurately assess the relationships between life satisfaction and economics.

<sup>4</sup>This doctrine bears a resemblance to the ancient Greek philosophy of hedonism, which also held that moral duty is fulfilled in the gratification of pleasure-seeking interests. But hedonism prescribes individual actions without reference to general happiness.

<sup>5</sup>This phrase can be traced back to "Scottish Enlightenment." According to John Rae (2003), the original author of that famous phrase is Francis Hutcheson, beloved Adam Smith's professor at Glasgow College.

<sup>6</sup>The utilitarian approach was both democratic and egalitarian. Each individual interest was to receive equal weight in the measurement of general welfare. Thus, if something adds more to a peasant's pleasure than it subtracts from the happiness of an aristocrat, it is desirable on utilitarian grounds. Likewise, if a government action enhances the happiness of the community more than it diminishes the happiness of one subset, intervention is justified.

<sup>7</sup>The fact that different individuals have different tastes, incomes, goals and ambitions makes comparisons of utility (gained or lost) between individuals difficult by any objective criteria. Bentham recognised this difficulty, but felt that such comparisons must be made, or else social reform is impossible. His welfare theory is therefore subjective (i.e. normative) in content.

of qualitative pleasures. Do pleasures of the mind, for instance, receive more or less emphasis than pleasures of the body? Bentham could not resolve this question. In addition, there is a shortcoming in Bentham's theory: the "fallacy of composition." This fallacy entails the assertion that because something is true for a part, it is also true for the whole, or that the collective interest is the sum of individual interests (Ekelund Jr & Hébert, 1990). However, one can overcome some of these analytical difficulties at a country level if an appropriate weight can be determined. The realization that interpersonal comparisons are necessary for normative issues of economic policy has led to renewed interest in Bentham's concept of measurable and interpersonally comparable utility (Kahneman et al., 1997; Muller, 2003). Thus, there has been an increased interest in studies assessing the relationship between socio-economic factors and happiness (e.g. Clark & Oswald, 1994; Gerdtham & Johannesson, 2001; Theodossiou, 1998; Winkelmann & Winkelmann, 1998). Diener & Lucas (2000) presented an excellent and comprehensive literature review on the differences in societal levels of happiness, need fulfilment, relative standard, culture and evaluation theory.<sup>8</sup>

Although the sociological construct of life satisfaction or happiness is not complete and its determinants are not fully exhibited, its measurement has been underway for a long time, presumably because subjective indicators may be used as social and economic policy tools if they are refined to reach a high degree of accuracy (Møller & Dickow, 2002; Møller, 2001). This may allow for the refinement of social indicators. Happiness has been measured since the 1960s.<sup>9</sup> A

<sup>8</sup>After a thorough review of these theories, Diener and Lucas (2000) propose an evaluation theory. According to their proposed evaluation theory, subjective well-being refers to the summation of evaluative reactions that occur when an individual encounters external stimuli. Evaluation theory also acknowledges that there are basic individual differences in the way people react to information from an environment. In summary, evaluation theory maintains that subjective well-being results from the evaluations of incoming information that has relevance for well-being. Certain types of information are likely to be chronically salient, and therefore have ongoing effects: the meeting of goals and biological needs, and cultural norms. Other types of information such as comparison to others or comparison to one's past will be relevant in evaluating one's well-being in specific circumstances. Over time, a person's processing of information in terms of the meaning and values he or she attaches to it will be the paramount factor governing long-term subjective well-being.

<sup>9</sup>The so-called "happiness surveys" undertaken by Gurin et al. (1960) and Bradburn and Caplovitz (1965) to assess global well-being were the forerunners of the later in-depth studies of psychological well-being. The latter were conducted by Campbell et al. (1976) among others, who also experimented with the use of affective mood indicators in measuring contentment in more specific domains and spheres of life. However, Drewnowski's (1974) first attempt at compiling comprehensive measures of well-being set the stage for universally applicable development programs aimed at raising the level of living of the world's poor. The so-called "basic needs" approach to development succeeded in attracting a large number of policy makers as well as social scientists. Generally, development targets in the basic needs strategy fall into two separate but complementary need categories:

1) Personal consumption needs such as food, shelter, and clothing; and 2) Essential public services such as health, sanitation, clean water, education, transport and cultural facilities. (For further information, see Streeten, 1977; Lisk, 1977; Ghai et al., 1977; and International Labour Office, 1977). The prospects of adopting a basic needs strategy in the South African situation are discussed by Natrass (1979) and Simkins (1980) among others.

It should be noted that the "absolute" indicators distinguished by Kamrany and Christakis (1970) refer only to those categories of "scientific indexes" on which experts have reached substantial agreement. In other words, normative judgments are always involved in determining scale values in quality of life measurements.

There is little agreement on absolutes, zero points and saturation thresholds with the possible exception of a lower-level threshold described as a "zero-level" or "survival with nil need satisfaction" by Drewnowski (1974), which is associated with a sub-human level of existence. By contrast, a "human" but minimum level of need satisfaction is only guaranteed when "basic needs" are met.

It is conventional practice not to assign an optimal value to social indicators—perhaps a subtle means of implying that development is open-ended. Beyond the saturation point, which Drewnowski (1974) refers to as the "affluence" level, further system inputs directed towards improving well-being in a particular sphere of life may be without increased utility for welfare and may therefore represent a waste of system resources. Once the "affluence" level has been achieved, further system inputs may even result in depressed well-being (for example, excessive intake of calories may harm rather than improve physical and mental health).

striking example of a measurement technique aimed at capturing the subjective component in defining the qualities of life is Cantril's (1965) "self-anchoring" scale. Subjects were required to describe their life situation in relation to the "best" and "worst" worlds imaginable to them. More recently, Møller and Schlemmer (1983) proposed the index of "felt privation", which was computed by dividing the percentage in each group adjudging an item to be among the 30 - 40 most important by the percentage expressing satisfaction with the issue. A minimum index of 1.0 was taken as the cut-off point. Finally, Veenhoven also proposed the measurement of average happiness across nations in *World database of happiness, Catalogue of Happiness in Nations*. In discussing the rationale of measurement of average happiness in Chapter 5 (Validity of happiness as indicator of livability) of the introductory text of Happiness in Nations (*World database of happiness*), Veenhoven argued that: "[t]he observed differences in average happiness between nations do not seem to result from cultural bias in its measurement. It is also unlikely that they result to a great extent from cultural variation in outlook on life. All in all, it is fairly probable that the differences in happiness, as observed in survey studies, do reflect differences in livability of nations" (emphasis added).

However, this does not mean that the observed differences in average happiness reflect differences in the livability of nations, nor does it mean that cultural variation in outlook on life has nothing to do with these differences.

This literature review suggests that a theory of happiness or life satisfaction needs a further sociological construct. In this regard, evaluation theory seems to be moving in the right direction. However, the measurements proposed remain relevant only within a single country. This is because life satisfaction or happiness is influenced by different factors in each country, and developed countries with similar livability conditions, for example, display a different average of happiness (see e.g. *World database of happiness*; Inglehart & Rabier, 1986; Veenhoven, 1991). In addition, Easterlin found that "[t]he happiness differences between rich and poor countries that one might expect on the basis of the within-country differences by economic status are not borne out by the international data" (1974: 106-7).<sup>10</sup> Di Tella et al. (1998, 2003) reduced biases due to culturally determined response behaviours by using country fixed effects. Helliwell (2003) also used fixed effects to reduce biases due to culturally determined response behaviours but at regional levels. Although this technique is appealing in using a regression equation for cross-sectional studies, the coefficients of individual-specific dummy variables, which include unobserved effects, could give an almost perfect but meaningless fit, i.e. could include the effect of other unobserved

<sup>10</sup>For further information on happiness, see Easterlin (2002). Moreover, Suh et al. (1998) found that emotions played less of a role in life satisfaction judgments among collectivists than it did among individualists. If so, individual needs and goals may be sacrificed for the good of a collective goal, resulting in lower subjective individual well-being. Thus, culture in a collectivist Asian country may differ in the value it places on experiencing affective well-being than that in an individualist country such as the U.S. However, in a collectivist society, individual well-being may be improved due to mutual support among individuals, which provides a feeling of belonging to society that strengthens social cohesion.

variables that have little to do with countries' cultural fixed effects. [Kapteyn et al. \(2007\)](#) and [Kristensen et al. \(2008\)](#) used anchoring vignettes technique to study cross-country differences in self-reports of work disability and job satisfaction, respectively. However, this technique hinges on the assumption of "vignette equivalence", i.e. "[t]he domain levels represented in each vignette are understood in the same way by all respondents, irrespective of their country of residence or other socio-demographic variables" ([Kristensen et al., 2008](#)). Kristensen et al. attempted to overcome this assumption by including more covariates in a chopit model, which provided them with a change in countries' ranking; here the difficulty is that their results depended on the inclusion of more covariates and the choice of these covariates.

In their National Accounts of Well-being (NAWB), departing from the single question on whether respondents were satisfied with their life, which was generally a means for measuring well-being, [Michaelson et al. \(2009\)](#) argued that "because [NAWB] are not limited to measures of life satisfaction, they provide a more textured approach to understanding, what contributed to people's well-being and therefore a basis for further exploration and action" (14). They went on to argue that "The practical up shot of all of this for well-being measurement is that attempting to assess a psychological state using a single question such as the satisfaction is to invite a relatively high degree of measurement error. Combined with the observation that the multifaceted nature of well-being means that in reality, it is unlikely to consist of one single internal state, this makes a strong case for using a range of different measures" (55-56).

As components of national well-being or profiles to be measured, [Michaelson et al. \(2009: 21-35\)](#) proposed: personal well-being (emotional wellbeing—positive feelings, emotional wellbeing—absence of negative feelings, satisfying life, vitality, resilience & self-esteem, positive functioning) and social well-being (supportive relationships, trust and belonging).

Echoing [Michaelson et al.'s \(2009\)](#) view point, as a future research direction, [Forgeard et al. \(2011\)](#) suggested a "dashboard [approach] of measures and indicators that can help us understand our strengths... Thus, [they] recommend that future measures of wellbeing present their results in a way that takes advantages of the variety of constructs that are measured" (97-98).

The difficulty with the "dashboard approach" of [Michaelson et al. \(2009\)](#) and [Forgeard et al. \(2011\)](#) is that their components of well-being are not uncorrelated, i.e. they are not independent. This makes these components unfit for measuring well-being in more than a one-dimensional space of well-being, because the independence of the elements of a space's basis is necessary for measurement within the space. [Michaelson et al. \(2009\)](#) encountered this difficulty, when they acknowledged that "Attempt to use the statistical patterns of the responses to validate our structure was made using factor analysis, however these were dominated by responses code effects and did not provide conclusive evidence about the underlying structure of well-being" (59).

Moreover, it would be difficult for Michaelson et al. (2009) and Forgeard et al. (2011) to find, in the domain of psychology, a set of uncorrelated or independent components used as a basis for a multidimensional space of well-being. In other words, the dashboard approach does not provide a compelling measurement of well-being.

Furthermore, according to Michaelson et al. (2009), “*satisfying life* [is] showing a much larger range than other components. This seems to provide some justification for the way in which satisfaction-based indicators have often been treated as outcome measures in well-being research in that they seem both to summarize people’s overall sense of their personal well-being and to distinguish between those at different ends of the distribution” (29). Therefore, one must go “back to” life satisfaction as the bedrock of the measurement of well-being.

However, an analytical framework enabling the comparison of countries’ life satisfaction or happiness is still missing in literature. Oguz, Merad and Snape (2013) proposed a measurement of the UK’s national well-being. However, it was not designed to compare well-being among countries. Oishi (2010) also suggested in his conclusion the need of a new measurement tool for international comparison of well-being. Furthermore, OECD (2013: p. 52) suggested that further research is needed to inform the best approach to international comparison.

To fill this gap, we determine a unit of measurement of countries’ life satisfaction which is the “umbrella” of satisfaction by using traditional technique of weighted average, which is also easier to implement. Thus, the determination of a unit of measurement by using an appropriate weight for each country will enable the comparison of countries’ life satisfaction and their level curve of life satisfaction over time. To our knowledge, this has not been attempted in previous research.

### 3. Comparing Countries’ Life Satisfaction

Here we use a survey questionnaire item to determine countries’ expressed life satisfaction and dissatisfaction (see **Appendix A**). Combined with the weighted average technique, this enables the determination of the unit of measurement of national life satisfaction and the comparison of countries’ life satisfaction. In the weighted average technique, the random variable, i.e. the subjective expressed life satisfaction, has a value in each country with a probability corresponding to an adjusted weight based on an objective value of each country’s suicide rate.<sup>11</sup> Indeed, this technique, which determines the average value of a random variable, homogenizes the values of the random variable with their multiplication by their respective weights so that they can be added together on the numerator of the weighted average. That is, this technique, applied to the subjective expressed life satisfaction, homogenizes the countries’ cross-cultural differences because each

<sup>11</sup>The connection between external manifestations and internal states of mind was raised by Easterlin, when he stated: “Or one may seek to gauge well-being from various behavioral indicators, for example, measures of the prevalence of social disorganization (delinquency, suicide, and so forth). Ultimately, however, the relevance of such measures rests on an assumed connection between external manifestations and internal states of mind—in effect, on a model of human psychology” (1974, 117, emphasis added).

value of the subjective expressed life satisfaction is multiplied by its respective weight.

### 3.1. Determination of Countries' Satisfaction with a Survey Questionnaire Item

To determine countries' expressed satisfaction, we use a four-point scale questionnaire item and regroup the responses into two categories: "satisfied with life" and "dissatisfied with life".<sup>12</sup> Diener (1984) found that people reporting themselves as very happy tend to be rated by those around them as being happy. Frey and Stutzer (2002a, 2002b) also reported that self-reported happiness is the best indicator of happiness. The standard questionnaire item is thus as follows:<sup>13</sup>

This questionnaire item will be used throughout a country. The number of respondents who are very satisfied or satisfied with life will be placed in the category "satisfied with life", while those who are dissatisfied or very dissatisfied with life will be placed in the category "dissatisfied with life".<sup>14</sup> Thus, we will obtain the percentage of people expressing satisfaction and dissatisfaction with life in a country. Assume the following example:

If researchers are concerned about the accuracy of self-reported happiness or

**Table 1.** Questionnaire item for life satisfaction.

Please tick one row	
1	Very satisfied with life
2	Satisfied with life
3	Dissatisfied with life
4	Very dissatisfied with life

**Table 2.** Percentages of satisfied and dissatisfied people with life.

Categories	Percentage
Number of people satisfied with life	60 = (SA)
Number of people dissatisfied with life	40 = (DSA)
Total	100 = (SA + DSA)

<sup>12</sup>To make the study clearer, the respondents are divided among two categories: "satisfied with life" and "dissatisfied with life". However, to ensure that respondents easily find a box that corresponds to their respective situations, we use a four-point scale questionnaire and regroup "satisfied with life" and "very satisfied with life" in one category, while "dissatisfied with life" and "very dissatisfied with life" are put in the other category even if one may perceive it as a loss of information. We also use "life satisfaction" in the text instead of "satisfaction with life" to make it pithier.

<sup>13</sup>If the study is based on "happiness" instead of "satisfaction with life", "satisfied with life" and "dissatisfied with life" should be replaced by "happy" and "unhappy" respectively in **Table 1** and **Table 2**.

<sup>14</sup>The division in two categories is used because Veenhoven stated: "Though responses seldom change from "happy" to "unhappy", switches between "very" and "fairly" are rather commune" (2012: p. 335).



practice in survey questionnaires.<sup>15</sup>

### 3.2. Determination of Countries' Unit of Measurement of Satisfaction

Suppose we want to determine a unit of measurement of life satisfaction in  $n$  countries ( $1, 2, \dots, n$ ). One cannot use a simple average of the percentage of people satisfied with life in  $n$  countries because satisfaction is influenced by different factors in each country.<sup>16</sup> Therefore, the issue is to construct an average weighted satisfaction ( $AWSA$ ) among countries that enables the comparison of the adjusted weighted satisfaction ( $JWSA$ ) of each country to this  $AWSA$ , which will become a unit of measurement of satisfaction among countries. The construct must fulfil two criteria: the weight must be specific to each country and  $JWSA$  must counter countries' cross-cultural differences of life satisfaction.<sup>17</sup> To do so, we propose a proxy weight for dissatisfaction based on the suicide rate and the percentage of very dissatisfied people to determine the unit of measurement and a probability distribution of life satisfaction and dissatisfaction or correction factors, which counter countries' cross-cultural differences of life satisfaction and dissatisfaction.

Within this context, the question is to find an appropriate weight for life satisfaction and dissatisfaction specific to each country. For instance, extreme life dissatisfaction may be a factor in taking one's life.<sup>18</sup> Since the suicide rate is

<sup>15</sup>The extensive explorations into the validity of measures of well-being conducted by Andrews and Withey (1976: p. 175-217) among others have focused on what is usually referred to as "construct validity" or "internal validity". A case is made here for an external validity check. For example, Campbell et al. (1976: p. 199-207) compared fluctuations in domain satisfaction in a limited number of cases in which external circumstances had significantly changed (between observations). A validation check may be used to establish the reliability of the findings given the limited number of cases. For further supports of the reliability and validity of subjective well-being measurement one can refer to Schimmack & Oishi (2005: p. 404), Diener, Inglehart & Tay (2012), and OECD (2013: p. 21).

<sup>16</sup>One could consider determining an index for life satisfaction which includes multiple factors affecting satisfaction in a country. This is not necessary however, because as we have seen the expressed life satisfaction of respondents is a good indicator for life satisfaction in a country. The issue here is rather the determination of a unit of measurement which enables us to compare the expressed life satisfaction between countries.

<sup>17</sup>It should be noted that the construction of an index of measurement is not unusual in economics or social sciences. One could think for instance of the Pareto index, Theil index or the Human Development index.

<sup>18</sup>Although causes of suicide may be complex (e.g. socio-economic factors, alcohol and other drug abuse, feelings of hopelessness, depression, chemical imbalances within brain functions, psychological disorders, schizophrenia), suicide remains a planned rational decision or the result of an instinctive irrational decision. In either case, for a person who commits suicide, life is not worth living. In other words, he or she is dissatisfied with life at the point in time in which he or she ends his or her life. It also follows that people who are satisfied with life do not by and large commit suicide because for them, life is worth living. Several mechanisms might explain the association between life satisfaction and suicide. Within this context, stability of subjective well-being and life satisfaction has been previously reported (e.g. Koivumaa-Honkanen et al., 2001; Koivumaa-Honkanen et al., 2000; Haight & Hendrix, 1998; Moscicki, 1995; Sorenson, 1991; Canetto, 1991; Headley, 1989; Fawcett et al., 1987; Inglehart & Rabier, 1986).

It should be noted however that some people may say that they are satisfied with life but do commit suicide. This could be due to a sudden change in life circumstances within a cultural context that makes them suddenly dissatisfied with life to the extent that life is not worth living for them. One could think of Japanese society in which some people commit suicide (*hara-kiri*) when they feel dishonored. This was brought to my attention by John Barkley Rosser, Jr. In a final analysis, dissatisfaction with life at a given point in time appears to be influenced by socio-economic and cultural factors, which may in an extreme case lead to suicide. The suicide rate thus depicts by and large a socio-economic and cultural content related to levels of dissatisfaction in a given culture. It could be argued that suicide is not just an expression of extreme life dissatisfaction. To clarify this issue, let us consider for instance three factors such as long-time unemployment (A), alcohol and drug abuse (B) or depression (C), which may lead to suicide in a given cultural context through extreme life dissatisfaction. Formally, we can write for instance: Factor A may imply extreme life dissatisfaction; factor B may imply extreme life dissatisfaction; factor C may imply extreme life dissatisfaction; and extreme life dissatisfaction in turn may imply suicide. Even though causes of suicide are complex and could be due to several factors (here three factors), one can say that extreme life dissatisfaction may be conducive to taking one's life, since complex factors may imply extreme life dissatisfaction, which in turn may imply suicide.

country specific,<sup>19</sup> this suggests that a proxy weight for dissatisfied people who will commit suicide in any given year ( $RS$ ) may be the country's suicide rate. This idea has an empirical foundation in Finnish data. According to Helliwell, "in one large Finnish sample those with below-average life satisfaction were four times more likely than others of the same age to commit suicide over the following ten years" (2004: p. 2). One may want to use other objective health outcomes such as anxiety, stress, high blood pressure and psychiatric conditions to rescale survey reports. However, the criterion which determines with certainty and objectivity whether a person is dissatisfied with life is suicide. This enables to anchor  $RS$  to those who said that they are dissatisfied with life and committed suicide.

However, one needs to find a proxy weight for dissatisfied people not committing suicide that given year, because dissatisfied people comprise those who will commit suicide and those who will not. In some religions, suicide is forbidden and families are ostracized when one of its members commits suicide. This may prevent some dissatisfied people who believe in these religions from committing suicide. Again, in this case, people who defied the established rule to commit suicide must have experienced an extreme dissatisfaction with life within their cultural context. The rate of suicide in these cultural contexts will be commensurate with levels of dissatisfaction within these cultures. It should be pointed out that this will be the case for any objective criterion, because countries have simply different cultural characteristics. This is why we are constructing an appropriate weight for both dissatisfaction and satisfaction for each country.<sup>20</sup> Suppose that this proxy weight is  $P$ . Since  $P$  is a positive real number, one can always find another positive real number,  $C$ , so that  $P$  is equal to  $C$ , multiplied by  $RS$ , i.e.  $P = C \cdot RS$ . However, the weight that dissatisfied people attach to suicide is generally greater than that attached to dissatisfaction because suicide may be the extreme outcome of life dissatisfaction. Otherwise, if dissatisfied people did not attach more weight to suicide than dissatisfaction, majority of them would have committed suicide. This however is not the case. That is, as an extreme outcome, those who are very dissatisfied with life commit suicide. Moreover, the proxy weight for dissatisfied people committing suicide must be

<sup>19</sup>According to Eckersley and Dear (2002), correlations between suicide and other possibly relevant cultural variables, such as tolerance of suicide, belief in God and national pride, are not significant. Although suicide and cultural variables may not be statistically significant in their work, as stated before they are related to one another. Moreover, the suicide rate is country dependent. See WHO (1989, 1990, 1991, 1994) and WHO (1999).

<sup>20</sup>One could also argue that instead of using suicide rate alone, one could add other objective health outcome variables such as anxiety, stress, high blood pressure, psychiatric conditions and the like to improve the cross-cultural comparisons. However, this analysis seems incorrect for the following reasons. Indeed, beside solving the problem of adding more objective and heterogeneous variables which are not only unnecessary to construct a weight for dissatisfaction, but adding more of these variables does not tell us more objectively and with more certainty whether a person is dissatisfied with life than suicide does. Therefore, there is no point of adding other objective variables to construct the weight for dissatisfaction. Within this context, it should be noted that determining a weight for dissatisfaction is different from estimating dissatisfaction with a set of independent objective variables.

greater than those not committing suicide. As a result, for  $P$  to be positive and smaller than  $RS$ ,  $C$  must be positive and smaller than one. Therefore, a plausible candidate for  $C$  may be the positive correlation coefficient ( $\rho$ ) between the percentage of very dissatisfied people variable and the suicide rate variable, which is less than one since all dissatisfied people do not commit suicide.<sup>21</sup> It follows that a proxy weight for dissatisfied people but not committing suicide that given year may be  $P = \rho \cdot RS$ , because  $\rho$  is related to dissatisfied people. The estimates of  $\rho$  will indicate whether  $\rho$  is positive, i.e. whether the empirical foundation of our idea of anchoring suicide rate to dissatisfied people is relevant.

Thus, a proxy weight for dissatisfied people may be that for dissatisfied people who will commit suicide plus that of dissatisfied people who will not commit suicide in a given year, i.e.  $RS + \rho \cdot RS = RS(1 + \rho)$ .<sup>22</sup> One could think of  $RS \cdot (1 + \rho)$  as the weight attached to dissatisfaction in a country and which is country specific.<sup>23</sup> It should be noted that the determination of this weight does not concentrate on only the value of extreme dissatisfaction, but on the extreme and non-extreme dissatisfaction, i.e. on dissatisfaction.

$RS \cdot (1 + \rho)$  can be written as  $RS \cdot (1 + \rho) = RS \cdot (1/2) \cdot V \left[ (RS/\sigma_{RS}) + (VDSA/\sigma_{VDSA}) \right]$ , where  $V$  is the variance, and  $RS/\sigma_{RS}$  and  $VDSA/\sigma_{VDSA}$  are the suicide rate variable and percentage of very dissatisfied people variable divided by their standard deviations, respectively.<sup>24</sup>

Thus, our proxy weight for dissatisfied people in a given year can also be seen as the suicide rate that year multiplied by half the variance of the sum of the suicide rate variable and percentage of very dissatisfied people variable whose variances are equal to one (i.e. normalized), and whose covariance,

$COV \left[ (RS/\sigma_{RS}), (VDSA/\sigma_{VDSA}) \right]$ , reflects the specific relationship between suicide rate and percentage of very dissatisfied people within a country.

<sup>21</sup>We do not mean that  $C$  is equal to  $\rho$ . We simply mean that  $C$  could be its proxy. It should be noted that Bray and Gunnell (2006) found that correlations between suicide rate and life satisfaction could be negative. However, Bray and Gunnell (2006) used Spearman's rank correlation, which is different from the linear correlation  $\rho$  we used in our study.  $\rho$  is positive because the suicide rate variable and the percentage of very dissatisfied people variable move in the same direction.  $\rho$  can be seen as the slope of the regression line of the suicide rate and the percentage of very dissatisfied people variables, which are normalized.

<sup>22</sup>It should be noted here that the sum of the two weights is not equal to 1, because the weights are not probabilities. Instead, one could think for instance of the weights attached to the numerical grades obtained in mathematics (weight x Grade = 2 times 70) and philosophy (weight x Grade = 5 times 95) by a high school student in the field of literature (or whose major is literature) in order to compute his or her weighted grade point average.

<sup>23</sup>It is quite exceptional that an annual suicide rate of a country be equal to zero. However, in the event that this occurred, the weight attached to dissatisfaction  $RS(1 + \rho)$  becomes equal to zero. In this case, one needs a change in the referential of suicide rates ( $RS$ s) for each country from 0 to the average suicide rate  $ARS$  of the study period or to make a translation of coordinate  $ARS$  so that the new weight for dissatisfaction becomes  $[ARS + RS](1 + \rho)$  instead of  $[0 + RS](1 + \rho) = RS(1 + \rho)$  or  $[RS + ARS](1 + \rho)$  instead of  $[RS](1 + \rho) = RS(1 + \rho)$ . For the rest of our study, we will consider  $RS(1 + \rho)$  as the weight attached to dissatisfaction because suicide rates are all different from zero in our data.

<sup>24</sup>See **Appendix A**.

Normalizing the weights for dissatisfaction and satisfaction so that their sum equals one, i.e. ( $[RS(1+\rho)]$  + proxy weight for satisfaction = 1), it follows that a proxy weight for satisfaction in a country in a given year is one minus the suicide rate ( $RS$ ) that year multiplied by one plus the correlation coefficient, i.e.  $[1 - RS \cdot (1 + \rho)]$ . Similarly, one could think of  $[1 - RS \cdot (1 + \rho)]$ <sup>25</sup> as the weight attached to satisfaction in a country and is country specific. Thus, the weight attached to satisfaction in a country is derived from the weight attached to dissatisfaction in the same country.

Let us refer to the percentage of people satisfied with life in  $n$  countries as  $SA_1, SA_2, \dots, SA_n$  and one minus the suicide rate ( $RS$ ) multiplied by  $(1 + \rho)$  in  $n$  countries as  $[1 - RS \cdot (1 + \rho)]_1, [1 - RS \cdot (1 + \rho)]_2, \dots, [1 - RS \cdot (1 + \rho)]_n$ . Thus, the weighted satisfaction for country  $i$  is  $[\{1 - RS \cdot (1 + \rho)\}_i] \cdot SA_i$ ,  $i = 1, 2, \dots, n$ . In other words,  $[1 - RS \cdot (1 + \rho)]_i$  is the weight attached to  $SA_i$ . While the average weighted satisfaction ( $AWSA$ ) for  $n$  countries is

$$AWSA = \left[ \sum_{i=1}^n \{1 - RS \cdot (1 + \rho)\}_i \cdot SA_i \right] / \left[ \sum_{i=1}^n \{1 - RS \cdot (1 + \rho)\}_i \right] \quad (1)^{26}$$

$AWSA$  will be our unit of measurement for life satisfaction.

Similarly, the weighted dissatisfaction for country  $i$  is  $[\{RS \cdot (1 + \rho)\}_i] \cdot DSA_i$ ,  $i = 1, 2, \dots, n$ . While the average weighted dissatisfaction ( $AWDSA$ ) for  $n$  countries is

$$AWDSA = \left[ \sum_{i=1}^n \{RS \cdot (1 + \rho)\}_i \cdot DSA_i \right] / \left[ \sum_{i=1}^n \{RS \cdot (1 + \rho)\}_i \right] \quad (2)^{27}$$

Similarly,  $AWDSA$  will be our unit of measurement for life dissatisfaction.

The adjusted weight,  $[\{1 - RS \cdot (1 + \rho)\}_i] / \left[ \sum_{i=1}^n \{1 - RS \cdot (1 + \rho)\}_i \right]$ , of satisfac-

<sup>25</sup>Again, in the case where  $RS = 0$ , the weight attached to satisfaction should be

$\{1 - [(ARS + RS)](1 + \rho)\}$  instead of  $\{1 - RS(1 + \rho)\} = \{1 - [0 + RS](1 + \rho)\}$ . Again, for the rest of our study, we will consider  $\{1 - RS(1 + \rho)\}$  as the weight attached to satisfaction because suicide rates are all different from zero in our data.

<sup>26</sup>Again, there may be a different assessment of dissatisfaction and unhappiness or satisfaction and happiness in a country. In this case, one will obtain two different values of the correlation coefficient  $\rho$  the value of the correlation coefficient between suicide rate and very life dissatisfaction and that of the correlation coefficient between suicide rate and very unhappiness. However, our technique of measuring life satisfaction or happiness will remain the same. That is, using life satisfaction or happiness does not undermine the generality of our analysis even though the two concepts are different.

<sup>27</sup>Notice that the correlation coefficient ( $\rho$ ) between the percentage of very dissatisfied people and suicide rate can be easily determined for a country  $i$  when one has several values of  $VDSA_i$  and  $RS$  for country  $i$ . This should be done for all countries  $i = 1, 2, 3, \dots, n$ , in order to determine  $AWSA$  and  $AWDSA$ . It should also be noted that the variable suicide is not replaced by dissatisfaction otherwise its weighted average would have been written as  $\sum_{i=1}^n \left[ \left( \frac{RS_i}{\sum_{i=1}^n RS_i} \right) \cdot SUICIDE_i \right]$ , where  $RS$

is the suicide rate for country  $i$  and  $SUICIDE_i$  its suicide variable. In addition, in our analysis the subjective behaviours, i.e. reported dissatisfaction and satisfaction are anchored to the observed behaviour, i.e. observed suicide rate of very dissatisfied people, in order to determine a weighted scheme in which the subjective and observed variables interact.

tion for country  $i$  ( $i = 1, 2, \dots, n$ ) enables the adjustment of life satisfaction for country  $i$  because the weight of life satisfaction,  $\left[ \{1 - RS \cdot (1 + \rho)\}_i \right]$ , is a share of the sum of the specific weights for  $n$  countries,  $\left[ \sum_{i=1}^n \{1 - RS \cdot (1 + \rho)\}_i \right]$ . As a result, the weighted satisfaction for country  $i$ ,  $\left[ \{1 - RS \cdot (1 + \rho)\}_i \right] \cdot SA_i$ , is adjusted by dividing it by the sum of the specific weights for  $n$  countries. Thus, the adjusted weighted satisfaction for country  $i$ ,

$$JWSA_i = \left[ \{1 - RS \cdot (1 + \rho)\}_i / \sum_{i=1}^n \{1 - RS \cdot (1 + \rho)\}_i \right] \cdot SA_i,$$

becomes a share of  $AWSA$  for  $n$  countries, because  $AWSA$  is the sum of  $JWSA_i$  for  $n$  countries. Given that the random variable  $SA$  takes a value in each of the  $n$  countries, one could think of the coefficient of  $SA_i$  in  $JWSA_i$ ,  $\left[ \{1 - RS \cdot (1 + \rho)\}_i / \sum_{i=1}^n \{1 - RS \cdot (1 + \rho)\}_i \right]$ , or correction factor of satisfaction as the probability that the random variable  $SA$  takes the value  $SA_i$  in country  $i$ . It follows that the values of  $SA_i$  ( $i = 1, 2, \dots, n$ ) are homogenized with their multiplication by their respective weights on the numerator of  $AWSA$  so that they can be added together. Thus, as adjusted weighted satisfaction,  $JWSA_i$  counters the cross-cultural differences of life satisfaction among  $n$  countries. Similarly, the adjusted weighted dissatisfaction for country  $i$ ,

$$JWDSA_i = \left[ \{RS \cdot (1 + \rho)\}_i / \sum_{i=1}^n \{RS \cdot (1 + \rho)\}_i \right] \cdot DSA_i,$$

becomes a share of  $AWDSA$  for  $n$  countries, because  $AWDSA$  is the sum of the adjusted weighted dissatisfaction of  $n$  countries. Again, given that the random variable  $DSA$  takes a value in each of the  $n$  countries, one could think of the coefficient of  $DSA_i$  in  $JWDSA_i$  or correction factor of dissatisfaction as the probability that the random variable  $DSA$  takes the value  $DSA_i$  in country  $i$ . It also follows that the values of  $DSA_i$  ( $i = 1, 2, \dots, n$ ) are homogenized with their multiplication by their respective weights on the numerator of  $AWDSA$  so that they can be added together. Thus, similarly, the adjusted weighted dissatisfaction counters the cross-cultural differences of life dissatisfaction among  $n$  countries.

### 3.3. Comparison of Countries' Satisfaction

Having transformed qualitative variables (satisfaction and dissatisfaction) into quantitative variables ( $JWSA_i$  and  $JWDSA_i$ ), we can now use the  $AWSA$  or our unit of measurement to determine the number of units of satisfaction in each country. To do so, we simply divide the  $JWSA_i$  of each country by  $AWSA$ . Thus, we obtain:

$$k_i = \left[ \{1 - RS \cdot (1 + \rho)\}_i / \sum_{i=1}^n \{1 - RS \cdot (1 + \rho)\}_i \right] \cdot (SA_i) / AWSA, \quad i = 1, 2, \dots, n$$

$$k_i = JWSA_i / AWSA, \quad i = 1, 2, \dots, n$$

where for any  $i$ ,  $k_i$  is a positive real number.

$k_i$  tells us how many units of  $AWSA$  are contained in country  $i$ 's adjusted weighted satisfaction ( $JWSA_i$ ). Thus,  $k_i$  is country  $i$ 's coordinate of adjusted weighted satisfaction. This enables us to compare the satisfaction of  $n$  countries by simply comparing the values of  $k_i$  for  $i = 1, 2, \dots, n$ .

Similarly,

$$k_j = \left[ \frac{\{RS \cdot (1 + \rho)\}_j}{\sum_{i=1}^n \{RS \cdot (1 + \rho)\}_i} \right] \cdot (DSA_j) / AWDSA, \quad j = 1, 2, \dots, n$$

$$k_j = JWDSA_j / AWDSA, \quad j = 1, 2, \dots, n$$

where for any  $j$ ,  $k_j$  is a positive real number.

Again,  $k_j$  tells us how many units of  $AWDSA$  are contained in country  $j$ 's adjusted weighted dissatisfaction ( $JWDSA_j$ ). Similarly,  $k_j$  is country  $j$ 's coordinate of adjusted weighted dissatisfaction. This also enables us to compare the dissatisfaction of  $n$  countries by simply comparing the values of  $k_j$  for  $j = 1, 2, \dots, n$ .

It should be noted that if we have three categories: "satisfied with life", "dissatisfied with life" and "none of the above", instead of two categories: "satisfied with life" and "dissatisfied with life", one can still compare countries' satisfaction even though the sum of the percentage of people who are satisfied with life and that of people who are dissatisfied with life does not add up to 100 per cent because of the percentage of respondents who tick "none of the above".

This means that the sum of  $SA$  and  $DSA$  will be in general different from 100 per cent in each survey. The coefficient of adjustment  $\beta$  of the percentage of people who are satisfied and dissatisfied with life should be determined as

$$\beta(SA + DSA) = \beta \cdot SA + \beta \cdot DSA = 100\% \quad \text{or} \quad \beta = (100\%) / (SA + DSA).$$

Thus, the adjusted percentage of people who are satisfied with life and that of people who are dissatisfied with life are respectively:

$$JSA = \beta \cdot SA = [100\%(SA)] / [SA + DSA] \quad \text{and}$$

$$JDSA = \beta \cdot DSA = [100\%(DSA)] / [SA + DSA].$$

In this way, the same referential percentage of 100 per cent is maintained; otherwise  $JSA$  and  $JDSA$  will not add up to 100 per cent and  $JDSA$  cannot be determined knowing  $JSA$  and vice versa.<sup>28</sup> Again, when we have three categories instead of two, the average adjusted weighted percentage of people who are satisfied and dissatisfied with life will be the respective unit of measurement of satisfaction and dissatisfaction of  $n$  countries. However, for consistency, we propose to use either three or two categories for each country. Given these two alternatives, our suggestion is to use the design of the two categories in **Table 1**

<sup>28</sup>To see that, suppose we choose  $\beta$  so that  $(\beta SA + \beta DSA)$  is different from 100%. In this case,  $(JSA + JDSA)$  is different from 100% because  $JSA = \beta SA$  and  $JDSA = \beta DSA$ . It follows that knowing  $JSA$  does not enable us to determine  $JDSA$  since  $(100\% - JSA)$  is different from  $JDSA$ .

because it is a clear expression of satisfaction-dissatisfaction.

To illustrate our technique, we use four countries as cases, the Netherlands, the United Kingdom (UK), Belgium and France, and employ their data on life satisfaction in *Eurobarometer Surveys* series (1986-1995) and their data on suicide rates in *World Health Statistics Annual* (1990-1996), which contain the data for the period 1986-1995.

From 1986 to 1995, the ranking of the four countries' coordinate of life satisfaction is depicted in **Table 3** as well as their adjusted weighted life satisfaction,

**Table 3.** Estimates of the coordinates and their ranking by year; Adjusted weighted life satisfaction; Adjusted weights; Units of measurement of life satisfaction and Correlation coefficients.

Year	Rank				Unit of measurement or average weighted satisfaction
	1	2	3	4	
1986	The Netherlands 0.29; 23.50; 0.26	The UK 0.28; 22.71; 0.27	Belgium 0.23; 18.62; 0.24	France 0.19; 15.45; 0.23	80.30 1986
1987	The Netherlands 0.29; 23.80; 0.26	The UK 0.28; 23.36; 0.27	Belgium 0.23; 18.88; 0.24	France 0.19; 15.61; 0.23	81.57 1987
1988	The Netherlands 0.28; 24.30; 0.26	The UK 0.27; 23.68; 0.27	Belgium 0.23; 20.65; 0.24	France 0.20; 17.74; 0.23	86.39 1988
1989	The Netherlands 0.28; 24.84; 0.26	The UK 0.27; 23.65; 0.26	Belgium 0.24; 21.05; 0.25	France 0.20; 17.98; 0.23	87.53 1989
1990	The Netherlands 0.27; 24.48; 0.26	The UK 0.26; 22.74; 0.26	Belgium 0.25; 21.93; 0.25	France 0.20; 18.34; 0.23	87.49 1990
1991	The Netherlands 0.27; 18.39; 0.26	The UK 0.26; 22.89; 0.26	Belgium 0.25; 22.51; 0.25	France 0.20; 18.39; 0.23	88.20 1991
1992	The Netherlands 0.27; 24.46; 0.26	The UK 0.26; 23.14; 0.26	Belgium 0.23; 21.05; 0.25	France 0.20; 18.20; 0.23	87.91 1992
1993	The Netherlands 0.29; 24.73; 0.26	The UK 0.26; 22.75; 0.27	Belgium 0.25; 21.41; 0.24	France 0.18; 15.95; 0.23	84.85 1993
1994	The Netherlands 0.28; 24.47; 0.26	The UK 0.27; 23.48; 0.27	Belgium 0.24; 21.13; 0.24	France 0.19; 16.75; 0.23	85.84 1994
1995	The Netherlands 0.28; 24.60; 0.26	The UK 0.26; 22.46; 0.27	Belgium 0.25; 21.34; 0.24	France 0.19; 16.81; 0.23	85.21 1995
Correlation coefficient	The Netherlands 0.321	The UK 0.557	Belgium 0.011	France 0.223	

Source of data on suicide rate: *World Health Statistics Annual* (1990, 1991, 1992, 1993, 1994, 1996); Source of data on life satisfaction: *Public Opinion Analysis* (1986-1995), *Eurobarometer Surveys* series (1986 to 1995). The first numbers below the countries are their coordinate of life satisfaction or number of units of life satisfaction or values of  $k_i$  which is obtained by dividing the second number (i.e. the adjusted weighted life satisfaction) by the corresponding units of measurement or average weighted satisfaction in the last column. The third numbers below the countries are the adjusted weights or the values of the coefficient of expressed life satisfaction in *JWSA*, The second numbers below the countries (i.e. adjusted weighted life satisfaction) and the units of measurement are left in percentage for scaling reason.

adjusted weights, unit of measurement of life satisfaction and correlation coefficients between the suicide rate variable and very dissatisfied people variable. Our technique is limited to four European countries because their data on suicide rates, and life satisfaction and dissatisfaction from 1986 to 1995 were complete. We used a limited set of countries because we were unable to get an additional complete set of data. To avoid a lengthy paper, from the illustration, we excluded the table on the ranking of the countries' coordinate of life dissatisfaction as well as other tables related to life dissatisfaction.

The first numbers below the countries are their coordinates of life satisfaction, or number of units of life satisfaction or values of  $k_i$ ; the second set of numbers are countries' adjusted weighted life satisfaction or values of  $JWSA_i$ ; and the third set of numbers are the adjusted weights or values of the coefficient of expressed life satisfaction in  $JWSA_i$ .

The adjusted weights are stable in the Netherlands and France, while they are instable in Belgium and the UK. From 1989 to 1992, there is a slight simultaneous decrease and increase in adjusted weights in the UK and Belgium, respectively. It is due to the respective decrease and increase in their suicide rates. However, we are unable to explain the underlying causes of these social phenomena. The Netherlands has the highest level of life satisfaction. It is followed by the UK, Belgium and France. The ranking of the four countries' coordinate of life satisfaction remains the same from 1986 to 1995. For instance, by dividing the 1986 coordinate of the Netherlands by that of each of the other countries, one can see that respondents in the Netherlands were 1.03, 1.26 and 1.52 times more satisfied with life in 1986 than those in the UK, Belgium and France, respectively. Similarly, by dividing Belgium's 1986 coordinate by that of France, our estimate shows that Belgium was 1.21 times more satisfied with life in 1986 than France. Moreover, this trend continues from 1986 to 1995. While, in [Inglehart and Rabier's Table 1.17 \(1986: p. 38\)](#), by dividing the percentage of life satisfaction in Belgium by that in France (84/74), we found that Belgium was 1.13 times more satisfied with life in 1982-83 than France. Similarly, in [Inglehart and Rabier's Table 1.17a \(1986: p. 38\)](#), by dividing the mean score of the overall life satisfaction in France by that in Belgium (2.21/1.71), we found that Belgium was 1.29 times more satisfied with life over the period 1975-79 than France. Thus, it seems that our ranking supports [Inglehart and Rabier \(1986\)](#)'s findings. That is, "the Belgians are so much happier than the French." However, this support is partial because their technique is questionable. Indeed, their rankings depend solely on the percentage of countries' life satisfaction or on the mean score of their overall life satisfaction. As a result, Inglehart and Rabier's rankings of "life satisfaction" and "overall life satisfaction" are instable between the periods 1975-79 and 1982-83 for Ireland, Northern Ireland, Luxembourg and Belgium as they are different from one another. Furthermore, either the value 93 of the percentage of people who are "satisfied or very satisfied with life as a whole" in Luxembourg is correct, and in this case Luxembourg's ranking is incorrect be-



cause 93 should be above 92 (Luxembourg ranks second instead of the Netherlands), or Luxembourg's ranking is correct, and then the value 93 is incorrect because 93 cannot be below 89. The same logic holds for Northern Ireland and Ireland whose percentage of people "satisfied or very satisfied with life as a whole" is 89 and 84, respectively.

The last column in **Table 3** corresponds to the values of the unit of measurement by year, which fluctuate around their mean, 85.52, within the range of (80.3, 88.20). Thus, our technique represents an improvement as compared with Inglehart and Rabier's technique, and an improvement in general as compared with the techniques in which the mean score is used for comparisons. As indicated earlier, the task at hand is to construct a weighted life satisfaction which enables the comparison of countries' life satisfaction.

The last line of the table represents the correlation coefficients which are positive, confirming that the empirical foundation of our idea of anchoring suicide rate to dissatisfied people is relevant.

Now, let us turn to the comparison of countries' level curve of life satisfaction over time.

#### **4. Comparing Countries' Level Curve of Life Satisfaction over Time**

In his pioneering work, Easterlin found that national comparisons among countries over time reveal an association between income and happiness, which is weaker than, if not inconsistent with, that shown by comparisons within countries. As an explanation, he suggested a Duesenberry-type model, involving relative status considerations as an important determinant of happiness (1974: p. 111-112, 118). Diener et al. (1995) computed a regression analysis across 38 nations in which life satisfaction and happiness were each separately predicted from income. This enabled them to compute the residual values from the predicted equation and to compare both the happiness and life satisfaction levels of countries. However, this comparison rested on one variable, the "substantial predictor in the sample," which is income (12). Blanchflower and Oswald (1999) compared happiness for the U.S. from 1972 to 1998 and life satisfaction for Great Britain from 1973 to 1998. Their study provides some support for Easterlin's pioneering work even though the picture is not simple. For instance, their results indicate that some groups in society such as American men and Blacks have become happier through the decades (19).

In this section, we propose another technique based on the weighted average. The reason is as follows. In Table 6 (1960) and Table 7 (1965), Easterlin (1974) presented the rating of personal happiness (min: 0; max: 10) of fourteen countries and the percentage distribution of population by happiness of nine countries, respectively, and asked on page 108: "What one would like most, of course, is historical series on happiness as countries developed?" This suggests the need for countries' level curve of life satisfaction over time to compare their respective

happiness over time. To compare countries' level of life satisfaction over time, we first determine their weighted level curve of satisfaction over time. Second, we determine their adjusted weighted level curve of satisfaction over time. Then we compare countries' adjusted weighted level curve of life satisfaction over time.

#### 4.1. Determination of a Country's Level Curve of Satisfaction over Time

Here, we use the fact that an increase (decrease) in life satisfaction in a country results in a decrease (increase) in life dissatisfaction to construct a level curve of satisfaction over time for each country.

From **Table 2**, one can see that if the percentage of people who are satisfied with life ( $SA$ ) increases, then the percentage of people who are dissatisfied with life ( $DSA$ ) decreases because the sum of the two percentages must be 100 per cent. However, the coefficient of  $SA$  in  $JWSA$  is smaller than one because its numerator is contained in its denominator, which is the sum of weights attached to  $SA$  in each of the  $n$  countries. The same logic holds for the coefficient of  $DSA$  in the adjusted weighted dissatisfaction ( $JWDSA$ ).

As a result,  $JWSA$  is smaller than  $SA$  and  $JWDSA$  is smaller than  $DSA$ . It follows that  $JWSA + JWDSA$  is below 100 per cent.

Moreover, there is no reason for the sum of  $JWSA$  and  $JWDSA$  to be constant as  $SA + DSA$ , which is equal to 100 per cent. This suggests that the weighted level curve of satisfaction over time of a country, in which  $Y = JWSA$  and  $X = JWDSA$ , cannot be a decreasing straight line as  $SA + DSA = 100$  per cent since  $(JWSA + JWDSA) \neq \text{constant}$ . However, it may have the shape of the right branch of a hyperbola. Formally,

$$Y = A/(X)^\alpha, A > 0, \alpha > 0 \quad (3)$$

where  $Y$  represents  $JWSA$ ,  $X$  represents  $JWDSA$ , and  $A$  and  $\alpha$  (positive real numbers) are constants.

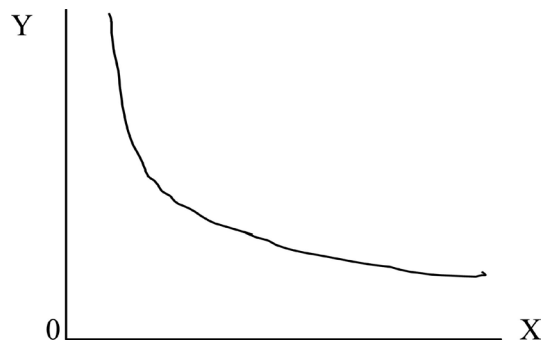
Taking the logarithm of both sides in Equation (3), we obtain

$$\log(Y) = \log(A) - \alpha \cdot \log(X) \quad (4)$$

To determine the value of constant  $A$  and that of elasticity  $\alpha$ , one needs to collect data on the percentage of satisfied and dissatisfied people in a country from several surveys to compute  $Y = JWSA$  and  $X = JWDSA$  for each survey and run an ordinary least-squares (OLS) regression of Equation (4). This will result in an estimated equation:

$$\log(Y) = a_j - b_j \cdot \log(X), j = 1, 2, \dots, n \quad (5)$$

The sign and level of significance of the estimated coefficients will tell us whether our weighted level curves of satisfaction over time have the shape of the right branch of a hyperbola. The estimate " $a_j$ " of country  $j$  will enable us to determine  $A_j$ , because  $a_j = \log(A_j)$  implies  $e^{a_j} = A_j$ . Similarly, we will obtain



**Figure 1.** Weighted level curve of satisfaction over time in a country.

the value of  $\alpha$  because the estimate “ $b_j$ ” equals  $\alpha$ , i.e.  $\alpha = b_j$ . This means that Equation (3) becomes

$$Y = A_j / (X)^{b_j} = WL_j, A_j > 0, b_j > 0, j = 1, 2, \dots, n \quad (6)$$

If the adjusted weighted percentage of people satisfied with life ( $Y$ ) is on the vertical axis and that of people dissatisfied with life ( $X$ ) is on the horizontal axis, we obtain the weighted level curve of satisfaction over time ( $WL_j$ ). The graph of Equation (6) is as follows in **Figure 1**.

This curve tells us that as the adjusted weighted level of dissatisfaction of a country ( $X$ ) increases, its adjusted weighted level of satisfaction ( $Y$ ) decreases like the right branch of a hyperbola as on an indifference curve.

#### 4.2. Determination of an Average Level Curve of Satisfaction over Time

The weighted level curve of satisfaction for each country will enable us to determine the average weighted level curve of satisfaction for all countries.

From Equations ((1) and (2)), we know  $AWSA$  and  $AWDSA$  for  $n$  countries. Again, having calculated  $AWSA$  and  $AWDSA$  from several surveys, we can run an OLS regression of Equation (4), in which  $Y = AWSA$  and  $X = AWDSA$ .

Similarly, the estimates “ $a_j$ ” and “ $b_j$ ” in Equation (5) enable us to determine the values  $\tilde{A}$  and  $b$  or  $A$  and  $\alpha$ , respectively. Formally, the functional form of the average weighted level curve of satisfaction over time ( $AWL$ ) is

$$Y = \tilde{A} / (X)^b = AWL, \tilde{A} > 0, b > 0 \quad (7)$$

where  $\tilde{A}$  is the estimated value of constant  $b$  and  $b$  that of  $\alpha$ .

#### 4.3. Comparison of Countries' Level Curve of Satisfaction over Time

An adjustment of the average weighted level curve of satisfaction enables us to determine the family representative or the unit of measurement of the level curves of satisfaction. Then, each country's weighted level curve of satisfaction will be adjusted so that it can be compared to the family representative. Thus, the adjusted weighted level curve of each country yields a constant coefficient

which will be the level number of satisfaction for the country with respect to the unit of measurement over the study period.

The derivations of the unit of measurement of the level curves of satisfaction ( $JY = 1/[X]^b$ , (9)), countries' adjusted weighted level curves of satisfaction ( $Jl_j = [A_j \cdot D_j / \tilde{A}] / [X]^b$ ,  $j = 1, 2, \dots, n$ , (10)) and their level numbers ( $K_j = A_j \cdot D_j / \tilde{A}$ ,  $j = 1, 2, \dots, n$ , (12)) are presented in Appendix B.

To compare countries' adjusted weighted level of satisfaction over time, we simply need to compare the values of

$$K_j = Jl_j / JY = [A_j \cdot D_j / \tilde{A}] \cdot JY / JY = A_j \cdot D_j / \tilde{A}, \quad j = 1, 2, \dots, n \quad (12), \quad (B.5)$$

Suppose  $Jl_1 = (1/2) / (X)^{1/2}$ ,  $Jl_2 = (2) / (X)^{1/2}$  and  $JY = 1 / (X)^{1/2}$  are the adjusted weighted level curves of satisfaction over time of countries 1 and 2 and the average adjusted weighted level curve of satisfaction over time, respectively. We have

$$Jl_1 = (1/2) \cdot JY \quad \text{and} \quad Jl_2 = (2) \cdot JY$$

If we represent the graphs of the two countries' adjusted weighted level curve of satisfaction as well as that of the average adjusted weighted level curve over time, we obtain **Figure 2**.

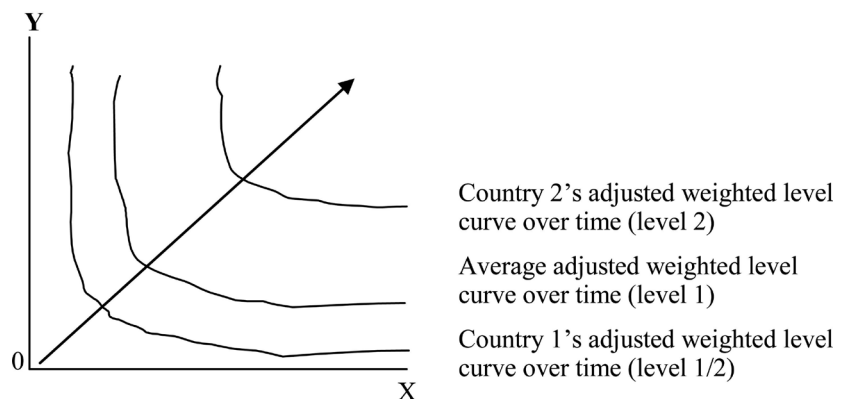
In this example,  $K_1 = (A_1 \cdot D_1) / \tilde{A} = 1/2$  and  $K_2 = (A_2 \cdot D_2) / \tilde{A} = 2$ . If we divide  $K_2$  by  $K_1$ , we obtain

$$K_2 / K_1 = 2 / (1/2) = 4 \quad \text{or} \quad K_2 = 4 \cdot K_1$$

One can see that country 2's adjusted weighted level curve of satisfaction over time is four times higher than that of country 1.

To determine countries' adjusted weighted level curve of dissatisfaction over time, one needs to take  $Y$  and  $X$  as the dissatisfaction and satisfaction variables, respectively, and then follow the procedure we outlined in the determination of countries' level curve of satisfaction over time.

It should be noted that if we had a five-point instead of a four-point scale questionnaire item in **Table 1**, "very satisfied", "satisfied", "dissatisfied", "very dissatisfied" with life and "none of the above", we would have three categories, "satisfied with life", "dissatisfied with life" and "none of the above", instead of



**Figure 2.** Adjusted weighted level curves.

two categories, “satisfied with life” and “dissatisfied with life.”

In this case, each country’s weighted level curve of satisfaction and the average weighted level curve of satisfaction over time for n countries will be determined as before.

Similarly,  $l_j$  (the ratio of country  $j$ ’s weighted level curve to the average weighted level curve of satisfaction) will be determined as before. This will enable us to determine the adjusted weighted level curves of satisfaction over time for n countries and compare them as before.

Again, for consistency, we propose using either three or two categories for each country. Given these two alternatives, our suggestion again is to design the questionnaire item according to the format in **Table 1** because it represents a clear expression of satisfaction-dissatisfaction.

To illustrate our technique again, we can now turn to our estimates of OLS regressions, and the four countries’ level curves of life satisfaction over time as well as their level numbers and unit of measurement of life satisfaction over time, which are depicted in **Table 4** and **Table 5**, respectively.

All the coefficients have the negative sign and are statistically significant at the 5 per cent level, indicating that the weighted level curves of satisfaction over time have the shape of the right branch of a hyperbola. These results enable us to determine the weighted level curves of life satisfaction, adjusted weighted level curves, level numbers, average weighted level curve and average adjusted weighted level curve, or unit of measurement of life satisfaction over time, which are in **Table 5**. To our knowledge, this is the first attempt to determine such a

**Table 4.** Estimation of the log linear OLS regression of the average weighted level curve and weighted level curves of the four countries over the period 1986-1995.

Weighted satisfaction	Constant	Weighted dissatisfaction	Adjusted R <sup>2</sup>
Average weighted satisfaction	4.85	-0.14* (4.44)	0.67
France	3.32	-0.22* (2.72)	0.41
Belgium	3.27	-0.18* (24.56)	0.98
The UK	3.24	-0.13* (13.40)	0.95
The Netherlands	3.19	-0.05* (2.24)	0.30

(\*) means statistically significant at the 5% level. N.B.: The terms in parentheses are the t-statistics; there are 10 observations and each regression equation has 8 degrees of freedom; the aim of the econometric regressions is to determine the respective values of  $\alpha$  over the period 1986-1995.

**Table 5.** Estimates of weighted level curves of life satisfaction, adjusted weighted level curves, level numbers, average weighted level curve and unit of measurement over the period 1986-1995.

	Rank				Unit of measurement or family representative or average adjusted weighted level curve	Average weighted level curve
	1	2	3	4		
	The Netherlands	The UK	Belgium	France		
Weighted level curve	$Y = 3.19/X^{0.05}$	$Y = 3.24/X^{0.13}$	$Y = 3.27/X^{0.18}$	$Y = 3.32/X^{0.22}$		
Adjusted weighted level curve	$Y = 1.24/X^{0.14}$	$Y = 1.01/X^{0.14}$	$Y = 0.88/X^{0.14}$	$Y = 0.80/X^{0.14}$	$Y = 1/X^{0.14}$	$Y = 4.85/X^{0.14}$
Level number	1.24	1.01	0.88	0.80	Level 1	

level curve of life satisfaction over time in literature.

Over the period 1986-1995, the Netherlands has the highest level number of satisfaction. It is followed by the UK, Belgium and France. In addition, the ranking of the level numbers corresponds to that of the four countries' coordinate by year and over the same period in **Table 3**. Again, by dividing the Netherlands' level number by that of each of other countries, our estimates show that the Netherlands' life satisfaction over time is 1.22, 1.40 and 1.55 times higher than that of the UK, Belgium and France, respectively, over the period 1986-1995.

## 5. Discussion and Conclusion

In this paper, we provide an analytical framework that enables us to determine a unit of measurement of life satisfaction and dissatisfaction for several countries and a unit of measurement for their level curves of life satisfaction. These in turn allow us to compare countries' life satisfaction as well as their level curve of life satisfaction over time. As an illustration of our technique, we use four countries as case study. These include: the Netherlands, the UK, Belgium and France. Our estimates show that the Netherlands has the highest ranking of life satisfaction by year as well as that of the level curve of life satisfaction over the period 1986-1995. The Netherlands is followed by the UK, Belgium and France. That is, the ranking of life satisfaction has remained the same for the four countries by year as well as over the period 1986-1995.

The underlining factors to these rankings of expressed life satisfaction and level curves of life satisfaction may be due to differences in outlook in life. Indeed, given that material living conditions, social relationship and health status are clearly related to life satisfaction in most countries in general and in the four European countries in particular, namely, the Netherlands, the UK, Belgium and France (Eurostat, 2015), these countries should be similar in terms of life satisfaction. This however is not the case in our study, because the two Northern countries, the Netherlands and the UK rank ahead of the two relatively Southern countries, Belgium and France. The same ranking is observed in the map of Inglehart, Foa et al. (2008). Then, one may probably look at countries' outlook to have a better understanding of the ranking of these relatively Southern and Northern countries.

France ranks last probably because of its negative outlook. Senik (2014) coined the low level of happiness in France, observed in international surveys, as "The French unhappiness puzzle". According to her, "this points to school and childhood environment as a valuable locus of public policy." This is reiterated in her conclusion. One of the consequences of this social set-up coined by Senik is called "the French happiness deficit".

The Netherlands and the UK rank before Belgium probably because of their positive outlook, which rests in part on their strong will to conquer their respective natural environments and to never back down. This is exemplified in the

case of the Netherlands by the construction of the polders, which extends on the sea the living space of the country. In the case of the UK, the positive outlook is exemplified by its conquest of the sea that enables it to create a huge empire.

The Netherlands ranks before the UK, probably because it is a more homogenous society compared to the UK where citizens with diverse foreign origins do not feel integrated into the society or treated as equal to local citizens. As a result, many of them do not feel satisfied with life in the UK, reducing the UK's score in life satisfaction.

Concerning the level curves of life satisfaction, as we have seen, the ranking of the four countries of our study remains the same as that of their expressed life satisfaction. The stability of the rank of a country's level curve of life satisfaction is consequently related to the stability of its expressed life satisfaction. Given that [Easterlin \(1995\)](#) also reported the stability of Americans' average happiness from 1972 to 2002, one could argue that expressed life satisfaction and the level curves of life satisfaction are in general stable in the short and medium terms. Therefore, the suggestions concerning the ranking of the four countries, namely, the Netherlands, the UK, Belgium and France, in their expressed life satisfaction remain the same as those in their level curves of life satisfaction over the period 1986-1995.

One important insight of this paper is that the proposed analytical framework is an academic advancement of research because the technique enables to compare people's happiness or life satisfaction in the provinces, regions or states within a country when one uses the suicide rate at the level of provinces, regions or states. Similarly, the framework may be used to compare happiness or life satisfaction of all countries. Beside its academic aspect, following the spirit of Bentham's inquiry, the technique has also a practical social aspect because knowing how many times a province, region or state is more satisfied with life than other provinces, regions or states within a country may enable the legislator to bring about, through direct intercession on welfare issues, an alignment between the interests of a province, region or state and those of other provinces, regions or states. This reinforces social cohesion, because provinces, regions or states within a country will feel that they have a stake in the improvement of the country. This may foster economic development within the country.

Once the question concerning life satisfaction is asked to respondents, subsequent questions on the reason of their satisfaction or dissatisfaction with life could be asked for improvement in their satisfaction. We believe that this represents a positive direction for policy makers as they strive to improve the well-being of the population.

## **6. Limitations and Future Research**

However, we point out that the determination of countries' level curve of life satisfaction may be subject to generational changes because some values of a country may change from generation to generation. Therefore, the level curves

of life satisfaction or happiness over time should be determined within a generation. Moreover, one drawback of this study is the lack of data (only four cases). Further empirical studies on dissimilar countries are necessary to strengthen the validity of our technique of comparing countries' life satisfaction and their level curve of life satisfaction over time because in "Western industrialized nations", "states which are happiest have higher suicides rates than those which are less happy" (Daly et al., 2010).

In the event that a future study on dissimilar countries finds a result undermining ours, one needs to determine another weighting skim to apply our technique.

## Acknowledgements

This paper benefited from the communications with Valerie Møller, Ruut Veenhoven, John Barkley Rosser Jr, Adrian Hunt and the comments of an anonymous referee. We also would like to thank the Assistant Editor Ray Wong for his professional handling of this paper, Ariane Debyser at the European Commission, Public Opinion Analysis and Meinhard Moschner at GESIS-Leibniz Institute for the Social Sciences (*Institut für Sozialwissenschaften*), (Department of Data Archive and Data Analysis), who graciously provided us with Eurobarometer Surveys data. It should be added that all remaining mistakes in this paper, if any, are mine. The first draft of this paper was posted on the website of Social Science Research Network in the USA.

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## Appendix

### Appendix A: Questionnaire Item for Life Satisfaction

**Table S1.** Questionnaire item for life satisfaction.

Please tick one row	
1.	Very satisfied with life ( )
2.	Satisfied with life (satisfied or slightly satisfied) ( )
3.	Dissatisfied with life (dissatisfied or slightly dissatisfied) ( )
4.	Very dissatisfied with life ( )

#### Derivation of a proxy weight for dissatisfied people variable

##### Proposition

$$RS \cdot (1 + \rho) = RS \cdot (1/2) \cdot V \left[ (RS/\sigma_{RS}) + (VDSA/\sigma_{VDSA}) \right] \quad (A.1)$$

where  $RS$  is the suicide rate,  $V$  is the variance,  $RS$  is the variable suicide rate,  $VDSA$  is the percentage of very dissatisfied people variable,  $\rho$  is the correlation coefficient between the two variables and  $\sigma_{RS}$  and  $\sigma_{VDSA}$  are their respective standard deviations.

##### Proof

Factoring out  $1/2$ ,  $RS \cdot (1 + \rho)$  can be written as

$$\begin{aligned} RS \cdot (1 + \rho) &= RS \cdot (1/2) \cdot \{2 + 2\rho\} \\ &= RS (1/2) \cdot (1 + 1 + 2COV[RS, VDSA]/\sigma_{RS} \cdot \sigma_{VDSA}), \end{aligned}$$

as the correlation coefficient  $\rho = COV[RS, VDSA]/\sigma_{RS} \cdot \sigma_{VDSA}$ , where  $COV[RS, VDSA]$  is the covariance of the variables  $RS$  and  $VDSA$  and  $\sigma_{RS}$  and  $\sigma_{VDSA}$  are their respective standard deviations. Thus, the proxy weight for dissatisfied people,  $RS \cdot (1 + \rho)$ , can be written as

$$\begin{aligned} RS \cdot (1 + \rho) &= RS (1/2) \left\{ \left( \frac{\sigma_{RS}^2}{\sigma_{RS}^2} \right) + \left( \frac{\sigma_{VDSA}^2}{\sigma_{VDSA}^2} \right) \right. \\ &\quad \left. + 2COV \left[ (RS/\sigma_{RS}), (VDSA/\sigma_{VDSA}) \right] \right\} \end{aligned}$$

as  $1 = \sigma_{RS}^2/\sigma_{RS}^2$ ,  $1 = \sigma_{VDSA}^2/\sigma_{VDSA}^2$  and

$$COV[RS, VDSA]/\sigma_{RS} \cdot \sigma_{VDSA} = COV \left[ (RS/\sigma_{RS}), (VDSA/\sigma_{VDSA}) \right].$$

$RS \cdot (1 + \rho)$  can be written as

$$\begin{aligned} RS \cdot (1 + \rho) &= RS \cdot (1/2) \cdot \left\{ \left[ \frac{V(RS)}{\sigma_{RS}^2} \right] + \left[ \frac{V(VDSA)}{\sigma_{VDSA}^2} \right] \right. \\ &\quad \left. + 2COV \left[ (RS/\sigma_{RS}), (VDSA/\sigma_{VDSA}) \right] \right\}, \end{aligned}$$

where  $V$  is the variance, because  $V(RS) = \sigma_{RS}^2$  and  $V(VDSA) = \sigma_{VDSA}^2$ .

$RS \cdot (1 + \rho)$  can also be written as

$$\begin{aligned} RS \cdot (1 + \rho) &= RS (1/2) \left\{ V(RS/\sigma_{RS}) + V(VDSA/\sigma_{VDSA}) \right. \\ &\quad \left. + 2COV \left[ (RS/\sigma_{RS}), (VDSA/\sigma_{VDSA}) \right] \right\}, \end{aligned}$$

because  $V(RS/\sigma_{RS}) = V(RS)/\sigma_{RS}^2$  and  $V(VDSA/\sigma_{VDSA}) = V(VDSA)/\sigma_{VDSA}^2$ . As

$$\begin{aligned}
 &V[(RS/\sigma_{RS})+(VDSA/\sigma_{VDSA})] \\
 &= V(RS/\sigma_{RS})+V(VDSA/\sigma_{VDSA})+2COV[(RS/\sigma_{RS}),(VDSA/\sigma_{VDSA})],
 \end{aligned}$$

it follows that

$$RS \cdot (1 + \rho) = RS \cdot (1/2) \cdot V[(RS/\sigma_{RS})+(VDSA/\sigma_{VDSA})].$$

### Appendix B: Derivations of the Unit of Measurement, Adjusted Weighted Level Curves and Level Numbers

Now we can determine the unit of measurement of the level of satisfaction and compare different countries' level curve of satisfaction over time.

Let us call  $Y_1 = A_1/(X)^{b_1}$ ,  $Y_2 = A_2/(X)^{b_2}$ , ...,  $Y_n = A_n/(X)^{b_n}$  the weighted level curves of satisfaction over time for n countries, respectively. By dividing each country's weighted level curve by the average weighted level curve of satisfaction over time in Equation (7),  $Y = \tilde{A}/(X)^b$ , we obtain

$$\begin{aligned}
 l_j &= WL_j / AWL, \quad j = 1, 2, \dots, n \quad \text{or} \\
 l_j &= [A_j/(X)^{b_j}] / [\tilde{A}/(X)^b], \quad j = 1, 2, \dots, n
 \end{aligned}$$

This can also be written as

$$l_j = [A_j/\tilde{A}]/(X)^{b_j-b} \quad \text{for any } l_j = [A_j/\tilde{A}]/(X)^{b_j-b} \quad (8) \text{ (B.1)}$$

From Equation (7),  $Y = \tilde{A}/(X)^b$ , if we divide the average weighted level curve of satisfaction by  $\tilde{A}$ , we obtain the average adjusted weighted level curve of satisfaction over time:

$$JAWL = JY = 1/[X]^b \quad (9) \text{ (B.2)}$$

*JAWL* will be the representative of the family of levels of satisfaction.

As in the adjustment of weighted satisfaction and dissatisfaction which yields *JAWSA<sub>i</sub>* and *JAWDSA<sub>i</sub>* (in the section on the Determination of countries' unit of measurement of satisfaction),  $l_j$  will need an adjustment. However, it will be functional to compare the  $(l_j)$ 's to each other. Thus,  $l_j$ ,  $j = 1, 2, \dots, n$ , must belong to the family of *JAWL* for this comparison. For  $l_j$ ,  $j = 1, 2, \dots, n$ , to belong to the family, the adjustment should be such that

$$\left\{1/[X]^{(b_j-b)}\right\} \cdot \left\{1/[X]^{q_j}\right\} = 1/[X]^b \quad \text{for any } j = 1, 2, \dots, n.$$

This means that  $1/[X]^{b_j-b+q_j} = 1/[X]^b$  for any  $j = 1, 2, \dots, n$  or  $b_j - b + q_j = b$  for any  $j = 1, 2, \dots, n$ . That is,  $q_j = 2b - b_j$  for any  $j = 1, 2, \dots, n$ . The functional factor of adjustment is therefore  $1/[X]^{q_j} = 1/[X]^{2b-b_j}$  for any  $j = 1, 2, \dots, n$ .

Multiplying and dividing  $l_j$  by the functional factor of adjustment, we obtain  $l_j = \{l_j\} \cdot \left\{1/[X]^{2b-b_j}\right\} / \left\{1/[X]^{2b-b_j}\right\}$ .

Replacing  $l_j$  within the braces by its expression in Equation (8),  $l_j = [A_j/\tilde{A}]/(X)^{(b_j-b)}$ , we obtain

$$l_j = \left\{[A_j/\tilde{A}]/(X)^{(b_j-b)}\right\} \cdot \left\{1/[X]^{2b-b_j}\right\} / \left\{1/[X]^{2b-b_j}\right\}.$$

This can be written as

$$\begin{aligned}
 I_j &= \left\{ \left[ A_j / \tilde{A} \right] / [X]^{b_j - b + 2b - b_j} \right\} / \left\{ 1 / [X]^{2b - b_j} \right\} \\
 &= \left\{ \left[ A_j / \tilde{A} \right] / [X]^b \right\} / \left\{ 1 / [X]^{2b - b_j} \right\}.
 \end{aligned}$$

Replacing  $X$  in the last brackets by its average value of adjusted weighted dissatisfaction ( $AD$ ) determined from the surveys of country  $j$ , which amounts to determining the value of the functional factor of adjustment at the average value of dissatisfaction, we obtain the adjusted  $I_j$ :

$$JI_j = \left[ A_j \cdot D_j / \tilde{A} \right] / [X]^b \quad \text{for any } j = 1, 2, \dots, n, \text{ where } D_j = [AD]^{2b - b_j} \quad (10) \text{ (B.3)}$$

$JI_j$  will be the adjusted weighted level curve of satisfaction over time of country  $j$ .

Let  $JAWL = JY = 1 / [X]^b$  be our unit of measurement for the levels of satisfaction. We have

$$JI_j = \left[ A_j \cdot D_j / \tilde{A} \right] \cdot JY, \quad j = 1, 2, \dots, n \quad (11) \text{ (B.4)}$$

$JI_j$  tells us at how many average adjusted weighted levels of satisfaction country  $j$ 's adjusted weighted level curve of satisfaction is, where  $\left[ A_j \cdot D_j / \tilde{A} \right]$  indicates the level number for country  $j$ .

If we divide  $JI_j$  by  $JY$ , we obtain the level number of satisfaction:

$$K_j = JI_j / JY = A_j \cdot D_j / \tilde{A}, \quad j = 1, 2, \dots, n \quad (12) \text{ (B.5)}$$