# A Cross-State Comparison of Measures of Subjective Well-Being

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Abstract

Using data drawn from the 2010 American Time Use Survey Well-Being Module, this study examines the relationship between three measures of subjective well-being based on time-use data and an objective measure of well-being. Whereas the measures of affect—net affect and the U-index—are uncorrelated with the objective quality-of-life ranking of the fifty states in the United States, the measure of meaningfulness shows a significant correlation with objective ranking. The reason for the significant correlation between the measure of meaningfulness and the objective measure of well-being is because, when engaged in similar activities, people living in states with better quality of life felt their lives to be more meaningful than those living in states with poor amenities, not because time use varies substantially by state.

Key words: time use, subjective well-being, U-index, net affect, meaningfulness

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## 1. Introduction

Recently, economists and policy makers have increased their interests in measures of subjective well-being (Di Tella and MacCulloch 2006; Dolan and Metcalfe 2012; Frey and Stutzer 2002; Stiglitz, Sen, and Fitoussi 2009). For example, Stiglitz et al. (2009) pointed out that quality of life depends on multi-dimensions—material living standards; health; education; personal activities; political voice and governance; social connections and relationships; environment; and personal/economic security—but many of these dimensions are not included in conventional income measures, and hence suggested employing both objective and subjective measures to get information about people's well-being.

An often-used measure of subjective well-being is based on a single survey question regarding global life satisfaction, such as "In general, how satisfied are you with your life?" in the Behavioral Risk Factor Surveillance System (BRFSS). The four valid responses to the question—very satisfied, satisfied, dissatisfied, and very dissatisfied—are usually treated in a cardinal way by assigning 1 to 4, where "very satisfied" is assigned 4. However, it is well known that reports of subjective well-being based on a single question on global life satisfaction do not reflect stable inner states of well-being: they are rather judgments that individuals form on the spot and thus are influenced by contexts and moods and neglect the duration of the life episode (Schwarz and Strack 1999). As a way to overcome these problems, Kahneman, Krueger, Schkade, Schwarz, and Stone (2004a) suggested collecting moment-to-moment feelings by using the Day Reconstruction Method (DRM). In the DRM, respondents first fill out a detailed time diary of the previous day and then provide numerical responses. For example, the DRM uses a scale from 0 to 6 about how they felt during each episode on selected affect dimensions, such as happy, warm/friendly, enjoying myself, frustrated/annoyed, depressed/blue, hassled/pushed around, angry/hostile, worried/anxious, and criticized/put down. Though the DRM involves a

retrospective report on an emotional state, Kahneman, Krueger, Schkade, Schwarz, and Stone (2004b) showed that the DRM achieves accurate recall: the diurnal patterns of affect and tiredness from the DRM match those from the more expensive Experience Sampling Method, which collects information on respondents' experiences in real time through an electronic diary. Kahneman et al. (2004a) defined net affect as the average of positive emotion less the negative ones for each episode and suggested the population average of duration-weighted net affect as a new measure of national well-being.

One common problem with both global life satisfaction and net affect is that both of these measures use the responses in a cardinal way and thus make interpersonal comparison difficult. As an alternative measure of subjective well-being, Kahneman and Krueger (2006) and Krueger, Kahneman, Schkade, Schwarz, and Stone (2009) proposed the U-index, which is based on an individual's time-use data and measures the percent of time the respondent spends in an unpleasant state. An episode is classified as unpleasant if the highest rating on any negative affect dimension is strictly greater than the ratings of positive affect dimensions. Therefore, though based on cardinal responses of an individual's moment-to-moment affect, the U-index is an ordinal measure at the level of feelings and allows for interpersonal comparison.

While global life satisfaction represents a respondent's assessment of how well one's life desires and goals are satisfied, both the U-index and net affect represent a respondent's assessment of moment-to-moment positive and negative affect dimensions and the use of time in activities with various affect dimensions during a short period, usually a day. Because of these differences, global life satisfaction is moderately correlated (0.38) with daily net affect at the individual level (Kahneman et al. 2004b, p. 1779). Similarly, Knabe, Rätzel, Schöb, and Weimann (2010) found that, at the individual level, the correlation of the self-reported general

life satisfaction with the two measures of experienced utility—net affect, and the U-index—are weaker (around 0.36 in absolute values) than that between the U-index and net affect (around 0.73 in absolute values).

Furthermore, the measure of global life satisfaction and the U-index may even portray different pictures regarding the well-being of the same people. For example, in an international comparison 810 women in Columbus, U.S.A. and 820 women in Rennes, France, Krueger, Kahneman, Schkade, et al. (2009) and Krueger, Kahneman, Fischler, et al. (2009) showed that whereas American women are more satisfied with their lives than French women, the U-index is lower among French women than among American women, which means that French women spend less of their time engaged in unpleasant activities than American women. Knabe et al. (2010) found that although the employed are more satisfied with their lives than the unemployed, the two measures of experienced utility—net affect and the U-index—do not differ between the two groups because the unemployed can compensate for having more negative affect for similar activities by using the time the employed are at work on more enjoyable activities.

Based on the idea of the U-index, Krueger, Kahneman, Schkade, et al. (2009) suggested development of National Time Accounting (NTA) as a complement to the National Income and Product Accounts, and NTA can be used to compare the well-being of groups of individuals, countries, and eras. To facilitate NTA, they have recommended adding a module on affective experience to the American Time Use Survey (ATUS). Loewenstein (2009), however, argued that the U-index, by categorizing an activity simply as either pleasant or unpleasant, discards useful information to allow for interpersonal comparability. He also suggested that the module should also ask if a particular activity was a "valuable use of time," because the U-index measures the quality of a person's life in terms of happiness only, but individuals might have

different criteria for what makes their own life worthwhile. Similarly, White and Dolan (2009) showed that, in addition to affect, thoughts—measured as responses to the statements "I feel the activities in this episode were worthwhile and meaningful/were useful to other people/helped me achieve important goals"—also influence subjective well-being. For example, some activities with relatively low scores of positive feelings, such as work and time with children, are nonetheless rewarding and contribute to overall subjective satisfaction. As a result, the module added to the 2010 ATUS includes affect questions as well as a question on meaningfulness of the activity.

Because one of the main reasons economists and policy makers are interested in measures of subjective well-being is to better monitor progress in quality of life beyond simple measures of income and to better guide public policy, it is important to examine how well various measures of subjective well-being reflect the objective differences in quality of life so that policy makers can develop better and more appropriate policies to improve well-being in society. Oswald and Wu (2010) is the first to provide evidence that the measure of global life satisfaction from the BRFSS contains objective information about the quality of lives across the fifty states in the United States. Using a sample of 1.2 million individuals drawn from the 2005-2008 BRFSS, they first estimated the state dummies in a subjective well-being regression analysis where the cardinal coding of the responses to the question on global life satisfaction is the dependent variable and various respondents' characteristics are the independent variables. They then showed that these state dummies are substantially correlated (0.60) with the state-by-state quality-of-life rankings in the United States from Gabriel, Mattey, and Wascher (2003), generated by compensating differential approach based on objective state-level indicators, such as precipitation; humidity; heating degree days; cooling degree days; wind speed; sunshine;

coast; inland water; federal land; visitors to national parks; visitors to state parks; number of hazardous waste sites; environmental regulation leniency; commuting time; violent crime rate; air quality-ozone; air quality-carbon monoxide; student-teacher ratio; state and local taxes on property, income and sales and other; and state and local expenditures on higher education, public welfare, highways, and corrections. Relying on the concept of a compensating differential that pecuniary differences across locations in wages, housing, and other costs of living should compensate for the differences in nonpecuniary characteristics that affect the quality of life, Gabriel et al. (2003) estimated the weights on these indicators in three price equations (wage, housing, and non-housing cost-of-living). Then the weighted average of these indicators determined their quality-of-life rankings. Appendix Table A1 shows the state-by-state quality-of-life rankings from Gabriel et al. (2003).

Applying the same approach as Oswald and Wu (2010) to data drawn from the 2010 American Time Use Survey Well-Being (ATUS WB) Module, the first data source based on a large, nationally representative sample of the U.S. population that links self-reported well-being information to individuals' activities and time-use patterns, this paper examines the relationship between the three measures of subjective well-being based on time-use data—net affect, the U-index, and meaningfulness—and the objective quality-of-life ranking of the fifty states in the United States from Gabriel et al. (2003).[1] By doing so, one can observe how well these measures of experienced utility reflect the objective differences in the quality of human lives across states. This paper also analyzes whether the variations across states in the three measures of subjective

[1] Although the state-by-state quality-of-life ranking from Gabriel et al. (2003) is computed using data for the year 1990, this paper still uses this ranking because it seems to be the most recent estimate in the literature. Though the ranking is likely to have changed since 1990, it seems to be relatively stable over time. For example, according to the author's calculation, the spearman's rank correlation of the state-by-state quality-of-rankings reported in Gabriel et al. (2003, pp. 635-636) between 1981 and 1990 is 0.88 and is statistically significant at 1 percent level.

well-being based on time use come from the variations in activities and time-use patterns and/or from the variations in self-reported well-being for the same activity.

## 2. Data and Methodology

The ATUS is a time-use survey based on a nationally representative sample of the U.S. population and has been conducted continuously since 2003 by the U.S. Census Bureau. The ATUS sample is drawn from households that have completed their final interview with the Current Population Survey (CPS), a monthly survey of almost 60,000 households that is the primary source of information on the labor force characteristics of the U.S. population. Two to five months after the last CPS interview, one individual aged 15 or older from each selected household was randomly chosen to participate in the ATUS. Respondents were asked to sequentially report their own activities on a 24-hour, preassigned day of the week (the diary day), starting at 4 A.M. on the day before the interview and ending at 4 A.M. on the day of the interview. The diary days of the ATUS are inclusive of all days in a year: weekdays, weekends, and holidays, except Thanksgiving Day and Christmas Day. All ATUS data were collected using computer-assisted telephone interviewing.

In the 2010 ATUS, a Well-Being (WB) Module was added to capture how people felt during randomly selected three activities reported by each respondent. The selected activity must be at least 5 minutes in duration and the following activities and responses were not selected: sleeping (0101xx), grooming (0102xx), personal activities (0103xx), don't know/can't remember (500106), and refusal/none of your business (500105).[2] For each selected activity, respondents were asked seven questions: five affect questions (happy, pain, sad, stressed, and tired)[3], one

[2] In parentheses are the ATUS activity codes.
[3] The order of the five affect questions was randomly determined for each respondent.

question about how meaningful the activity was, and one question about whether the respondent was interacting with anyone during the activity. For the five affect questions and the one question about how meaningful the activity was, the respondent was asked to use a scale from 0 to 6, where a 0 means he/she did not experience the feeling at all and a 6 means the feeling was very strong.[4] After excluding the episodes with missing responses, and respondents below the age of 18, and those from DC, this paper used 35,813 episodes of activities from 12,167 respondents in the 2010 ATUS WB Module.[5]

## 2.1 U-Index

Using the responses available in the ATUS WB Module, I have constructed three measures of well-being: the U-index, net affect, and meaningfulness. Following Kahneman and Krueger (2006) and Krueger, Kahneman, Schkade et al. (2009), an episode is classified as unpleasant if the highest rating on any of the three negative affect dimensions (pain, sad, and stressed) is strictly greater than the rating of the positive affect dimension (happy). Then the U-index for state $j$, $U_j$, is constructed as the weighted average of these classifications over the episodes from the respondents in the state. Specifically,

$$U_j = \frac{\sum_i \sum_k w_{ikj} U_{ikj}}{\sum_i \sum_k w_{ikj}} \quad (1)$$

[4] The ATUS WB Module data files also contain four general health questions: general health status (excellent, very good, good, fair, and poor); whether the respondent was ever told he/she has hypertension by a doctor in the last five years; whether the respondent took any pain medication on the diary day; and how well rested the respondent felt on the diary day. A small number of ATUS respondents (431 out of 13,260) who do not meet the following criteria are not counted in the WB Module: i) Answer at least four of the seven questions about the activity for at least one of the three activities selected, and ii) Answer at least one of the final four general health questions.

[5] Respondents from DC are excluded because the quality-of-life ranking by Gabriel et al. (2003) does not include DC. The number of episodes per state is 716.3 on average, with the maximum of 3,697 for California and the minimum of 56 for Alaska. In addition to Alaska, the following four states have fewer than 100 episodes: Delaware (93), North Dakota (91), Vermont (81), and Wyoming (60).

where $i$ denotes respondent, $k$ denotes sampled activity, $U_{ikj}$ denotes an indicator variable for an episode $k$ being unpleasant for respondent $i$ in state $j$, and $w_{ikj}$ denotes the WB Module activity weight (WUFNACTWT) attached to activity $k$ for respondent $i$ in state $j$. The weights account for both i) differences between activities in the fraction of time spent in eligible activities and ii) differences between persons in the probability of having a specific eligible activity selected due to variation in the number of eligible activities. In the end, this U-index is an estimate for the fraction of time the individual in the state spends in an unpleasant state. Even though the U-index is based on cardinal responses, it relies only on an ordinal ranking of the feelings in each activity.[6]

## 2.2 Net Affect and Meaningfulness

Net affect for each episode (Kahneman et al. 2004a) is defined as the difference between the positive emotion (happy) and the average of the negative ones (pain, sad, and stressed) for the episode. Similar to Equation 1, net affect for each state is defined as the weighted average of net affect over the activities from the respondents in the state. In a similar fashion, meaningfulness has been constructed for each state as the weighted average of the responses to the question about how meaningful the episode was over the episodes from the respondents in the state. Both net affect and meaningfulness are cardinal measures of subjective well-being.

[6] This assumes that an individual uses that same scale for both negative and positive affect dimensions. However, Layard (2009) pointed out that it is difficult to compare the reported numbers for negative and positive feelings and as a result, the process increases measurement errors and loses much of the information compared to other cardinal measures. For example, even if two people have the same true value of unobserved feelings, a more optimistic person may overreport positive feelings and underreport negative feelings than the other person. Then the U-index may not be the same between the two people.

## 2.3 Regression Residuals

The focus here is not on the simple differences in these well-being measures across various people from different states, but rather on the differences due to socio-economic, institutional and geographic characteristics of states, net of other differences among the respondents. Hence, using each of these three *unweighted* measures of well-being for each episode (for example, $U_{ikj}$ for the U-index) as the dependent variable, I first estimated episode regressions controlling for the following respondents' characteristics: age and its square; a female dummy; five dummies for respondent's race/ethnicity (black, Hispanic, Asian, native American, and other; the reference group is white); five education dummies (some high school, high school, some college, college, and graduate school; the reference group is less than some high school education); two marital-status dummies (married and partnered; the reference group is single); three employment-status dummies (self-employed, unemployed, and not in the labor force; the reference group is employed); a dummy for interacting with anyone; eight dummies for family income during the last 12 months ($10,000-$19,999, $20,000-$34,999, $35,000-$49,999, $50,000-$74,999, $75,000-$99,999, $100,000-$149,999, $150,000 and over, and family income missing; the reference group is less than $10,000); a holiday dummy; six dummies for the days of the week (the reference group is Sunday); and eleven month dummies. Appendix Table A2 shows the unweighted descriptive statistics of most of these variables. Then similar to Equation 1, the residuals from these regressions are weighted to produce state-level average residuals.

## 2.4 Global Life Satisfaction

Similar to Oswald and Wu (2010), I have also calculated the state-level average life satisfaction from the 2010 BRFSS so that I can compare the magnitudes of the correlations between various

measures of subjective well-being and the qualify-of-life rankings. The BRFSS is a large health-related telephone survey that collects data from more than 400,000 U.S. residents 18years and older each year regarding their health-related risk behaviors, chronic health conditions, and use of preventive services. Since 2005 the question on global life satisfaction has been included in the BRFSS. Using a sample of 413,519 individuals drawn from the 2010 BRFSS, I regressed the individual level global life satisfaction to the same set of individual control variables as Oswald and Wu (2010), except the state dummies.[7] Then I have calculated the state-level average life satisfaction from the regression residuals. Obtaining state-level life satisfaction by including state dummies, as did Oswald and Wu (2010), is the same as obtaining them by averaging the individual-level residuals by state. I have adopted this method of averaging the residuals because, as described in the prior section, I have already used the same method for all measures of subjective well-being from the ATUS WB Module. For the measures of subjective well-being from the ATUS WB Module, the unit of analysis in the regression is an episode, not an individual, and the episode-level residuals from the regressions have to be weighted to produce state-level average residuals, which is not possible when state-level dummies are used instead.

**3. Results**

Table 1 shows the correlation among the state-level measures of subjective well-being without controlling for respondents' characteristics and the quality-of-life rankings. Because the quality-of-life rankings are an ordinal measure, I have reported the Spearman's rank correlation

[7] A few minor differences between Oswald and Wu (2010) and my BRFSS sample are i) they have excluded those above the age of 85; and ii) they have excluded those with income missing. The results are weighted by using the final weight (_FINALWT) from the BRFSS.

coefficients.[8] Table 1 illustrates that while the U-index and net affect are negatively and significantly correlated between the two, neither of them is significantly correlated with the quality-of-life rankings, although the signs of the correlation coefficients are in the right direction: positive for the U-index and negative for net affect. Meaningfulness is negatively correlated with the U-index, though insignificant at the 5 percent level, but significantly and positively correlated with net affect, 0.300, at the state level. More importantly, meaningfulness has a significant and negative correlation with the objective quality-of-life rankings. In Table 1, the absolute value of the Spearman's rank correlation coefficient between the two is greater than 0.5, which is a large association in behavioral science, according to Cohen's rule of thumb (Cohen 1988). The small value of correlation between meaningfulness and life satisfaction in Table 1 indicates that they are substantially different. Finally, when individual differences are not considered, life satisfaction has an insignificant correlation coefficient of around -0.272 with the quality-of-life rankings, which is a medium association according to Cohen's rule of thumb.

Because individual differences are not controlled for, the results in Table 1 reflect differences both in individuals and in states. To control for the differences in individual characteristics, as described in the prior section, I estimated the episode-level regressions using each of the *unweighted* measures of subjective well-being for each episode as the dependent variables (unpleasant, net affect, and meaningful). Table 2 shows the coefficients from these Ordinary Least Squares regressions, where standard errors have been adjusted for clustering by individual.[9] Because the dependent variables in this paper are the *unweighted* measures of subjective well-being for each *episode*, while those in the related literature are the *weighted*

[8] Though unreported, the Pearson product-moment correlation coefficients show more or less the same pattern as the Spearman's rank correlation coefficients in all tables.

[9] Instead of using different estimation methods, such as Logit or Ordered Logit, depending on whether the dependent variable is a dummy variable (unpleasant) or an ordered category between 0 and 6 (meaningful), I have used Ordinary Least Squares for comparability.

measures of subjective well-being by *individual*, it is not easy to directly compare the regression results in Table 2 to those in the literature. Nevertheless, the findings that unpleasantness increases with age at a decreasing rate and net affect decreases with age at an increasing rate in columns 1 and 2 of Table 2 are similar to those found in Krueger (2007, p. 207) with the U-index and Knabe et al. (2010, p. 882) for net affect. In column 3, meaningfulness of an episode also increases with age but at a decreasing rate. Different from the result in Krueger (2007) with the U-index, women have higher unpleasantness per episode than men, shown in column 1. However, women feel more meaningful than men, shown in column 3. While unpleasantness and net affect do not significantly vary by education in columns 1 and 2, more educated people have lower meaningfulness in column 3. Consistent with Knabe et al. (2010, p. 878), the coefficients on those who were unemployed (in columns 1 through 3) show that the unemployed felt more unpleasant, had lower net affect and felt less meaningful per episode than the employed. Finally, an episode in which respondents interacted with someone usually felt less unpleasant, had more net affect and felt more meaningful.

Kahneman, Krueger, Schkade, Schwarz, and Stone (2006) found a weak relation between income and experienced affect. They explained that such a weak relation could be because of hedonic adaptation—as people make more money, their aspirations quickly rise at the same time, resulting in no permanent gain in experienced affect—or because as income increases, although people experience more positive affect per episode by increasing in consumption of material goods, people shift their time use toward activities that are associated with higher tension and stress, such as work and commuting. In Table 2 of this paper, on the contrary, higher income decreases unpleasantness per episode in column 1 and increases net affect in column 2. The main reason for this difference between Table 2 and the findings of Kahneman et al. (2006) could be

because the dependent variables in Table 2 are unweighted measures of subjective well-being for each episode and the amount of time spent on each episode is not yet considered. Nevertheless, the findings in Table 2 are still consistent with the second explanation by Kahneman et al. (2006) that as income increases, people at least experience more positive affect per episode. However, the fact that higher income is associated with feeling less meaningful for each episode in column 3 seems to be at odds with both explanations and merits further research. Finally, the coefficients on the days of the week shown in columns 1 and 2 indicate that measures of positive affect decrease during weekdays compared with the weekend. However, column 3 shows that there is no change in meaningfulness between weekdays and weekends.

Table 3 shows the correlations among the state-level measures of subjective well-being obtained from the residuals of the above regressions. Still both the U-index and net affect have small and insignificant correlation coefficients with the quality-of-life rankings. Compared with Table 1, the correlation coefficient between meaningfulness and the objective measure have decreased slightly to -0.442 but are still significant in Table 3. Finally, the correlation coefficient between life satisfaction, obtained from the residuals of the regression described in section 2.4, and the quality-of-life rankings have increased to around -0.535, which is closer to the value found in Oswald and Wu (2010). Overall, the results in Tables 1 and 3 show that only meaningfulness and life satisfaction are significantly correlated with the quality-of-life rankings, regardless of controlling for individual differences.

As shown in Equation 1, the three measures of state-level subjective well-being based on time use are averages of measures of affect or meaningfulness using the weight based on activities and episode duration. Therefore, the variations across states in the three measures of subjective well-being based on time use could come from two sources: i) variations in activities

and the duration of the activities, and ii) variations in affect and meaningfulness for the same episode.[10] In an effort to discover the main source of the correlation between meaningfulness and the quality-of-life rankings found in Table 3, I have created two counterfactuals. First, to control for the differences in the activities, I have additionally included 309 activity dummies to the regressions. And to remove the effect of episode duration, I have divided the activity weight by the duration, because the activity weight variable in the ATUS WB Module, WUFNACTWT, already contains the duration of the selected episode. Second, to control for variations in affect and meaningfulness for the same episode among individuals, I assigned the overall average of affect and meaningfulness for the same activity, while keeping the activities and duration unchanged.

Table 4 shows that when only the differences in time use are controlled for, while keeping the variations in affect and meaningfulness unchanged, the correlation coefficient between meaningfulness and the objective rankings becomes -0.370, somewhat smaller than the value in Table 3, but still statistically significant.[11] In Table 5, however, when only the variations in affect and meaningfulness across individuals are removed by using the overall average value of affect and meaningfulness, while keeping the activities and duration unchanged, the correlation coefficient between meaningfulness and the objective rankings, -0.199, decreases by more than half of that in Table 3, and becomes insignificant. These results in Tables 4 and 5 indicate that those people living in states with better amenities tend to provide higher values for meaningfulness for similar activities than those living in states with poor amenities, but there is not much variation in time use across states.

[10] This is similar to the analysis of Knabe et al. (2010), who decomposed the difference in the experienced utility between unemployed and employed persons into two components: a saddening effect (differences in affect) and a time-composition effect (differences in time use).

[11] Because no such counterfactuals are possible, the state-level measures of average life satisfaction in Tables 4 and 5 are the same as that in Table 3.

## 4. Discussion

In an effort to examine how well various measures of subjective well-being reflect the objective differences in quality of life, this paper has analyzed the relationship between the three measures of subjective well-being based on the 2010 ATUS WB Module—net affect, the U-index and meaningfulness—and the objective quality-of-life ranking of the fifty states in the United States. The results show that whereas the U-index and net affect are uncorrelated with the objective quality-of-life ranking of the fifty states in the United States, the measure of meaningfulness shows a significant correlation with the objective ranking. And the reason for such a correlation between meaningfulness and the objective ranking is because people living in states with better quality of life felt more meaningful when engaged in similar activities than those living in states with poor amenities, not because time use varies substantially across states.

These empirical results certainly raise a few interesting questions. The first is whether the absence of significant correlation between the U-index and the quality-of-life ranking and between net affect and the quality-of-life ranking is because the U-index and net affect are relying on three randomly selected activities from a single day, which might be insufficient to provide enough information on respondents' subjective well-being. However, the fact that meaningfulness, another measure based on the same three randomly selected activities from a single day, is well correlated with the quality-of-life ranking shows that those activities in the ATUS WB Module provide enough information on respondents' subjective well-being.

The second question is whether the reason for such differences in correlations is because the measure of meaningfulness (also global life satisfaction) is directly using the responses in the ATUS WB Module (in the BRFSS), while both the U-index and net affect are transformations of

the direct responses and, as a results, may have measurement errors or lose valuable information available in the direct responses (Layard 2009; Loewenstein 2009). In order to see if that is the case, I have examined the Spearman's rank correlation coefficients between each of the direct responses to the four affect questions (happy, pain, sad, and stressed) and the quality-of-life rankings. After controlling for individual characteristics, the correlation coefficients with the quality-of-life rankings are -0.203 for happiness, 0.147 for pain, 0.074 for sadness, and 0.033 for stress, and none of them are statistically significant at the 5 percent level. This result indicates that even the direct responses to the affect questions are not significantly correlated with the quality-of-life rankings.

The U-index and net affect both measure the presence of pleasure and the absence of displeasure, which corresponds to affective (or hedonistic) views of subjective well-being, while meaningfulness and life satisfaction measure a cognitive state or a positive attitude towards one's life, which corresponds to cognitive (or attitudinal) views of subjective well-being (Angner 2010; Brülde 2007). Then the difference in correlations found in the previous section might be because of the fact that both the U-index and net affect are rather affective (or hedonistic) measures of subjective well-being, while both meaningfulness and life satisfaction are rather cognitive (or attitudinal) measures. However, further research is needed to understand why there are such differences depending on the nature of subjective well-being measured.

Krueger, Kahneman, Schkade, et al. (2009) suggested development of NTA based on the U-index to compare the well-being of groups of individuals, countries, and eras. However, the finding in this paper that the U-index is not correlated with the objective differences in the quality of human lives across states raises concerns about using it to monitor progress in quality of life beyond simple measures of income.

Between the two cognitive measures of subjective well-being found to be correlated with the objective quality-of-life ranking, meaningfulness, unlike the measure of global life satisfaction, is not likely to be influenced by contexts and moods, and also takes the duration of the life episode into account. In this sense, meaningfulness seems to be a better and reliable indicator of subjective well-being, although it still has a shortcoming of being a cardinal measure.

This is the first study that used the newly available 2010 ATUS WB Module to examine the external validity of the measures of subjective well-being. Even though the 2010 ATUS WB Module is a large sample, it does not yet cover all activities listed in the ATUS, and for some states, there seem to be too few observations for a more detailed analysis. When more data are available, it will be interesting to analyze which activities are contributing how much to the variations across states in meaningfulness. Finally, because the findings in this paper are based only on the U.S. data, they might not generalize to other countries. As more and more countries collect data on time use and subjective well-being, it would be fruitful to examine whether the same pattern of correlation is observed between the measures of subjective well-being and objective differences in quality of life.

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**Table 1 Spearman's Rank Correlation among the State-level Measures of Well-Being**

| | U-index | Net affect | Meaningfulness | Life satisfaction | Ranking |
|---|---|---|---|---|---|
| U-index | 1 | | | | |
| Net affect | -0.751*** | 1 | | | |
| Meaningfulness | -0.262* | 0.300** | 1 | | |
| Life satisfaction | 0.032 | 0.051 | 0.042 | 1 | |
| Ranking | 0.126 | -0.124 | -0.522*** | -0.272* | 1 |

Note: Only fifty states, excluding DC, are included because the quality-of-life ranking does not include DC.
* Statistically significant at the .10 level; ** Statistically significant at the .05 level; *** Statistically significant at the .01 level.

## Table 2 Coefficients of Episode Regressions

| Coefficient | (1) Unpleasant | (2) Net affect | (3) Meaningful |
|---|---|---|---|
| Age | 0.010*** | -0.083*** | 0.030*** |
| | (0.001) | (0.007) | (0.005) |
| Age squared | -0.000*** | 0.001*** | -0.000*** |
| | (0.000) | (0.000) | (0.000) |
| Female | 0.019*** | 0.019 | 0.184*** |
| | (0.005) | (0.038) | (0.028) |
| Black | -0.022*** | 0.367*** | 0.530*** |
| | (0.008) | (0.060) | (0.042) |
| Asian | 0.003 | 0.054 | 0.284*** |
| | (0.014) | (0.105) | (0.080) |
| Hispanic | 0.003 | 0.184*** | 0.411*** |
| | (0.009) | (0.062) | (0.043) |
| Native American | -0.046 | 0.446** | 0.517*** |
| | (0.029) | (0.227) | (0.161) |
| Other | 0.063** | -0.145 | 0.218* |
| | (0.028) | (0.199) | (0.122) |
| Some high school | -0.006 | 0.114 | -0.040 |
| | (0.018) | (0.143) | (0.091) |
| High school | -0.013 | 0.188 | -0.061 |
| | (0.017) | (0.130) | (0.081) |
| Some college | 0.000 | 0.094 | -0.146* |
| | (0.017) | (0.130) | (0.081) |
| College | -0.012 | 0.108 | -0.353*** |
| | (0.017) | (0.133) | (0.084) |
| Graduate | -0.019 | 0.121 | -0.346*** |
| | (0.018) | (0.137) | (0.088) |
| Married | -0.044*** | 0.444*** | 0.272*** |
| | (0.006) | (0.043) | (0.030) |
| Partner | -0.014 | 0.117 | 0.111 |
| | (0.014) | (0.101) | (0.079) |
| Self-employed | 0.008 | -0.087 | 0.124** |
| | (0.010) | (0.071) | (0.050) |
| Unemployed | 0.044*** | -0.364*** | -0.133** |
| | (0.012) | (0.084) | (0.060) |
| Not in labor force | 0.038*** | -0.300*** | -0.117*** |
| | (0.007) | (0.053) | (0.038) |
| Interacting with anyone | -0.026*** | 0.412*** | 0.665*** |
| | (0.004) | (0.030) | (0.024) |
| Family income missing | -0.069*** | 0.346*** | -0.137 |
| | (0.018) | (0.131) | (0.090) |
| Family income $10,000-$19,999 | -0.025* | 0.098 | -0.070 |
| | (0.015) | (0.107) | (0.071) |
| Family income $20,000-$34,999 | -0.050*** | 0.229** | -0.108 |
| | (0.014) | (0.099) | (0.067) |
| Family income $35,000-$49,999 | -0.074*** | 0.421*** | -0.187*** |
| | (0.014) | (0.102) | (0.070) |
| Family income $50,000-$74,999 | -0.077*** | 0.393*** | -0.164** |
| | (0.014) | (0.099) | (0.069) |
| Family income $75,000-$99,999 | -0.068*** | 0.365*** | -0.178** |
| | (0.015) | (0.104) | (0.073) |
| Family income $100,000-$149,999 | -0.076*** | 0.439*** | -0.246*** |

| | | | |
|---|---|---|---|
| | (0.015) | (0.105) | (0.075) |
| Family income $150,000 and over | -0.082*** | 0.426*** | -0.352*** |
| | (0.016) | (0.111) | (0.081) |
| Holiday | -0.064*** | 0.497*** | 0.364*** |
| | (0.016) | (0.127) | (0.095) |
| Monday | 0.049*** | -0.398*** | -0.035 |
| | (0.010) | (0.071) | (0.050) |
| Tuesday | 0.036*** | -0.305*** | 0.022 |
| | (0.010) | (0.068) | (0.050) |
| Wednesday | 0.050*** | -0.428*** | 0.053 |
| | (0.010) | (0.067) | (0.049) |
| Thursday | 0.042*** | -0.313*** | -0.014 |
| | (0.010) | (0.068) | (0.051) |
| Friday | 0.027*** | -0.278*** | -0.048 |
| | (0.009) | (0.069) | (0.050) |
| Saturday | 0.010 | -0.058 | -0.000 |
| | (0.007) | (0.052) | (0.038) |
| Constant | 0.014 | 4.399*** | 2.889*** |
| | (0.030) | (0.223) | (0.160) |
| Number of observations | 35,813 | 35,813 | 35,813 |
| R-squared | 0.023 | 0.038 | 0.060 |

Note: Robust standard errors are in parentheses. The regressions also include eleven month dummies. * Statistically significant at the .10 level; ** Statistically significant at the .05 level; *** Statistically significant at the .01 level.

**Table 3 Spearman's Rank Correlation among State-level Measures of Well-Being, Individual Characteristics Controlled For**

| | U-index | Net affect | Meaningfulness | Life satisfaction | Ranking |
|---|---|---|---|---|---|
| U-index | 1 | | | | |
| Net affect | -0.744*** | 1 | | | |
| Meaningfulness | -0.282** | 0.344** | 1 | | |
| Life satisfaction | -0.201 | 0.087 | 0.239* | 1 | |
| Ranking | 0.148 | -0.131 | -0.442*** | -0.535*** | 1 |

Note: Only fifty states, excluding DC, are included because the quality-of-life ranking does not include DC.
* Statistically significant at the .10 level; ** Statistically significant at the .05 level; *** Statistically significant at the .01 level.

**Table 4 Spearman's Rank Correlation among State-level Measures of Well-Being, Individual Characteristics, Activities, and Duration Controlled For**

| | U-index | Net affect | Meaningfulness | Life satisfaction | Ranking |
|---|---|---|---|---|---|
| U-index | 1 | | | | |
| Net affect | -0.729*** | 1 | | | |
| Meaningfulness | -0.293** | 0.220 | 1 | | |
| Life satisfaction | -0.194 | 0.051 | 0.297** | 1 | |
| Ranking | 0.085 | -0.096 | -0.370*** | -0.535*** | 1 |

Note: Only fifty states, excluding DC, are included because the quality-of-life ranking does not include DC.
* Statistically significant at the .10 level; ** Statistically significant at the .05 level; *** Statistically significant at the .01 level.

**Table 5 Spearman's Rank Correlation among State-level Measures of Well-Being, Individual Characteristics Controlled For, Same Affect and Meaningfulness for the Same Episode**

| | U-index | Net affect | Meaningfulness | Life satisfaction | Ranking |
|---|---|---|---|---|---|
| U-index | 1 | | | | |
| Net affect | -0.957*** | 1 | | | |
| Meaningfulness | -0.036 | 0.116 | 1 | | |
| Life satisfaction | -0.081 | 0.089 | 0.046 | 1 | |
| Ranking | -0.030 | 0.048 | -0.199 | -0.535*** | 1 |

Note: Only fifty states, excluding DC, are included because the quality-of-life ranking does not include DC.
* Statistically significant at the .10 level; ** Statistically significant at the .05 level; *** Statistically significant at the .01 level.

## Appendix

### Table A1 Quality-of-Life Ranks by State, 1990

| State | Quality-of-life rank | State | Quality-of-life rank |
|---|---|---|---|
| Alabama | 26 | Montana | 4 |
| Alaska | 23 | Nebraska | 16 |
| Arizona | 20 | Nevada | 29 |
| Arkansas | 3 | New Hampshire | 43 |
| California | 42 | New Jersey | 47 |
| Colorado | 34 | New Mexico | 14 |
| Connecticut | 32 | New York | 50 |
| Delaware | 30 | North Carolina | 17 |
| Florida | 10 | North Dakota | 6 |
| Georgia | 36 | Ohio | 33 |
| Hawaii | 38 | Oklahoma | 21 |
| Idaho | 5 | Oregon | 22 |
| Illinois | 48 | Pennsylvania | 35 |
| Indiana | 44 | Rhode Island | 12 |
| Iowa | 15 | South Carolina | 18 |
| Kansas | 19 | South Dakota | 2 |
| Kentucky | 24 | Tennessee | 28 |
| Louisiana | 8 | Texas | 25 |
| Maine | 9 | Utah | 39 |
| Maryland | 45 | Vermont | 13 |
| Massachusetts | 27 | Virginia | 31 |
| Michigan | 49 | Washington | 41 |
| Minnesota | 46 | West Virginia | 11 |
| Mississippi | 7 | Wisconsin | 37 |
| Missouri | 40 | Wyoming | 1 |

Source: Table 3 of Gabriel, Mattey, and Wascher (2003, pp. 635-636).

## Table A2 Descriptive Statistics of Individuals, Unweighted

| Variables | Mean | Minimum | Maximum |
|---|---|---|---|
| Unpleasant | 0.157 | 0 | 1 |
| Net affect | 3.34 | -6 | 6 |
| Meaningful | 4.29 | 0 | 6 |
| Age | 48.02 | 18 | 85 |
| Female | 0.564 | 0 | 1 |
| White | 0.666 | 0 | 1 |
| Black | 0.142 | 0 | 1 |
| Asian | 0.033 | 0 | 1 |
| Hispanic | 0.141 | 0 | 1 |
| Native American | 0.007 | 0 | 1 |
| Other | 0.012 | 0 | 1 |
| Less than some high school | 0.037 | 0 | 1 |
| Some high school | 0.082 | 0 | 1 |
| High school | 0.267 | 0 | 1 |
| Some college | 0.285 | 0 | 1 |
| College | 0.206 | 0 | 1 |
| Graduate | 0.122 | 0 | 1 |
| Married | 0.509 | 0 | 1 |
| Partner | 0.034 | 0 | 1 |
| Single | 0.458 | 0 | 1 |
| Self-employed | 0.073 | 0 | 1 |
| Unemployed | 0.064 | 0 | 1 |
| Not in labor force | 0.309 | 0 | 1 |
| Employed | 0.554 | 0 | 1 |
| Interacting with anyone | 0.555 | 0 | 1 |
| Family income missing | 0.042 | 0 | 1 |
| Family income less than $10,000 | 0.068 | 0 | 1 |
| Family income $10,000-$19,999 | 0.117 | 0 | 1 |
| Family income $20,000-$34,999 | 0.174 | 0 | 1 |
| Family income $35,000-$49,999 | 0.135 | 0 | 1 |
| Family income $50,000-$74,999 | 0.180 | 0 | 1 |
| Family income $75,000-$99,999 | 0.111 | 0 | 1 |
| Family income $100,000-$149,999 | 0.101 | 0 | 1 |
| Family income $150,000 and over | 0.072 | 0 | 1 |
| Holiday | 0.016 | 0 | 1 |
| Sunday | 0.259 | 0 | 1 |
| Monday | 0.097 | 0 | 1 |
| Tuesday | 0.103 | 0 | 1 |
| Wednesday | 0.102 | 0 | 1 |
| Thursday | 0.099 | 0 | 1 |
| Friday | 0.098 | 0 | 1 |
| Saturday | 0.242 | 0 | 1 |
| Number of observations | | 12,167 | |