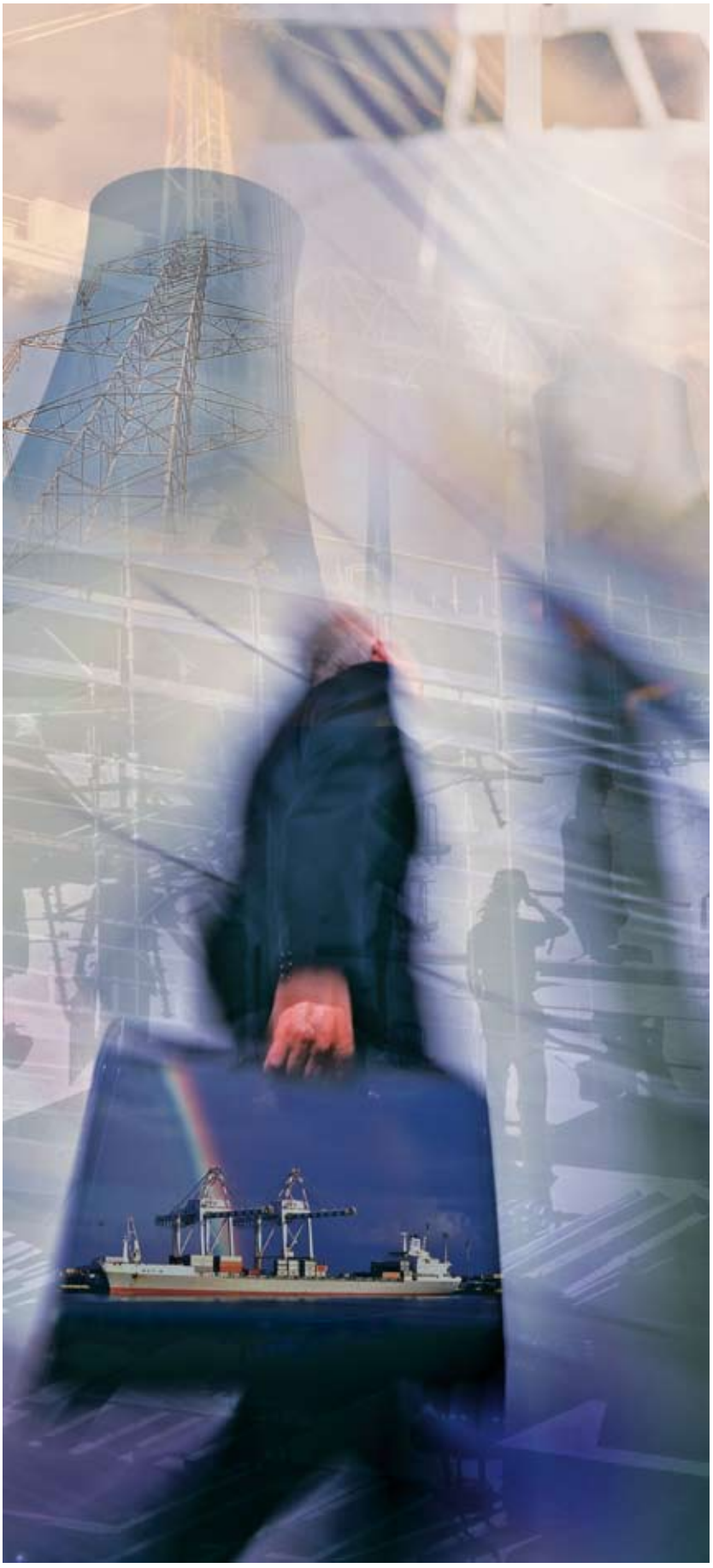

Queensland

The Economic Society of Australia Inc.

Proceedings of the 37th Australian Conference of Economists

Papers delivered at ACE 08

30th September to 4th October 2008

Gold Coast Queensland Australia

ISBN 978-0-9591806-4-0

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The Paper following forms part of - *Proceedings of the 37th Australian Conference of Economists*
ISBN 978-0-9591806-4-0

Are they keeping up with Tokyo?: an empirical analysis of consumption externalities between regions of Japan

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Draft version; June 2008

Abstract

This paper investigates whether consumption externalities are existing between regions of Japan. If there are consumption externalities between regions, it can be consider that the anxiety about regional disparity of Japan would be influenced by them. And thus, we should carefully design the policy of interregional redistribution, taking account of such externalities.

For this purpose, we estimate the effect of reference variable on life satisfaction, employing a random utility model and the regional grouped data of subjective well-being. From the results of regression analysis, we found that the circumstance in Tokyo obviously has negative influence on life satisfaction in the other regions. Moreover, the other regions are keeping up with Tokyo.

JEL classification: R15, D62

Keywords: Subjective well-being, Consumption externalities, Regional disparity

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1 Introduction

The purpose of this paper is investigating whether consumption externalities are existing between regions of Japan. It is thought that such externalities cause an excessive anxiety about regional disparity and thus the necessity of interregional redistribution would be over-evaluated. Therefore, it is important to verify the existence of consumption externalities between regions, because concern about regional disparity is not small in Japan.

An economic disparity between rural and urban regions has been thought of as an issue that should be solved in Japan. As the latest case, the government of Japan referred to such regional disparity in the *Annual Report* in 2004.[1]

Who is concerned about this issue? According to the questionnaire survey of *The Nikkei* (Japan economy newspaper), we can observe those are residents in rural area. The survey shows following results. For a question asking 'How do you think about an economic disparity between regions?', 76% of respondents in rural districts answer 'I think rural region is declining, whereas urban region is prospering', while 64% of respondents similarly answer in urban districts. Moreover, for a question asking 'How do you judge such disparity?', 51% of respondents in rural districts answer 'it is serious problem that should be solved immediately'. On the other hand, the same answer comes from only 39% of respondents in urban districts.[2]

Although the residents in rural area of Japan are not facing an absolute poverty observed in developing countries, why do they conclude regional disparity should be solved? Intuitively, it could be reason that their well-being are reduced by relative deprivation. Since rural residents can obtain various information about urban life, they can realize regional disparity and acknowledge that they are relatively deprived in comparison with urban life. For example, about 36% of information and communication enterprises including the broadcasting or publishers are located only in Tokyo while about 10% of nations reside there.[3] It seems that various information about Tokyo are circulated to all of the other regions of Japan.

From classic literature about consumer behavior such as Veblen (1899) and Duesenberry

[1] See Chapter 2, *the Annual Report on the Japanese Economy and Public Finance* 2004 by the Cabinet Office.

[2] *The Nikkei* December 24, 2007. Urban districts are defined as cities with a population over, or around, million people. Rural districts are towns and villages under 10 thousands population.

[3] A sorce is obtained from *the Establishment and Enterprise Census* 2006, the Ministry of Internal Affairs and Communications. Incidentally, in Osaka, the second-largest prefecture, only 8.8% of enterprises of this industry are located.

(1949), it has been considered that individuals seek to keep own state superior, or at least equal, to the others. Sometime such behavior brings yearning or jealousy. It is called as consumption externalities that are defined as the welfare effects caused by the other individual's consumption.[4]

Whether the above-mentioned anxiety about regional disparity of Japan can be regarded as the result of consumption externalities? To answer this question, we investigate whether consumption externalities are found between regions of Japan. Unfortunately, we can not estimate utility function whose formula is assumed in standard consumer theories. Thus, we apply a factor analysis of subjective well-being (hereafter SWB). Particularly, it is appropriate for our intention to examine the relationship between SWB and the consumption of the others.

A SWB analysis is commonly based on the survey of life satisfaction. From the results of previous researches, it has been obvious that individual evaluates life satisfaction referring to various standards. Helliwell (2002) and Bjornskov et al. (2008) are the latest seminal papers about in this field. According to their review of previous literature, the factors are divided into the individual level and the country level. As the individual level determinants, socioeconomic status, higher level of education, marriage and having children increase life satisfaction, while being unemployed has a strongly negative influence on individual well-being. On the other hand, life satisfaction roughly decreases until people reach mid-40s, after that, it increases again. Religiosity or spirituality seems to be significant factor of well-being. As the country level, macroeconomic factors such as national income, volatility of growth and inflation rate are listed. In addition, institutional and political factors such as democracy and the structure of government, and cultural factors like social capital and gender equality are also important to life satisfaction.

In this stream of SWB analysis, it is interesting that life satisfaction is influenced by circumstances of the other people. Easterlin(1995) pointed out that raising the incomes of all does not increase the happiness of all while people with higher incomes are happier at a given time. Thus, he suggested that 'judgments of personal well-being are made by comparing one's objective status with a subjective living level norm, which is significantly influenced by the average level of living of the society as a whole' (Easterlin, 1995, p.36).

More directly, many of literature show the evidence that individual well-being is negatively

[4]See, Carroll et al. (1997), Alvarrez-cuadrado et al. (2004), and Liu and Turnovsky (2003).

influenced by the income of the reference group, using Netherlands's data (van de Stadt et al., 1985), German Socio-economic Panel (Ferrer-i-Carbonnell, 2005), British Household Panel Survey (Clark and Oswald, 1996), data of United States (MacDonald and Douthitt, 1992; Daly and Wilson, 2006) and so on. In addition, such income comparisons are 'upwards', in other words, people whose incomes are lower than the reference level strongly express their dissatisfaction (Ferrer-i-Carbonnell, 2005; Daly and Wilson, 2006). On the other hand, Kines et al. (2007) show that the incomes of the spatial neighbourhood did not influence life satisfaction, and refute a relative deprivation hypothesis. However, Kingdon and Knight (2007) point out that the influence of neighbourhood depends on the spatial or social distance between individual and neighbour. Diener and Biswas-Diener (2002) and Senik (2005) survey the amount of literature of this field.

From the perspective of above-mentioned SWB analysis, we can indirectly recognize the existence of consumption externalities if it is obvious from our empirical analysis that the degree of life satisfaction is significantly correlated with the consumption, or the income, of the others.

While it is common that individual well-being data is employed in previous literature, we use regional grouped data which summarized as the proportion of respondents because of the limitation of data availability. Thus, we examine another estimation in order to complement the robustness of our analysis. It is a regression analysis of suicide rate. While SWB data is obtain at the 12 regional units, suicide rate is published at the unit of 47 prefectures. Committing suicide can be thought of as an expression of extreme dissatisfaction with current life in accordance with Helliwell (2004) and Daly and Wilson (2006). Thus, for instance in our regression analysis, if suicide rate is positively correlated with the consumption, in the other region, we can confirm that negative consumption externalities would be found between regions of Japan.

The remaining of this paper is composed of the followings. In the next section, we and discuss a theoretical model that explains our intuition. And then, we describe a framework of empirical analysis and data set in section 3. The estimation results are shown and discussed in section 4. After that we propose some concluding remarks in section 5.

2 Analytical Framework

While we use the grouped data of region, our intuition is based on the behavior of individual. Therefore, we need to make our model to fit for our available data. In this section, we describe a theoretical model for our empirical analysis. In order to keep our findings robust, we carry out two types of empirical analyses with SWB data and suicide rate statistics. According to Daly and Wilson (2006), random utility model is appropriate for the estimation with such data.

2.1 Revealing life satisfaction

A standard SWB data represents only the degree of life satisfaction of the respondent, not her/his utility level. In other words, she/he may assess the current level of own utility as unsatisfactory because of some reason although she/he has maximized utility. Thus, we can not directly estimate utility function with SWB data based on the standard consumer theory. On the other hand in random utility model, a consumer's behavior is considered to depend on the probabilistic choice among expected utilities. Thus, the degree of life satisfaction is thought to be influenced by the arguments of utility function on the assumption that individual reveals life satisfaction. Therefore, we can conjecture what factors are important to the individual utility from the regression analysis of SWB in such model.

Suppose the model of two-region where individuals reside and assume the markets at each region are geographically divided. The mobility of individual between markets is imperfect because of the large travel cost to go shopping, or to commute. Individual residing each region consumes private goods and enjoy an exogenous living environment such as public goods. Assuming classical conditions for well-behaving function are fulfilled, utility function for individual i residing region j is shown as;

$$U_i^j = u(c_i^j, g^j) + \delta_i^j \quad i = 1, ..., n \quad j = 1, 2, \tag{1}$$

where c_i^j is a vector of private goods consumption and g^j represents the level of the living environment of region j. While the first component $u(\ )$ is a deterministic partial utility, δ_i^j is the random term that represents a preference for region j or characteristics of individual i.

Assume that individual can inform her/himself of the circumstances of the other region, and thus expect the utility which is obtained if she/he resides there.[5] With superscript k which denotes the other region, particularly metropolitan, the expected utility in region k is shown as;

$$U_i^k = u(c_i^k, g^k). \tag{2}$$

We assume that the negative value of δ_i^j in equation (1) illustrates an individual's preference for the other region, and thus equation (2) doesn't have a random term. Suppose that individual can not choose the most preferable variety of private goods due to large travel cost although she/he is informed through the various media that the private goods which she/he wants to purchase are sold in region k.

An individual's behavior is defined as answering the question of life satisfaction in our model. In the above situation, whether individual is satisfied with the current level of utility in region j is non-specific although she/he has maximized own utility. Then we assume individual answers as the followings when she/he is asked 'How satisfied are you with your current life as a whole?'

$$\begin{aligned} \text{'I'm } \textit{satisfied}\text{'} \quad \text{if} \quad U_i^j - U_i^k &\geq 0, \text{ or} \\ \text{'I'm } \textit{unsatisfied}\text{'} \quad \text{if} \quad U_i^j - U_i^k &< 0. \end{aligned} \tag{3}$$

As regards above-mentioned matters, which of the answers is chosen by the respondent depends on the difference between the deterministic components in equation (1) and (2), and the size of the random term δ_i^j. Thus, we can induce an individual's answer 'I'm satisfied' as the following probability;

$$\Pr(\text{Satisfied}) = \Pr(U_i^j \geq U_i^k) = f(c_i^j, c_i^k, g^j, g^k) + \delta_i^j. \tag{4}$$

[5] More strictly saying, individual i can be thought to compare own circumstances with that of the others in the same region. However, we ignore such behavior in present our paper, because the influence of the consumption of the reference group cannot be clearly defined in accordance with Kingdon and Knight (2007). Moreover, although individual i can be thought to compare own current condition with past experiment, we don't focus it to keep our analysis simple.

Then we need to fit the above model of individual behavior to the regional level for the estimation with aggregated group data. Denote the value with subscript j and k as the aggregated value of region j and k, respectively. The proportion of individuals answering 'I'm satisfied' in region j (π_j) is written as the following probabilistic variable.

$$\pi_j = \Pr(\text{SATISFIED}) = F(c_j, c_k, g_j, g_k) + \delta_j \tag{5}$$

Note that c_j and c_k represents the average level of consumption in region j and k respectively. δ_j is the random term of region j that consists of δ_i^js.

In this context of random utility model, we define consumption externalities as the significant correlation between π_j and c_k or g_k, whereas they are explained as the marginal utility of the reference consumption in a standard theory. Thus it is expected if there are jealousy type of externalities between regions, π_j negatively correlates with c_k or g_k. It means people become unsatisfied as the average circumstances in the other region increases. On the other hand, π_j positively correlates with c_k or g_k in the case of admiration.

2.2 Committing suicide

In order to make our results more robust, we examine the another analysis with the larger sample of suicide rate. For this estimation, it seems to be appropriate that equation (1) is slightly modified as following.

$$U_i^j = u(c_i^j, g^j) - \theta_i \quad i = 1, ..., n \;\; j = 1, 2, \tag{6}$$

where θ_i is also random term and 'incorporates all possible exogenous risk factors that determine an individual's predisposition to commit suicide' (Daly and Wilson, 2006, p.7). Then, suppose Θ is the threshold of θ_i, and assume Θ is a function of the relative value of socioeconomic state with the circumstances of the other region. It is shown as $\Theta = \Theta\left(c_i^j/c_i^k, g^j/g^k\right)$, $\Theta' > 0$. Using this, we define the minimum utility that is bearable limitation by individual as;

$$\underline{U} = u(c_i^j, g^j) - \Theta\left(\frac{c_i^j}{c_i^k}, \frac{g^j}{g^k}\right). \tag{7}$$

It means that a relative deprivation raises the minimum utility and thus the probability of

her/his committing suicide.

Calculating the inequality between equation (6) and (7), the possibility that individual chooses to commit suicide is written as;

$$\text{Individual commits suicide if } \ \theta_i \geq \Theta\left(\frac{c_i^j}{c_i^k}, \frac{g^j}{g^k}\right). \tag{8}$$

Equation (8) means that individual commits suicide when her/his current utility is lower than the minimum level. We summarize the probability that individual commits suicide as the following.

$$\Pr(\text{suicide}) = \Pr(\theta_i \geq \Theta) = h(c_i^j, c_i^k, g^j, g^k) - \theta_i. \tag{9}$$

Similar to the model of revealing life satisfaction, we aggregate the probability of committing suicide for individual. We obtain the suicide rate (r_j) in region j as the following probabilistic variable.

$$r_j = \Pr(\text{SUICIDE}) = H(c_j, c_k, g_j, g_k) - \theta_j, \tag{10}$$

where θ_j is the random term of region j that consists of θ_i^js.

In spite of the above case of revealing life satisfaction, it is thought that r_j negatively correlates with c_j or g_j, because committing suicide can be thought of as expressing that individual is extremely unsatisfied. On the other hand, r_j positively correlates with c_k or g_k if jealousy type externalities are existing, and negatively correlates with c_k or g_k in the case of admiration.

Remaining issue of our analysis is how to verifiy whether individual in region j are keeping up with or running away from the people in region k.

According to Liu and Turnovsky (2003) who suppose that individual endogenously determines private consumption and supply of labor, it is defined that the marginal rate of substitution between consumption and leisure rises as the reference comsumption increases if individual is keeping up with the Joneses, and that it reduces as the reference comsumption increases if individual is running away from the Joneses.

In such model, it is appropriate to estimate the reaction function to the increase in the reference consumption. However, our theoretical model can not be competent to examine

such a regression analysis. Hence we suppose individual's choice among current and future consumption, but it is not obviously described in our model. We consider the relationship between people's preference for current consumption and life satisfaction, using another results of the survey of life satisfaction.

3 Econometric implementation

3.1 Econometric formulation

We next explain how to investigate these models by econometric procedure. While we couldn't use individual data, we employ the panel data of regions. According to standard econometric analysis,[6] a logit model is suitable for grouped data which we employ, thus we assume equation (5) and (10) can be summarized as the following linear function with log-odds ratio.

$$\ln \frac{y_{jt}}{1-y_{jt}} = \alpha + \boldsymbol{\beta}\mathbf{X}_{jt} + \epsilon_{jt}, \quad y_{jt} = \pi_{jt} \text{ or } r_{jt} \tag{11}$$

where $\mathbf{X}_{jt}$ represents a matrix of the arguments of function F in equation (5) and H in (10) at period t and, in addition, control variables for regional characteristics. $\boldsymbol{\beta}$ is the vector of their coefficients. ϵ_{jt} is disturbance that represents the random term in equation (5) and (10).

In the regional data, it is very likely that the macroeconomic factors or social incidents reported by the media affect all regions to varying degrees. Moreover, it can be easily thought that an economic, or social, condition of a region interacts with that of neighboring other regions. As such, it seems reasonable to allow correlation of the disturbances across regions. It is shown as,

$$E(\epsilon_{jt}\epsilon'_{kt}) = \sigma_{jk}.$$

Under this cross-sectional, or contemporaneous, correlation of the disturbances, we couldn't employ OLS estimators. It is known that GLS procedure is reasonable for such case, asymptotically. However, according to Beck and Katz (1995), feasible GLS estimators based on SUR techniques proposed by Parks (1967) are more or less efficient than OLS estimators,

[6] For example, see Greene (2000).

particularly in the case of panel data with a relatively less period than the number of cross-sectional observations. In the case of our paper, since SWB data is composed of 13 periods $\times$ 12 regions, and suicide data consists of 15 periods $\times$ 46 prefectures, it is not appropriate to carry feasible GLS with Parks method. Thus, we use OLS estimators and *panel-corrected standard errors* (PCSE) to take account for the cross-sectional correlation, following a recommendation of Beck and Katz (1995).[7]

Remaining issue is whether we assume the group specific term that denotes fixed or random effect in our model. Although it may be need to allow that our statistics have regional specific effects, it is possible that the estimators would be biased by short period observations if we apply the model including such specific term. Thus, we don't employ the model with regional specific effect in this paper.

3.2 Where is region k?

While we assume the reference region (region k) is one in a theoretical model, our statistics have 11 reference regions (in SWB data) or 45 reference prefectures (in suicide rate data). Therefore we re-assume where is the reference region for a regression analysis. We define the following three references.

The first is the simple average of the society except region j. It is defined as $c_{jk}^{AVE} = \mathbf{W}_j^{AVE} c_k,\ j,k = 1,...,m,\ j \neq k$. $\mathbf{W}_j^{AVE}$ is a weight matrix that has each factor $w_{jk} = 1/(m-1)$ and zero diagonals. m is the number of regions or prefectures. The second reference is the weighted average which is indicated as $c_{jk}^{WAV} = \mathbf{W}_j^{WAV} c_k$, where $\mathbf{W}_j^{WAV}$ is an alternative weight matrix that has each factor $w_{jk} = d_k / \sum_k d_k$ and zero diagonals. d_k represents the population density of k. This value means the reference is weighted towards urban regions, that is, people compare own state with that of urban residents. The final is the value of Tokyo denoted as $c_{jk}^{TOK} = c_{Tokyo}$. The economic statistics of Tokyo simply are involved in the estimation equations of every region as the reference, excluding the equation of Tokyo and South-Kanto which is explained in the later subsection.

[7] According to Beck and Katz (1995) and Frees (2004), PCSE are robust to the cases of nonspherical disturbances, particulaly heteroscedasticity concerned with our analysis, thus we don't intend to apply alternative procedure that takes account of nonspherical disturbances.

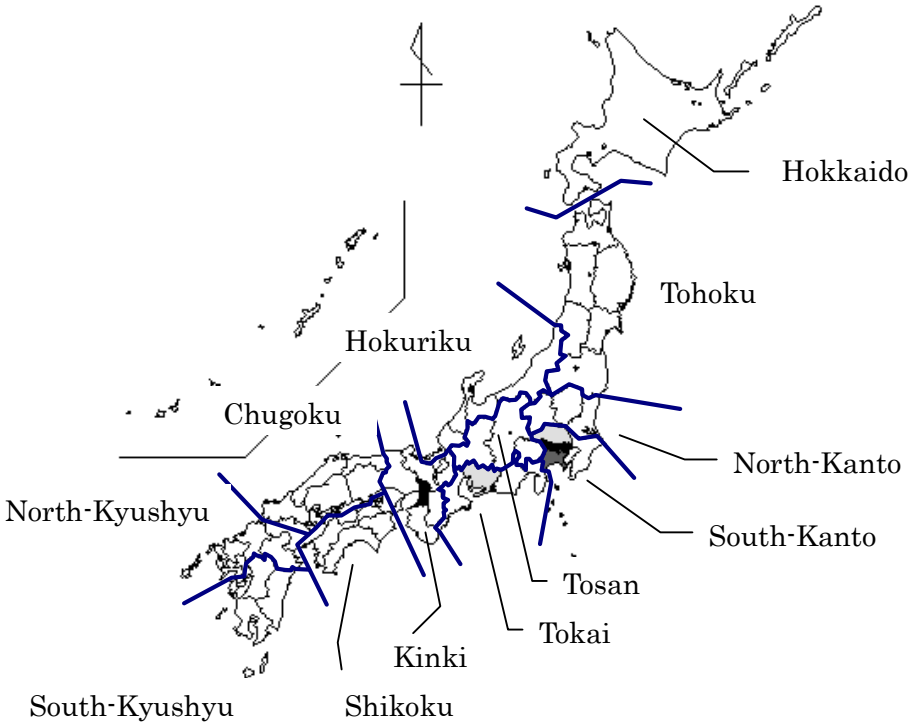

Figure 1: Regional group of prefectures

3.3 Data setting

3.3.1 *Dependent variables*

Subjective well-being (denoted as SWB in table). This data is printed in *the Annual Survey of Public Opinion regarding Quality of Life* conducted by the Cabinet Office. The question sentence is 'How satisfied are you with your current life as a whole?'. The five choices of answer are provided as followings; 1) satisfied, 2) passably satisfied, 3) slightly unsatisfied, 4) unsatisfied, 5) can't decide. We arrange the sum of answer 1) and 2) as the answer of 'satisfied'. The results of answer are summarized as the proportion of respondent to each choice according to the various type of group such as gender, age or job type. In the context of region, the answers are categorized according to 12 regions of residence. Figure 1 shows the regional group of prefectures. In this figure, the shaded areas represent the prefectures that have high population density, in that way, we know South-Kanto which involves Tokyo is the largest metropolitan area.

It is noted that such 12 regions grouping has been applied after 1991 data in this survey, and the survey itself did not be implemented in 1998 and 2000. Thus, we can only use the

13 periods observations from 1991 to 2005 except 1998 and 2000. On the other hand, we can obtain the other data sets employed as explanatory variables at prefecture level. Thus we employ the weighted average values with the share of population of each prefecture in each regional group in order to estimate the regression of revealing life satisfaction.

Suicide rate (SRATE). This is indicated as the proportion of deaths caused by suicide to prefecture population. This data is printed in *the Vital Statistics* conducted by the Ministry of Health, Labor and Welfare. Since we can obtain this data at prefecture level, we don't calculate the weighted average of each explanatory variable in the regression analysis of committing suicide. To make the results of regression of suicide consistent with that of regression of SWB, we employ the data from 1991 to 2005, but including the data of 1998 and 2000.

3.3.2 *Explanatory variables as the arguments of utility function*

We presume two patterns of utility structure that individual evaluates her/his utility with the level of private goods consumption (direct utility approach), or with the level of income and price (indirect utility approach). It is because we take account of various possibilities of individual behavior. In addition, we substitute living environment by the government spending and public capital stock.

Consumption per capita (CONS), *Income per capita* (INC).

The real values are picked from *the Annual Report on Prefectural Account*, and adjusted to the change of estimation method in the National Account. Since the latest period of the Prefectural Account is 2005, our estimation period is ended up to 2005. We denote the above-mentioned three references as the value with superscript $\_^{AVE}$, $\_^{WAV}$ and $\_^{TOK}$, respectively.

Price index (PRI).

In the case of indirect utility approach, we need price data in addition to income for regression. We employ *the Consumer price index* at regional level that takes account of a price disparity between regions with the standard value which is represented by the price level of Tokyo in 2005. We denote the price of the reference region in the same way as consumption or income.

Government spending (GVS), *Public capital stock* (PCAP).

They are the substitute variables for the level of living environment. The government spending is published in the *Annual Report on Prefectural Account*. The data of public capital stock is calculated from the fixed capital formation of public sector in the Prefectural Account and the previous capital stock data estimated by Doi (2002). According to Doi (2002), the public capital stock in Okinawa has not been estimated because of insufficient data. Thus, our analysis omits the observations of Okinawa. Both government spending and public capital stock are employed after per capita calculation. We denote the price of the reference region in the same way as consumption or income.

3.3.3 *Other control variables*

Then, we explain the control variables that represent the characteristics of region, whereas they are not obviously involved in the utility function in a theoretical model in the previous section. According to the previous literature of SWB analysis, we presume four types of regional characteristics such as economic, social, geographic and demographic factors.

Active job openings-to-applicants ratio (JOB), *Inflation rate* (INF).

Although, in the previous literature, it is familiar that unemployment rate reduces well-being, we use an active job openings-to applicants ratio as the substitute variable of unemployment rate because of insufficient period observation at prefectural level for unemployment rate. This data set is printed in *the Annual Report of Labor Market*, the Ministry of Health, Labor and Welfare. Moreover, according to the previous literature, it is known that an inflation rate significantly influences on well-being.

Population density (POP). *Duration of sunshine* (SUN).

These variables represent geographic factors. A population density conceivably influences individual evaluation of living environment in the region. For example, the higher population density may brings the higher crime rate, or conversely the higher convenience. This data is piked from *the Population Census* and *the Annual Report on Current Population Estimation* conducted by the Ministry of Internal Affairs and Communications. The duration of sunshine substitutes for an average temperature which is familiar in the previous SWB literature.[8] This statistics is printed in *the Annual Report of Meteorological Phenomena*, the Japan meteorological agency.

[8] We could obtain only the average normal value calculated as the average of the 30-year period from 1971 to 2000.

Proportion of unmarried women (UW) and *men* (UM),

Proportion of educated people (EDU).

These variables illustrate the social or cultural characteristics of region. The proportion of unmarried women and men are calculated as the proportion of the unmarried people whose age are from 45 to 54 years old to the same age population, using the statistics in *the Population Census* and *the Annual Report on Current Population Estimation*. Similarly, the proportion of educated people is defined as the proportion of workers who has graduated from university to the whole workers over 15 years old. Basic statistics are printed in *the Employment Status Survey*, the Ministry of Internal Affairs and Communications. Since these survey have three or five years interval, we need to estimate the values of uncovered years before analysis.

Gender ratio (GEN). *Proportion of old people* (OLD) and *young people* (YOU).

As a final, we consider the demographic characteristics. The gender ratio is defined as the proportion of men to women. The proportion of old people and young people represents the share of the persons over 65 years old and of the persons under 14 years old, respectively. It has been obvious by many literature that the gender ratio reduces life satisfaction, and that the regression of SWB is described as an U shape curve with a respondent's age.

4 Estimation results

In advance of estimation, we checked the properties of statistics. Since we found extremely high correlation between the references,[9] we excluded the references of price (PRI^{AVE}, PRI^{WAV}, PRI^{TOK}), and public goods (GVS^{AVE}, GVS^{WAV}, GVS^{TOK}, $PCAP^{AVE}$, $PCAP^{WAV}$, $PCAP^{TOK}$) in order to avoid multicollinearity.

Moreover, we considered the property of disturbances, using estimation residuals of simple OLS. According to simple t-test for covariance of residuals, around 15% of covariances in the case of SWB were significant at 0.1 level, on the other hand, around 45% of covariances in the case of suicide. Thus, contemporaneous correlation between prefectures would be higher than between regions. Homoscedastic disturbances between regions were supported in the SWB case, whereas disturbances between prefectures were recognized as heteroscedastic in the suicide case. Then, by the Q test suggested by Ljung and Box (1979), autocorrelation is found

[9] The correlation coefficiect is shown as around 0.98.

for around 17% of regions and around 28% of prefectures at 0.1 significant level. However, we didn't take account of autocorrelation because it would seem that this Q statistics were biased by small sample.[10] At the end of consideration about statistics, we verified a relationship between revealing life satisfaction and committing suicide. A correlation coefficient between SWB and suicide rate was -0.61. Thus, we can expect that the results of regression of suicide rate and SWB will have opposite sign frequently.

Table 1. Descriptive statistics

4.1 Revealing life satisfaction

The left three columns of table 2 show the results based on direct utility approach that assumes consumption of private goods are arguments of utility function, on the other hand, the right three columns show the results based on indirect utility approach that involves income and price as independent variables. Each of three columns is distinguished by the difference of the reference variable such as average, weighted average and Tokyo.

While consumption in own region does not have an obvious influence on SWB excluding the case of Tokyo, income significantly increases SWB. Since actual consumption consists of income and a withdrawal from a bank account, people would not feel life satisfaction when a deficit should be needed to keep or increase their consumption.

According to the coefficients of the references, consumption and income in Tokyo have significantly negative influence on SWB. Thus, an increase in consumption or income in Tokyo brings dissatisfaction to the people who reside the regions rather than Tokyo. It is question why average and weighted average consumption or income have positive (or no) effect in spite of the remarks of Easterlin (1995). One of the reasons is that people may not be able to know the *average* level obviously. As the other reason, it seems that people recognize the average as the state of the economy of Japan as a whole. If that is the case, people would think of an increase in the average consumption (or income) as desirable matter. On the other hand, an increase in consumption or income in Tokyo clearly reduces SWB of people who reside the region rather than Tokyo. Thus, we can consider the existence of the jealousy type of consumption externalities between Tokyo and the other regions.

[10] Since we estimated Q statistics at lag 2, they were computed by only 11 (for SWB) or 13 (for suicide) period observations of each region.

As regards the other explanatory variables, we obtain some interesting subjects. While public capital stock has positive effect on SWB, government spending shows negative sign. It seems that people can not realize an improvement in public service whereas they can know visible public infrastructure has been extended.

In the same way as previous literature, the higher inflation rate brings the lower satisfaction. However, price index does not seem to influence SWB. Thus, people seem to be concerned about a degree of change in price not about price level itself.

The proportion of unmarried women negatively influences on SWB, whereas that of men does not. It would be result affected by Japanese conventional view that forces women into marrying and being full-time housewife.

While the signs of the proportion of educated people, gender ratio and the proportion of young people are similar to the findings of previous literature, the proportion of old people is not significant. An ageing society does not seem to make people's well-being better in Japan.

It seems that two geographic factors are not significant because of a large difference about geographic conditions within region. Particularly, the prefecture at the one side of mountains is greatly different from the prefecture at the opposite side in respect of the weather condition, even though both prefectures exist in the same regional group.

Table 2. Regression results of revealing life satisfaction

4.2 Committing suicide

Next, we consider the results of the regression of suicide rate. The format of table 3 is similar to that of table 2. As above-mentioned expectation, almost of all coefficients in table 3 have opposite sign to the results in table 2.

Both consumption and income in own region show significantly negative relation with suicide rate. It means that an enrichment prevents people from committing suicide. On the other hand, an increase in consumption (or income) in Tokyo positively affects suicide rate in the other prefecture. Combining with above-mentioned the regression results of SWB, we can verify by larger sample that people are concerned about an expansion of economic disparity between Tokyo and own prefecture. Thus, we recognize, at least, the existence of consumption externalities that are defined as negative influence of the circumstances in Tokyo on the life satisfaction in the other prefecture.

The coefficients about public goods are inconsistent with the results of SWB. Particularly, public capital stock positively correlates with dependent variable again. The coefficient of government spending also shows the same sign as that of SWB regression. It seems to be inappropriate the statistics of government spending and public capital stock employed as the level of public goods.

Contrary to the results about SWB, active job openings-to-applicants ratio significantly reduces suicide rate, whereas the influence of inflation rate is positive but not significant. Since it would be appropriate that the larger sample is applied, a job condition seems to more significantly influence the quality of life rather than inflation rate.

From the coefficients of geographic factors, it can be thought of that population density brings an adverse influence on people's life, such as worsening public safety. On the other hand, the longer duration of sunshine seems to make people happy.

The proportion of unmarried people shows the result that is inconsistent with that about SWB. However, considering sample size and preciseness of sample, it seems to appropriate that bachelors can be more disappointed with their life rather than single women.

Other cultural and demographic factors show the same influences as previous literature. Particularly, an positive relation between suicide rate and old people's share can be thought to represent the serious situation of ageing society.

Table 3. Regression results of committing suicide

4.3 Are they keeping up with Tokyo?

From the results of both regressions with SWB and suicide rate, we verify the existence of negative consumption externalities from Tokyo to the other regions. As the final of analysis, we consider whether they are keeping up with Tokyo.

According to the definition of consumption externalities in a standard theory mentioned in section 2, it seems to be appropriate to estimate the reaction function of the other regions to the increase in the consumption in Tokyo. However, our theoretical model can not be competent to examine such a regression analysis. Hence we consider the relationship between people's preference for current consumption and life satisfaction, using the result of another questionnaire in *the Annual Survey of Public Opinion regarding Quality of Life*. This question asks 'Do you intend to enrich and enjoy your everyday life, or to weight saving and investment

for future life?' We use the proportion of respondents who answer 'I would like to enrich and enjoy everyday life' as the preference for current consumption (hereafter denoted as PCC). If it is obvious that the lower SWB brings the higher PCC, we will be able to deduce that the other regions are keeping up with Tokyo.

For our purpose, we estimate the correlation between PCC and SWB, using an instrumental variable method. We take the explanatory variables of the above analysis in subsection 3.1 as the instrumental variables. In other words, we consider the correlation between PCC and controlled SWB.

Table 4 show the results of the instrumental variable method, comparing the results of OLS. The results are categorized according to utility approach (direct or indirect) and reference (average, weighted average and Tokyo). Common instrumental variables are GVS, PCAP, INF, JOB, POP, SUN, UW, UM, EDU, GEN, OLD, YOU. In addition to them, CONS and the reference consumption are included in the case of direct utility approach. On the other hand, INC, PRI and the reference income are included in the case of indirect utility approach.

From the result of OLS, it is known that uncontrolled SWB negatively correlates with PCC, but not significant. There are similar results in the case of the instrumental variable method based on an indirect utility approach. Contrary to them, in the case of direct utility approach, controlled SWB significantly shows a negative correlation with PCC. Particularly, taking the consumption in Tokyo, such correlation becomes most significant.

As we know from the results of previous subsection, the increase in the consumption in Tokyo reduces the life satisfaction in the other regions. Therefore, we conclude that the increase in the consumption in Tokyo increases the PCC of people in the other regions through the reduction in their life satisfaction. In other words, it seems that the people in the other regions intend to increase their current consumption in order to keep up with Tokyo when the consumption in Tokyo increases.

Table 4. Correlation between PCC and SWB

5 Concluding Remarks

We investigated whether consumption externalities exist between regions of Japan. For this purpose, we intended to estimate the effect of reference variable on utility for individual. However, we can not obtain the statistic that represents the level of utility itself. Therefore, we employed subjective well-being (SWB) data and suicide rate, employing random utility model. Moreover, we could use only regional grouped statistics, contrary to previous literature about SWB analysis.

In spite of such limitations, we could obtain some interesting results. First, the reference denoted by the average consumption or income does not clearly affect life satisfaction regardless of whether it is computed as the arithmetical mean or weighted average. It means that the assumption of standard theory about consumption externalities could not be applied to an empirical analysis. Second, we found that the circumstance in Tokyo obviously has negative influence on the life satisfaction in the other regions. According to random utility model, individuals tend to be unsatisfied as the people in Tokyo are better off. As the final, we found that the increase in the consumption in Tokyo increases the preference for current consumption in the other regions through the reduction in their life satisfaction. In other words, the people in the other regions seem to be keeping up with Tokyo.

These results tell us that the anxiety about economic disparity between regions of Japan would be caused by negative consumption externalities. Thus we suggest that the policy of interregional redistribution should be carefully designed in order to avoid that such policy becomes harmful to the efficiency or growth of whole economy.

Remaining issues about our paper are the followings. While we focused on the effect of the circumstances only in Tokyo, there are still other huge cities such as Osaka or Nagoya. Thus, we need to modify a calculation of reference variable in order to the effect of other metropolitan. In addition, we should examine more suitable statistic that represents the level or quality of living environment rather than the government spending and public capital stock in our paper. Particularly, the government spending which is computed by the prefectural account may not be seen as an appropriate proxy for public goods. They are future extension of our paper.

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Table 1. Descriptive statistics

	Data desctiption	Mean	Max	Min	S.D.	Obs
SWB	Subjective well-being (logit scaled)	0.634	1.374	-0.032	0.290	156
SRATE	Suicide rate (logit scaled)	-8.463	-7.718	-9.120	0.243	690
CONS	Private consumption in pref. (per capita, millions yen)	1.802	2.616	1.233	0.204	690
INC	Prefectural income (per capita, millions yen)	3.047	5.202	2.238	0.458	690
PRI	Consumer price index	0.918	1.046	0.779	0.042	690
GVS	Government consumption in pref. (per capita, millions yen)	0.656	1.018	0.386	0.125	690
PCAP	Social capital stock in pref. (per capita, millions yen)	4.541	8.460	1.898	1.278	690
INF	Inflation rate	0.004	0.046	-0.022	0.012	690
JOB	Job openings / job applicants	0.820	2.680	0.290	0.380	690
POP	Population density (thousands people / km^2)	0.655	5.980	0.067	1.116	690
SUN	Duration of sunshine (thousands hours)	1.891	2.423	1.315	0.243	690
UW	Proportion of unmarried women	0.043	0.095	0.025	0.012	690
UM	Proportion of unmarried men	0.069	0.143	0.042	0.016	690
EDU	Proportion of educated people	0.211	0.429	0.094	0.053	690
GEN	Gender ration (men / women)	0.938	1.055	0.878	0.039	690
OLD	Proportion of people over 65 years old	0.181	0.271	0.086	0.036	690
YOU	Proportion of people under 14 years old	0.156	0.199	0.113	0.015	690

Table 2. Regression results of revealing life satisfaction (Dependent variable = SWB)

	Direct utility approach				Indirect utility approach		
	Average	Weighted average	Tokyo		Average	Weighted average	Tokyo
C	1.936	−1.865	7.409**	C	−4.577*	−2.533	3.543
	(0.528)	(−0.598)	(2.395)		(−1.703)	(−0.800)	(1.453)
CON_j	−0.095	−0.217	0.831**	INC_j	0.408***	0.547***	0.882***
	(−0.436)	(−1.118)	(2.096)		(2.633)	(3.098)	(5.534)
				PRI_j	−0.664	−1.220	0.313
					(−0.528)	(−0.910)	(0.234)
CON^{AVE}	0.577			INC^{AVE}	1.078***		
	(0.292)				(3.334)		
CON^{WAV}		0.908**		INC^{WAV}		0.444	
		(2.321)				(1.300)	
CON^{TOK}			−0.257***	INC^{TOK}			−0.113***
			(−3.784)				(−4.970)
GVS	−1.712**	−0.845	−2.349***	GVS	−0.893	−1.592*	−1.972***
	(−2.161)	(−1.013)	(−2.780)		(−1.226)	(−1.930)	(−2.775)
PCAP	0.168**	0.172***	0.049	PCAP	0.114**	0.196***	0.177***
	(2.555)	(3.074)	(0.891)		(2.005)	(3.239)	(3.195)
INF	−6.690*	−8.605***	−6.929**	INF	−10.098***	−9.516***	−7.592**
	(−1.785)	(−2.885)	(−1.986)		(−3.280)	(−2.845)	(−2.320)
JOB	0.105	0.133	0.060	JOB	0.172*	0.092	0.111
	(1.081)	(1.503)	(0.642)		(1.869)	(0.969)	(1.322)
POP	−0.091	−0.014	−0.209***	POP	−0.069	−0.052	−0.123**
	(−1.372)	(−0.209)	(−3.172)		(−1.225)	(−0.898)	(−2.018)
SUN	−0.090	−0.107	−0.082	SUN	−0.187	−0.111	0.016
	(−0.558)	(−0.767)	(−0.533)		(−1.382)	(−0.754)	(0.115)
UW	−15.266**	−18.233***	−13.964***	UW	−5.859	−3.604	−4.722
	(−2.584)	(−3.691)	(−2.690)		(−1.026)	(−0.590)	(−0.778)
UM	4.944	5.368	4.726	UM	−0.016	3.991	6.946
	(1.140)	(1.330)	(1.042)		(−0.004)	(0.955)	(1.614)
EDU	7.833***	8.488***	4.099**	EDU	5.822***	5.497***	1.567
	(5.173)	(6.812)	(2.261)		(4.459)	(3.546)	(0.973)
GEN	−5.088**	−3.926**	−8.660***	GEN	−2.973	−4.120*	−9.616***
	(−2.252)	(−2.003)	(−3.164)		(−1.369)	(−1.670)	(−3.878)
OLD	−3.658	−3.666	−0.755	OLD	0.781	2.330	2.476
	(−0.947)	(−1.484)	(−0.293)		(0.326)	(0.888)	(1.060)
YOU	15.767***	18.715***	10.280***	YOU	21.151***	23.098***	19.745***
	(3.322)	(3.939)	(2.234)		(4.650)	(5.003)	(4.365)
Adj. R^2	0.551	0.579	0.591	Adj. R^2	0.642	0.608	0.652
Obs.	156	156	156	Obs.	156	156	156

NOTE: The t values are in parentheses. They are computed by PCSEs. *, ** and *** indicate significance at the 0.1, 0.05 and 0.01 levels, respectively.

Table 3. Regression results of committing suicide (Dependent variable = suicide rate)

	Direct utility approach				Indirect utility approach		
	Average	Weighted average	Tokyo		Average	Weighted average	Tokyo
C	−8.361***	−6.967***	−6.993***	C	−7.188***	−7.210***	−8.085***
	(−6.607)	(−5.659)	(−12.045)		(−8.804)	(−6.774)	(−15.430)
CON_j	−0.177***	−0.181***	−0.190***	INC_j	−0.127***	−0.125***	−0.106***
	(−4.392)	(−4.762)	(−5.295)		(−6.618)	(−5.012)	(−4.595)
				PRI_j	0.520	0.521	0.286
					(1.510)	(1.494)	(0.939)
CON^{AVE}	1.301			INC^{AVE}	0.026		
	(1.645)				(0.113)		
CON^{WAV}		0.191		INC^{WAV}		0.025	
		(0.331)				(0.109)	
CON^{TOK}			0.051*	INC^{TOK}			0.428***
			(1.680)				(4.325)
GVS	−0.401***	−0.326***	−0.249**	GVS	−0.242***	−0.239**	−0.329***
	(−4.461)	(−4.129)	(−2.184)		(−2.916)	(−2.470)	(−3.870)
PCAP	0.051***	0.043***	0.042***	PCAP	0.022***	0.022***	0.035***
	(5.856)	(5.674)	(4.451)		(2.840)	(2.767)	(4.752)
INF	0.631	0.220	0.156	INF	0.555	0.531	−0.731
	(0.377)	(0.139)	(0.101)		(0.359)	(0.336)	(−0.568)
JOB	−0.090***	−0.102***	−0.093***	JOB	−0.077**	−0.078**	−0.084***
	(−2.656)	(−3.320)	(−2.790)		(−2.405)	(−2.429)	(−3.147)
POP	0.034***	0.030***	0.033***	POP	0.031***	0.031***	0.040***
	(5.811)	(3.444)	(5.863)		(5.979)	(5.663)	(7.258)
SUN	−0.245***	−0.231***	−0.236***	SUN	−0.227***	−0.227***	−0.234***
	(−5.055)	(−4.926)	(−5.060)		(−5.133)	(−5.085)	(−6.338)
UW	−1.763**	−1.453*	−0.671	UW	−1.905*	−1.898*	−2.715***
	(−2.102)	(−1.807)	(−0.579)		(−1.938)	(−1.727)	(−3.040)
UM	4.893***	4.460***	4.206***	UM	4.266***	4.284***	5.173***
	(6.271)	(6.243)	(4.882)		(5.001)	(4.794)	(6.285)
EDU	−1.476***	−1.401***	−1.357***	EDU	−1.537***	−1.537***	−1.766***
	(−7.417)	(−7.476)	(−7.023)		(−8.839)	(−8.730)	(−11.815)
GEN	−0.798*	−0.335	−0.104	GEN	−0.165	−0.171	−1.091**
	(−1.863)	(−0.918)	(−0.235)		(−0.362)	(−0.344)	(−2.257)
OLD	1.471**	2.263***	2.317***	OLD	2.415***	2.423***	0.964**
	(2.352)	(4.173)	(4.383)		(5.043)	(4.851)	(2.097)
YOU	−6.383***	−7.015***	−6.915***	YOU	−6.979***	−6.963***	−5.456***
	(−9.388)	(−9.770)	(−10.713)		(−10.616)	(−10.846)	(−9.359)
Adj. R^2	0.721	0.714	0.716	Adj. R^2	0.722	0.722	0.761
Obs.	690	690	690	Obs.	690	690	690

NOTE: The t values are in parentheses. They are computed by PCSEs. *, ** and *** indicate significance at the 0.1, 0.05 and 0.01 levels, respectively.

Table 4. Correlation between PCC and SWB

	Direct utility approach		
	Average	Weighted average	Tokyo
C	0.247***	0.235***	0.250***
	(3.094)	(2.958)	(3.216)
SWB	−0.232**	−0.214*	−0.237**
	(−1.997)	(−1.848)	(−2.093)
Second-Stage SSR	6.612	6.659	6.568
	Indirect utility approach		
	Average	Weighted average	Tokyo
C	0.209***	0.210***	0.198***
	(2.634)	(2.647)	(2.466)
SWB	−0.173	−0.175	−0.155
	(−1.498)	(−1.510)	(−1.329)
Second-Stage SSR	6.765	6.773	6.814
	OLS		
C	0.138**		
	(2.064)		
SWB	−0.061		
	(−0.682)		
SSR	6.980		

NOTE: The t values are in parentheses. They are computed by PCSEs. *, ** and *** indicate significance at the 0.1, 0.05 and 0.01 levels, respectively.