EFFECTS OF LEISURE ACTIVITIES ON HAPPINESS IN THE CASE OF JAPAN

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Abstract

With the increase interest in adopting a form of happiness to policy goals, a wide range of studies on subjective well-being (*SWB*) have become available. Leisure is a key component of our daily life which can affect *SWB*. Leisure activities is said to reduce stress and promote health. It can be a social activity that provides a sense of belonging or the time can be used for self-development. There is a wide range of leisure activities such as sports, hobbies, volunteer participation and socializing. This paper examines the underlying characteristics of leisure activities by conducting a principal component analysis across leisure related variables by using cross section data for 47 prefectures in Japan. The main results find that regions with greater active/external type tend to have higher levels of *SWB*, and regions with greater self-development type tend to have lower levels of *SWB*.

Keywords: Subjective well-being, leisure, Japan
JEL classification: I31, Z00

1. Introduction

There has been increasing number of researches on subjective wellbeing (*SWB*) across a number of disciplines in order to understand the determinants of *SWB*. In the area of economics, the relationship between income and happiness have been conducted, and many empirical studies can be found to support that income will have positive impacts on happiness (e.g. ic, et al., 2003; Sanfey, and Teksoz, 2005; Deaton, 2008; Stevenson and Wolfers, 2008; Perovic and Golem, 2010; Ambrey and Fleming, 2012, 2014; Florida et al. 2013; Barrington-Leigh and Behzadnejad, 2017). These previous studies suggest that income is a factor to enhance happiness. Though, in order to achieve higher income, longer hours of work may be necessary. This may lead to less time for leisure activities. However, leisure is considered to have a positive impact on happiness. Leisure activities are considered to reduce stress and improve health (Westman and Eden,1997). There are past studies which show a positive relationship between physical leisure activities such as sports and *SWB* (Menec and Chipperfield, 1997; Chaplin, 2009). Leisure can also be a social activity (e.g. visiting friends and family) and provide a connection or affiliation which can provide a sense of belonging (Lloyd and Auld, 2002). As stated in Maslow (1954)'s hierarchy of needs, love and belonging is a basic need of humans after physiological and safety. Tourism, a popular leisure activity is identified to have a positive effect on *SWB* (e.g. De Bloom et al, 2010; Nawijn, 2011). The relationship between happiness and other leisure activities such as hobbies (Lu and Hu, 2005; Chaplin 2009) and internet and email usage (Koopman-Boyden and Reid, 2009) have also been investigated.

With the popular notions that leisure enhances *SWB*, further studies have been conducted to examine the role that leisure time plays in affecting happiness (Wang and Wong, 2011, 2014 and how ethnicity and leisure satisfaction affected people's happiness (Spiers and Walker, 2008). In examining leisure and its relationship with happiness, leisure activities have adopted various classifications. Lloyd and Auld (2002) distinguish between the two types of leisure variables, person-centred and place centred. The former variables are leisure participation, satisfaction and attitude, and the latter variables include leisure environment and resources. Lloyd and Auld (2002) also classify leisure activities into six categories (mass media, social activities, outdoor activities, sports activities, cultural activities, and hobbies) based on the frequency of their participation. Newman, Tay and Diener (2014) describe two aspects of leisure: structural and subjective. Structural aspect to leisure is defined by the time spent or activity conducted outside obligated work time and the subjective aspect is defined

by the individual's subjective sense of being engaged in leisure, through perceived leisure frequency and perceived participation in leisure. Furthermore, Newman Tay and Diener (2014) identify five core psychological mechanisms that links leisure activities to *SWB*: detachment-recovery, autonomy, mastery, meaning and affiliation. These are based on the theories of *SWB* by Maslow (1954), Ryff and Keyes (1995), Ryan and Deci (2000) and Csikszentmihalyi (1990) which identify the psychological needs required to enhance *SWB*. This paper employs a principal component analysis to seven leisure activities (media, relaxation, self-development, hobby and entrainment, sports, volunteer and community activities and relationship) in order to identify underlying characteristics of the leisure activities.

Concerning studies on Japan, Fujii et al. (2005) examine the impact of leisure activities on happiness, targeting welfare facilities in Osaka city and Hashimoto and Atsumi (2015) focus on senior citizens in Kurashiki city. Other than studies which focus on senior citizens, Wakamatsu et al. (2007) investigate factors that contribute to happiness of university students, which include friends, entertainment and study. Moreover, Kawakubo and Oguchi (2015) examine the effects of interaction with others on subjective happiness for Japanese between the ages 20 to 59. However, these studies do not investigate the underlying characteristics of leisure activities. Yamada (2000) attempts to do this by analysing the relationship between leisure and happiness of senior citizens by dividing them into three types: mental leisure group, physical leisure group and neither mental nor physical leisure group.

In order to fill the gaps of previous studies, this paper investigates the underlying characteristics of various leisure activities by employing a principal component analysis and examines the impact they have on happiness for a wide age range, using cross section data on the 47 prefectures in the case of Japan.

The structure of this paper is as follows. In the next section, the data and methods are explained. Section 3 examines the results and provides discussions. Finally, the conclusion is provided referring to policy implications from the results obtained in this paper.

2. Data and Methods

This section will provide explanation on the data and methods applied to the analysis. The data employed are as follows. Note that the term subjective well-being, life satisfaction and happiness are used interchangeably.

Subjective well-being (*SWB*)

This paper employs *SWB* as a dependent variable. The data is from the Japanese General Social Surveys (JGSS-2001) by the Institute of Regional Studies at Osaka University of Commerce in collaboration with the Institute of Social Science at the University of Tokyo (2001) where the answers to the question, "Are you currently happy?" were collected from 2,790 valid respondents from 20 to 89 years of age throughout Japan. The responses were categorised into five levels of satisfaction from happy to unhappy. The aggregated and averaged results at the Japan prefecture level are provided by Matsumoto (2010). These *SWB* by prefecture is provided in Appendix 1.

Leisure time (*LT*)

The principal component analysis is utilized which can be an effective tool to understand the underlying characteristics of the leisure activities which include media, relaxation, self-development, hobby and entrainment, sports, volunteer and community activities and relationship. The definitions of these leisure activities are described in Appendix 2. As represented in Table 1, the results of conducting the principal component analysis obtains seven components. Taking into consideration that the first 3 components in Table 1 shows the eigenvalue to be more than 1 and that in Figure 1 on the scree plot of the eigenvalues, a certain level of difference can be observed between the third and fourth components, the first three components are selected. According to Table 1, the cumulative proportion of those three components amount to 70.3%, which indicates that they will have large impacts on the variance. Therefore, considering the characteristics of the three components as mentioned

above and from the principal component loading of Table 2, the following interpretation is made for each component.

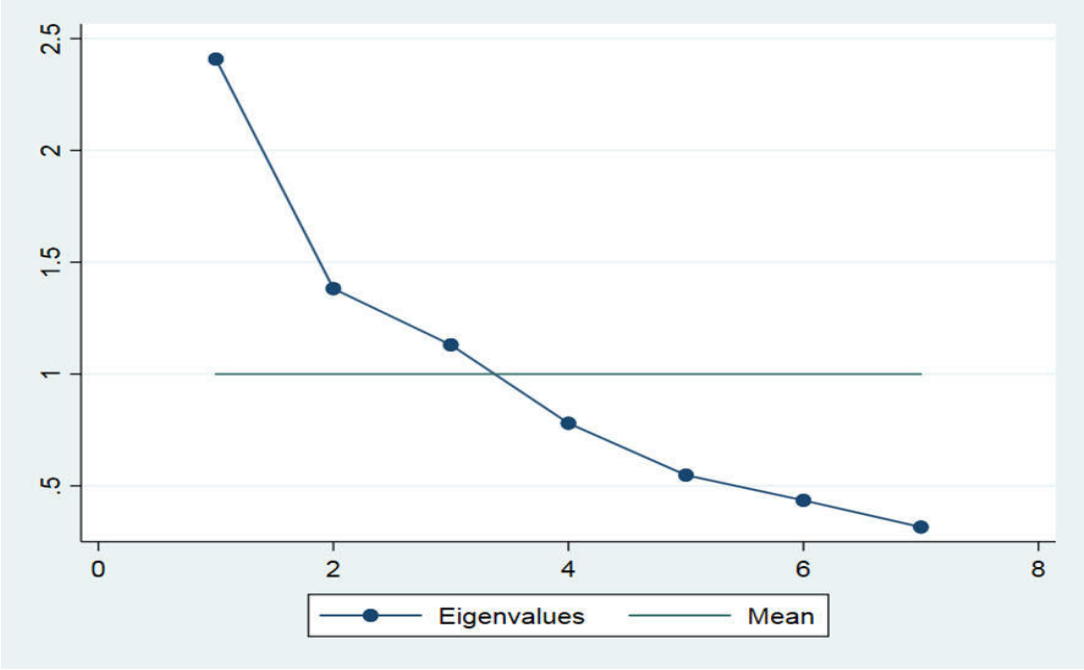
Table 1. Eigenvalues of observed matrix

Component	Eigenvalue	Difference	Proportion	Cumulative Proportion
Component 1	2.408	1.026	0.344	0.344
Component 2	1.382	0.252	0.197	0.542
Component 3	1.130	0.350	0.162	0.703
Component 4	0.780	0.232	0.111	0.814
Component 5	0.548	0.113	0.078	0.893
Component 6	0.435	0.119	0.062	0.955
Component 7	0.316	.	0.045	1.000

Table 2. Principal component loadings

Component	*Media*	*RX*	*SD*	*H/E*	*Sport*	*V/C*	*RP*
Component 1	-0.059	-0.426	0.557	0.450	-0.158	0.521	-0.076
Component 2	-0.480	-0.281	0.077	-0.072	0.600	-0.040	0.565
Component 3	0.696	-0.091	-0.137	0.447	0.094	-0.132	0.513
Component 4	0.129	0.522	0.159	0.254	0.683	0.211	-0.331
Component 5	-0.045	0.562	0.082	-0.191	-0.274	0.528	0.534
Component 6	0.493	-0.333	0.069	-0.671	0.248	0.353	-0.080
Component 7	0.144	0.177	0.793	-0.205	-0.062	-0.512	0.105
Unexplained	0	0	0	0	0	0	0

Figure 1. Scree plot of eigenvalues after principal component analysis



Component 1: “Self-development type (*SD-T*)”

Examining the principal component loading, *SD*, *V/C* and *H/E* are positive and large, while *RX* is negative and large. None of the other variables show any distinguished characteristics. These variables are related to education and contribution to society and so will be interpreted as the self-development type.

Component 2: "Active/External type (*AE-T*)"

This type shows positive and large values for *SPORT* and *RP*, but negative and large for *Media*. This implies that this type prefers external activities opposed to quiet internal activities. Therefore, we will identify this as the active/external type.

Component 3: "Entertainment type (*Ent-T*)"

This type shows a clear preference for *Media*. In addition, it shows a positive and large value for *RP* and *H/E*. The other variables show no distinguished characteristics. Hence, from these three variables, we will interpret this type to prefer relaxing and having fun.

Social/Economic Variables (*SocEcon*)

Other than leisure variables, this paper includes the following social and economic variables to control social and economic factors which will have an impact on *SWB*.

Real gross income per capita for each prefecture (*RPIpc*)

There are several previous empirical studies on the relationship between income and happiness. Frey and Stutzer (2002) find that income has a positive impact on *SWB* which is supported by a number of studies (e.g. Di Tella, et al., 2003; Sanfey, and Teksoz, 2005; Deaton, 2008; Stevenson and Wolfers, 2008; Perovic and Golem, 2010; Ambrey and Fleming, 2012, 2014; Florida et al. 2013; Barrington-Leigh and Behzadnejad, 2017). However, there are also studies that do not support this (e.g. Oswald, 1997; Layard, 2005; Boarini et al. 2006). This paper will examine the real gross income per capita for each prefecture (*RPIpc*) as the indicator for income. This paper will employ *RPIpc* which is expressed in natural logarithm, since the relationship between income and *SWB* is log linear (i.e. shows diminishing returns) (Sacks et al., 2010),

Marital status (*Mrd*)

Concerning previous empirical studies on the relationship between marital status and *SWB*, Perovic and Golem (2010) find that being single has negative and significant impact on *SWB* in transition countries. Studies on marital status for individual countries find significant relationships with *SWB* as in the analysis by Frey and Stutzer (2000) on Switzerland, Ambrey and Fleming (2012, 2014) on Australia, Barrington-Leigh and Behzadnejad (2017) on Canada. Similar results were found for Japan by Kuroki (2011), Ohtake (2004), Tsutsui, Ohtake and Ikeda (2009) and Morikawa (2010). This paper adopts the married couple rate (*Mrd*) which is expected to have a positive impact on *SWB*. *Mrd* is calculated from the ratio of married couples to the population over 15 years of age.

Safety (*Safety*)

The disaster rate is used as the safety related variable. The larger this index is, the lower the *SWB* is expected to be, since the region with high disaster rate represents higher risks. There is a previous study on the relationship between forest fire and happiness in Barcelona (Sekulova and van den Bergh, 2013). In this paper, the disaster rate is calculated through dividing the disaster damage costs by population. The disaster represents storms, heavy rain, floods, high tides, earthquakes, tsunamis, volcanic eruptions and others natural disasters.

Environmental variables (*Env*)

This paper includes climate variables to represent environmental factors since climate has a wide range of impacts which may affect *SWB*, such as the need for domestic heating and cooling, influence clothing requirements, change peoples' calorific requirements and restrict outdoor leisure activities (Maddison and Rehdanz, 2011). Climate may also possess potential health impacts such as stress and mental health disorder. Hence, this paper employs the following wide range of climate related variables.

Difference in temperature (*TempDif*)

Since large differences in temperature are considered to be taxing to adapt to, large differences in temperatures throughout the year is expected to decrease *SWB*. This was confirmed by Maddison and Rehdanz (2011) where they found that larger deviations from a

base temperature of 18.3°C lowers the life satisfaction. The impact of temperature differences has been examined using other methods. Barrington-Leigh and Behzadnejad (2017) examine the yearly and daily average differences in maximum and minimum temperatures and Frijters and Van Praag (1998) studied the difference between maximum and minimum temperature in one calendar year, the average temperature in January and July, and the annual average temperature. Florida, Mellander and Rentfrow (2013) used the average temperature in January and July and the difference between them. This paper examines the temperature from the month with the highest average daily maximum temperature with the temperature from the month with the lowest average daily minimum temperature.

Precipitation (*PD*)

Several previous empirical studies research the relationship between precipitation and *SWB* (e.g. Frijters and Van Praag, 1998; Maddison and Rehdanz, 2011; Feddersen et al., 2016; Barrington-Leigh and Behzadnejad, 2017). This paper examines the number of days of precipitation (*PD*). *PD* represents the number of days in a year with more than 1 mm of precipitation.

Annual average duration of sunshine (*Sun*)

The relationship between the amount of sunshine and *SWB* has been studied by Murray, Maddison and Rehdanz (2011) for Europe, where they found sunshine to have significant impact on *SWB* and Frijters and Van Praag (1998) also find a positive and significant impact in Russia. The same was found in the study by Feddersen, Metcalfe and Wooden (2016) on Australia. *Sun* examined in this paper represents the annual sum of hours that direct sunlight irradiates the surface of the earth.

Annual average relative humidity (*Hum*)

Humidity has been found to have significant negative impact on *SWB* in the studies by Murray, Maddison and Rehdanz (2011) on Europe, Frijters and Van Praag (1998) on Russia and Feddersen, Metcalfe and Wooden (2016) on Australia. Here, we use the annual average relative humidity (*Hum*) to examine its relationship with *SWB*.

The data source for the dependent and independent variables are provided in Appendix 3. Japan prefecture level data for all 47 prefectures for the year of 2001 are applied as the cross section data for the variables.

The following equation represents the basic model used to examine the determining factors impacting *SWB*.

$$SWB_i = \alpha + \beta_{1i} LT_i + \beta_{2i} SocEcon_i + + \beta_{3i} Env_i + e_i \qquad (1)$$

LT is the leisure related factors obtained by the principal component analysis, which represents *SD-T, AE-T, Ent-T*. *SocEcon* denotes social and economic factors including *RPIpc*, *Mrd*, *Safety*. *RPIpc* which are expressed in natural logarithms. *Env* refers to the climate related variables including *TempDif*, *PD*, *Sun* and *Hum*. *i* represents prefecture. *e* is the prefectural level error term.

The explanation of the models based on the above equation (1) is provided below. First, the correlation between *PD* and *Hum* are expected to be positive while the correlation between *PD* and *Sun* are predicted to be negative. Moreover, the correction between *Sun* and *Hum* is thought to be negative. Furthermore, the correlations between each of these three variables and *TempDif* are expected to be limited. The results of the correlations show that the correlation between the three variables and *TempDif* could not be clearly identified while the correlation among the three variables were found (See Appendix 4). Therefore, there is the possibility of multicollinearity if these three independent variables are included in the model at the same time. Hence, *PD*, *Sun*, *Hum* will be included independently in the models.

3. Results and Discussions

First, we will review the main results in Table 3 for each of the *LT* models. Models (1) - (3) only include *PD,* Models (4) - (6) only include *Sun* and Models (7) - (9) only include *Hum,* as the climate factor. Table 3 shows that the estimates of the coefficients are significantly negative in all the models for *SD-T*. This suggests that regions with a greater value of self-development type tend to have lower levels of *SWB*. This may be due to self-development type feeling less satisfied which motivates them to spend time in self-development or they are more vulnerable to social pressure to spend their time on self-development activities or the self-development type activities may be the cause for stress or frustration. On the other hand, with respect to *AE-T*, which is the second principal component, regions with a greater value of active/external types significantly show higher levels of *SWB* in all the models. This suggests that interaction with other people and participation in sports which provide opportunities to obtain social relations affect well-being, as found in previous studies (e.g. OECD, 2013; Kawakubo and Oguchi, 2015). Finally, with regards to *Ent-T*, the estimates of the coefficients are positive in all the models but are insignificant.

With regards to the results other than leisure related factors, regions with more disasters which is a proxy for safety has been identified to significantly decrease *SWB* in over half of the models. This implies that safety can have an impact on *SWB,* which supports the study by Sekulova and van den Bergh (2013). As for *TempDif,* one of the climate factors, is also found to have a significant negative impact on *SWB* in all the model except Model (9). This suggests that the larger difference in temperature leads to lower *SWB*, since the differences in temperatures creates the need to make adjustments in their daily lives and to maintain their health status. This result supports previous research conducted by Maddison and Rehdanz (2011). We also found that in all the models the estimates of the coefficients for *PD* and *Hum* are negative and statistically significant and those for *Sun* are significantly positive. The result for *PD* supports the previous researches such as Barrington-Leigh and Behzadnejad (2017) and the results for *Hum* and *Sun* is consistent with studies such as Frijters and Van Praag (1998), Brereton, Clinch and Ferreira (2008), Murray, Maddison and Rehdanz (2011) and Feddersen, Metcalfe and Wooden (2016). *RPIpc* and *Mrd* did not show significant and consistent results, which mean these results did not support that income and marriage status have impact on happiness, whereas previous studies on the relationship between income and happiness (e.g. Deaton, 2008; Stevenson and Wolfers, 2008; Perovic and Golem, 2010) and between marriage status and happiness (e.g. Frey and Stutzer, 2000; Ohtake, 2004; Perovic and Golem, 2010; Kuroki, 2011; Ambrey and Fleming, 2012, 2014; and Barrington-Leigh and Behzadnejad, 2017) achieved significant results.

Table 3. Determinants of SWB

Variables	Model (1)	Model(2)	Model(3)	Model(4)	Model(5)	Model(6)	Model(7)	Model(8)	Model(9)
RPIpc	0.233	-0.0531	-0.0958	0.0194	-0.192	-0.215	-0.0784	-0.337	-0.350
	(0.256)	(0.230)	(0.240)	(0.241)	(0.213)	(0.222)	(0.251)	(0.236)	(0.245)
Mrd	-2.418	5.274	-0.243	2.448	9.532	6.211	-5.388	2.181	-2.032
	(6.107)	(6.403)	(7.158)	(6.128)	(6.069)	(6.864)	(5.496)	(5.690)	(6.099)
Safety	-9.119**	-4.838	-6.650	-10.63***	-7.184*	-9.147**	-7.911**	-3.931	-5.772
	(4.001)	(4.201)	(4.280)	(3.815)	(3.939)	(4.061)	(3.834)	(4.086)	(4.095)
TempDif	-0.0204**	-0.0203**	-0.0192*	-0.0241***	-0.0241***	-0.0251**	-0.0169*	-0.0173*	-0.0168
	(0.00884)	(0.00911)	(0.0107)	(0.00843)	(0.00850)	(0.0101)	(0.00850)	(0.00884)	(0.0100)
PD	-0.00358***	-0.00329***	-0.00277**						
	(0.00109)	(0.00111)	(0.00132)						
Sun				0.000664***	0.000673***	0.000659***			
				(0.000160)	(0.000161)	(0.000190)			
Hum							-0.0307***	-0.0280***	-0.0255**
							(0.00806)	(0.00828)	(0.00958)
SD-T	-0.0614**			-0.0464**			-0.0611**		
	(0.0247)			(0.0229)			(0.0237)		
AE-T		0.0501*			0.0450*			0.0459*	
		(0.0264)			(0.0243)			(0.0257)	
Ent-T			0.0173			0.00259			0.0149
			(0.0340)			(0.0308)			(0.0319)
Constant	4.665***	4.858***	4.905***	3.282***	3.413***	3.559***	6.663***	6.686***	6.589***
	(0.406)	(0.402)	(0.442)	(0.463)	(0.453)	(0.470)	(0.706)	(0.734)	(0.864)
B-P/C-W test	0.25	0.88	1.35	0.02	0.13	0.06	0.46	0.87	0.48
Prob > chi2	0.6185	0.3478	0.2453	0.8748	0.7207	0.8146	0.4996	0.3521	0.4904
Ramsey RESET	0.34	0.66	0.23	0.86	0.24	0.36	0.89	2.1	1.68
Prob > F	0.7952	0.5838	0.872	0.4697	0.8666	0.7852	0.4537	0.1163	0.189
C/T IM-test	5.42	4.18	2.61	6.7	3.67	3.55	7.74	7.05	4.69
P-value	0.4909	0.6518	0.8562	0.3499	0.7215	0.7378	0.258	0.3163	0.5835
Observations	47	47	47	47	47	47	47	47	47
Adj. R-squared	0.3092	0.2678	0.2072	0.3874	0.378	0.3246	0.3555	0.3042	0.2527

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
B-P/C-W test: Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ramsey RESET: Ramsey regression specification-error test for omitted variables
C/T IM-test: Cameron & Trivedi's decomposition of information matrix test

Table 4. Variance inflation factors for each independent variable

Variable	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)
RPIpc	1.76	1.34	1.35	1.76	1.36	1.35	1.82	1.49	1.49
Mrd	1.79	1.86	2.14	2.03	1.97	2.31	1.56	1.54	1.65
Safety	1.24	1.29	1.24	1.27	1.34	1.31	1.22	1.28	1.2
TempDif	1.08	1.08	1.39	1.11	1.11	1.45	1.07	1.07	1.29
PD	1.47	1.44	1.89						
Sun				1.68	1.69	2.16			
Hum							1.5	1.47	1.83
SD-T	2.1			2.03			2.08		
AE-T		1.3			1.29			1.29	
Ent-T			1.63			1.57			1.53
Mean VIF	1.57	1.39	1.61	1.65	1.46	1.69	1.54	1.36	1.5

To assess the robustness of the results, the omitted variables in Models (1) - (9) of Table 3 will be investigated. The existence of omitted variables will lead to the problem of endogeneity, and therefore will influence the ability to obtain consistent and unbiased estimates. Hence, the Ramsey (1969) regression specification-error test (RESET) was conducted for omitted variables. The results in Table 3 shows that for all the models, it was not possible to reject the null hypothesis, which require no omitted valuables. Next, the condition of normality is assessed for each model of Table 3. The models need to satisfy normality for adequate statistical hypothesis testing to be made. Therefore, the conditional moments test with third-order moment conditions of Cameron & Trivedi's decomposition of information matrix (IM)-test was conducted. The results find that the null hypothesis of

normality cannot be rejected in all the models of Table 3. Furthermore, the test for homoscedasticity is performed. With heteroscedasticity, OLS estimator is not the best linear unbiased estimator (BLUE), and statistical inference would be biased, and t-statistics and F-statistics are inappropriate. Hence, the Breusch-Pagan / Cook-Weisberg test for heteroscedasticity was performed. From the results in Table 3, the null hypothesis of homoscedasticity could not be rejected in all the models.

Next, the variance inflation factors (VIFs) is calculated to confirm whether there is, in fact, the possibility of multicollinearity in the models of Table 3. From the results of Table 4, high value of VIFs could not be found for any of the variables in all the models since even the highest value of VIFs is 2.31 for *Mrd*. Hence, the assessment is that there is no fear of multicollinearity in all the models of Table 3.

Table 5. The mean of the standardized beta coefficients for each independent variable

Variable	Mean of standardized beta coefficient (absolute value)	Rank
Safety	0.258	6
TempDif	0.298	5
PD	0.458	3
Sun	2.678	1
Hum	0.516	2
SD-T	0.405	4
AE-T	0.256	7

Finally, the magnitude of the effects of each independent variable on *SWB* are assessed by calculating the standardized beta coefficients which are normalized by the ratio of the standard deviation of the regressor to the standard deviation of the dependent variable. The independent variables are examined for statistical significance and the means of these variables are compared. The results in Table 5 shows that the largest standardized beta coefficient which affects *SWB* is *Sun* (2.678). The second largest standardized beta coefficient is *Hum* (0.516), followed closely by *PD* (0.458). The fourth is *SD-T* (0.405), followed by *TempDif* (0.298), and *Safety* is sixth (0.258), followed by *AE-T* (0.256) with little difference. The results indicate that most of the climate variables have larger impacts on *SWB* than leisure activities.

4. Conclusions

A range of determining factors of *SWB* for Japan, with a focus on leisure related variables were examined. The results find that regions with higher self-development type leisure activities tend to have lower levels of *SWB*. Since this analysis employs the structural aspect of leisure (Newman et al., 2014), it does not take into consideration whether the individual perceived to be engaged in leisure through these activities. This provides an opportunity to conduct an analysis on the subjective aspect of leisure to understand the lower levels of *SWB* for this type. Moreover, some policy implications may also be found from the results. Since relationship related active/external type leisure activities is found to have a positive effect on *SWB*, these activities may be encouraged through the support of promotion of these activities and provisions of infrastructure. Further planning and preparation for natural disasters may also improve well-being. It may be necessary not only to provide reinforcement of infrastructures but to review the policies, systems and management to have the greatest impact in improving subjective well-being in the region. Furthermore, as climate factors such as temperature difference, humidity, precipitation and sunshine affect well-being, it will be necessary to improve services, goods and living environments to improve comfort from these climate factors.

Acknowledgement

The Japanese General Social Surveys (JGSS) are designed and carried out at the Institute of Regional Studies at Osaka University of Commerce in collaboration with Institute of Social Science at the University of Tokyo under the direction of Ichiro TANIOKA, Michio NITTA, Hiroki SATO and Noriko IWAI with Project Manager, Minae OSAWA. The project is financially assisted by Gakujutsu Frontier Grant from the Japanese Ministry of Education, Culture, Sports, Science and technology for 1999-2003 academic years, and the datasets are complied and distributed by SSJ Data Archive, Information Center for Social Science Research on Japan, Institute of Social Science, the University of Tokyo.

References

Ambrey, C. L. and Fleming, C. M. 2012. Valuing Australia's protected areas: A life satisfaction approach. New Zealand Economic Papers, Vol. 46 (3): 191-209.

Ambrey, C. L. and Fleming, C. M. 2014. Public greenspace and life satisfaction in urban Australia. Urban Studies, Vol. 51(6): 1290–1321.

Barrington-Leigh, C. and Behzadnejad, F. 2017. The Impact of Daily Weather Conditions on Life Satisfaction: Evidence from Canadian Cross-sectional and Panel Data. Journal of Economic psychology, Vol. 59: 145-163.

Boarini, R., Johansson, A., and d'Ercole, M. M. 2006. Alternative Measures of Well-being. OECD Economics Department Working Paper, No. 476.

Brereton, F., Clinch, J. P., and Ferreira S. 2008. Geography, Happiness and the Environment. Ecological Economics, Vol. 65: 386 – 396.

Chaplin, L. N. 2009. Please May I Have a Bike? Better Yet, May I Have a Hug? An Examination of Children's and Adolescents' Happiness. Journal of Happiness Studies, Vol.10: 541–562.

Csikszentmihalyi, M. 1990. Flow: The Psychology of Optimal Experience. New York: HarperPerennial.

Deaton, A. 2008. Income, health, and well-being around the world: Evidence from the Gallup World Poll. Journal of Economic Perspectives, Vol. 22(2): 53–72.

De Bloom, J., Geurts, S. A. E., Taris, T. W., Sonnentag, S., De Weerth, C., and Kompier, M. A. J. 2010. Effects of vacation from work on health and well-being: Lots of fun, quickly gone. Work and Stress, Vol. 24(2): 196-216.

Di Tella, R., MacCulloch, R., and Oswald, A. 2003. The Macroeconomics of Happiness. Review of Economics and Statistics, Vol. 85: 809-827.

Feddersen, J., Metcalfe, R., and Wooden, M. 2016. Subjective wellbeing: why weather matters. JOURNAL OF THE ROYAL STATISTICAL SOCIETY SERIES A-STATISTICS IN SOCIETY, Vol. 179 (1): 203 – 228.

Florida, R., Mellander, C., and Rentfrow, P. J. 2013. The happiness of cities. Regional studies, Vol. 47 (4): 613-627.

Frey, B. S. and Stutzer, A. 2000. Happiness, Economy and Institutions. Economic Journal, Vol. 110 (466): 918–938.

Frey, B. and Stutzer, A. 2002. Happiness and Economics. How the Economy and Institutions Affect Human Well-being, Princeton and Oxford: Princeton University Press.

Fujii, N., Ono, R., Yoneda, T., Shinohara, H., Nakata, Y., Nagao, T., and Ishikawa, Y. 2005. Relationship between leisure-time physical activities and quality of life in the community-dwelling older people. Kobe Daigaku Igakubu Hokengakka Kiyo, Vol. 20: 53-60.

Frijters, P. and Van Praag, B. M. 1998. The effects of climate on welfare and well-being in Russia. Climate Change, Vol. 39: 61–81.

Hashimoto, S. and Atsumi, N. 2015. A study on relationship between the leisure activities and the feeling of happiness of aged person. Journal of Japan Society of Civil Engineers, Ser. D3 (Infrastructure Planning and Management), Vol. 71 (5): I567-I576.

Kawakubo, A., and Oguchi, T. 2015. The influence of interaction with others in vacation on subjective happiness and depression. Stress Kagaku Kenkyu, Vol. 30: 69-76.

Koopman-Boyden, P. G., and Reid, S. L. 2009. Internet/E-mail Usage and Well-Being Among 65–84 Year Olds in New Zealand: Policy Implications. Educational Gerontology, Vol.35 (11): 990-1007.

Kuroki, M. 2011. Does social trust increase individual happiness in Japan? Japanese Economic Review, Vol. 62(4): 444-459.

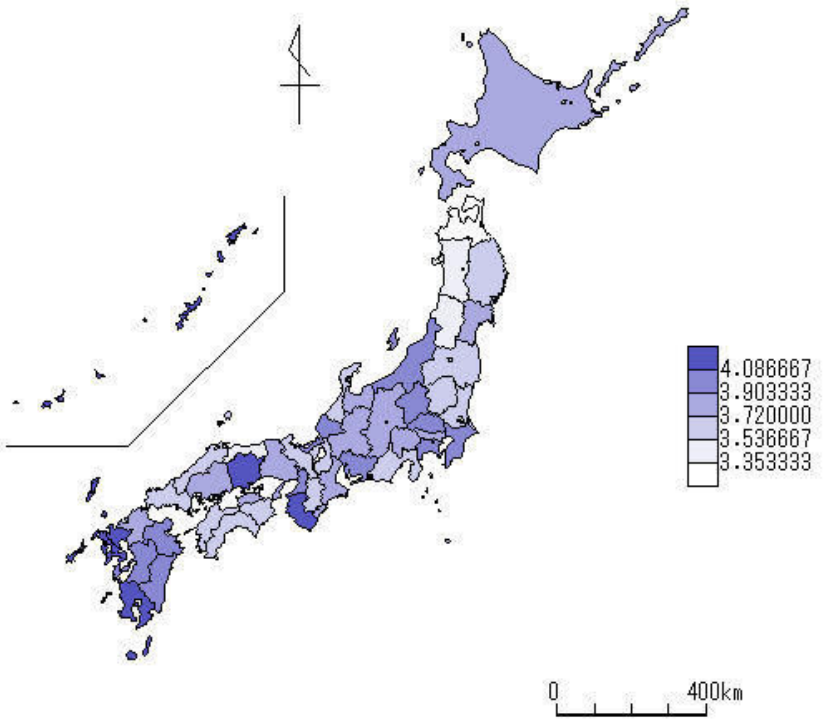
Layard, R. 2005. Happiness: lessons form a New Science. London: Penguin Books.

Lloyd, K. M. and Auld, C. J. 2002. The Role of Leisure in Determining Quality of Life: Issues of Content and Measurement. Social Indicators Research, Vol. 57 (1): 43–71.

Lu, L., and Hu, C-H. 2005. Personality, leisure experiences and happiness. Journal of Happiness Studies, Vol. 6: 325–342.
Maddison, D. and Rehdanz, K. 2011. The impact of climate on life satisfaction. Ecological Economics, Vol. 70 (12): 2437–2445.
Maslow, A. H. 1954. Motivation and Personality. New York: Harper.
Matsumoto, N. 2010. Clarification of value of social relations for subjective well-being -analysis of determinants of subjective well-being based on a social relationship structure model -. MSc thesis. Graduate School of System Design and Management, Keio University.
Menec, V. H., and Chipperfield, J. G. 1997. Remaining active in later life: The role of locus of control in senior's leisure activity participation, health, and life satisfaction. Journal of Aging and Health, Vol. 9(1): 105-125.
Morikawa, M. 2010. Chiiki kan keizai kakusa ni tsuite: Jishitsu chingin/koufukudo (Regional differences in the economy: real wage / happiness), RIETI discussion paper series, 10-J-043.
Murray, T., Maddison, D., and Rehdanz, K. 2011. Do geographical variations in climate influence life satisfaction?. Kiel Working Papers, 1694, Kiel Institute for the World Economy.
Nawijn, J. 2011. Happiness through Vacationing: Just a Temporary Boost or Long-Term Benefits? Journal of Happiness Studies, Vol.12(4): 651-665.
Newman, D. B., Tay, L., and Diener, E. 2014. Leisure and subjective well-being: A model of psychological mechanisms as mediating factors. Journal of Happiness Studies: An Interdisciplinary Forum on Subjective Well-Being, Vol.15(3): 555–578.
OECD 2013. OECD Guidelines on Measuring Subjective Well-being, https://www.oecd-ilibrary.org/economics/oecd-guidelines-on-measuring-subjective-well-being_9789264191655-en
Ohtake, F. 2004. Unemployment and Happiness. The monthly journal of the Japan Institute of Labour, Vol. 528: 59-68.
Oswald, A. 1997. Happiness and Economic Performance. Economic Journal, Vol. 107(445): 1815-1831.
Perovic, L. M. and Golem, S. 2010. Investigating Macroeconomic Determinants of Happiness in Transition Countries. Eastern European Economics, Vol. 48(4): 59-75.
Ramsey, J. B. 1969. Tests for Specification Errors in Classical Linear Least Squares Regression Analysis. Journal of the Royal Statistical Society: Series B, Vol. 31: 350-371.
Ryan, R. M., and Deci, E. L. 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, Vol. 55: 68-78.
Ryff, C. D., and Keyes, C. L. 1995. The Structure of Psychological Well-Being Revisited. Journal of Personality and Social Psychology, Vol. 69: 719 – 727.
Sacks, W. D., Stevenson, B., and Wolfers, J. 2010. Subjective well-being, income, economic development and growth. NBER working papers, No. 16441.
Sanfey, P. and Teksoz, U. 2005. Does Transition Make You Happy?, EBRD Working Paper, No. 91.
Sekulova, F. and van den Bergh, J. C. J. M. 2013. Climate change, income and happiness: An empirical study for Barcelona. Global Environmental Change, Vol. 23: 1467–1475.
Spiers, A. and Walker, G. D. 2008. The Effects of Ethnicity and Leisure Satisfaction on Happiness, Peacefulness, and Quality of Life, Leisure Sciences, Vol. 31: 84–99.
Stevenson, B. and Wolfers, J. 2008. Economic Growth and Subjective Well-Being: Reassessing the Easterlin Paradox. National Bureau of Economic Research Working Paper Series, No. 14282. Retrieved from http://www.nber.org/papers/w14282
The Institute of Regional Studies at Osaka University of Commerce and the Institute of Social Science at the University of Tokyo 2001. The Japanese General Social Surveys (JGSS-2001).
Tsutsui, Y., Ohtake, F., and Ikeda, S. 2009. The reason why you are unhappy. Osaka Economic Papers, Vol. 58(4): 20-57.
Wakamatsu, T., Uchiyama, S., Mohara, N., and Ohki, M. 2007. Factors which contribute to the quality of life in university students (1). Bulletin of Living Science, Vol. 29:189-202.
Wang, M., and Wong, M. C. S. 2011. Leisure and Happiness in the U.S.: Evidence from Survey Data. Applied Economics Letters, Vol. 18 (18): 1813-1816.
Wang, M., and Wong, M. C. S. 2014. Happiness and Leisure Across Countries: Evidence from International Survey Data. Journal of Happiness Studies, Vol. 15(1): 85-118.
Westman, M., and Eden, D. 1997. Effects of a respite from work on burnout: vacation relief and fade-out. Journal of Applied Psychology, Vol. 82:516.
Yamada, N. 2000. The Relationship between leisure activities, psycho-social development and life satisfaction in late adulthood. The Japanese Journal of Development Psychology, Vol. 11(1): 34-44.

Appendices

Appendix 1. SWB by Prefecture



Appendix 2. Definition of each Leisure Activity

Leisure activities	Definition
Television, radio, newspaper and magazine (*Media*)	Time spent watching television, listening to radio, reading newspapers and magazines (print and web).
Self-development (*SD*)	Time spent on education, self-development, and training during free time.
Relaxation (*RX*)	Time spent relaxing with family; breaks during work or school; tea/coffee breaks and taking naps.
Hobby/entertainment (*H/E*)	Time spent on hobbies and entertainment.
Sport (*Sport*)	Time spent on sports
Volunteer/community activity (*V/C*)	Time spent participating in volunteer/community activities such as cleaning parks and local community, fund raising, helping elders, recycling activities, traffic safety activities, PTA and election campaign activities.
Relationship (*RP*)	Time spent socializing and dining with friends, such as attending, weddings, school reunions and visiting/inviting friends.

Time spent on the leisure activities are obtained, based on average hours per days. It is calculated through average hours for weekdays multiplied by 5 days plus hours for Saturday and hours for Sunday.

Appendix 3. Data Sources

Variable	Source
Subjective well-being (*SWB*)	Japanese General Social Survey 2001: Institute of Regional Studies, Osaka University of Commerce in collaboration with Institute of Social Science, the University of Tokyo. The data are aggregated and averaged at prefecture level by Matsumoto (2010).
Income per capita (*RPIpc*)	Prefectural Accounts; Cabinet Office, Population Census, Population Estimates; Ministry of Internal Affairs and Communications
Married rate (*Mrd*)	Population Census, Population Estimates; Ministry of Internal Affairs and Communications
Disaster rate (*Safety*)	White paper on Fire Service, Population Census, Population Estimates; Ministry of Internal Affairs and Communications
Difference of temperature (*TempDif*)	Past Meteorological data; Japan Meteorological Agency
Days of precipitation (*RD*)	Past Meteorological data; Japan Meteorological Agency
Sunshine duration (*Sun*)	Past Meteorological data; Japan Meteorological Agency
Annual average relative humidity (*Hum*)	Past Meteorological data; Japan Meteorological Agency
Leisure time (*LT*)	Survey on time use and leisure activities; Ministry of Internal Affairs and Communications

Appendix 4. Correlation of the Climate Variables

Variables	*TempDif*	*PD*	*Sun*	*Hum*
TempDif	1.000			
PD	-0.064	1.000		
Sun	0.149	-0.770	1.000	
Hum	-0.040	0.703	-0.686	1.000