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

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**Abstract**

This study investigates whether consumption externalities exist between the regions of Japan. If there are consumption externalities between regions, anxiety about regional disparities in Japan may be influenced by them. Furthermore, we should carefully design a policy of interregional redistribution, taking into account such externalities.

For this purpose, we estimate the effect of the reference variable on life satisfaction, employing a random utility model and regionally grouped data on subjective well-being. From the results of the regression analysis, we find that circumstances in Tokyo obviously have a negative influence on life satisfaction in other regions. Moreover, the other regions are trying to keep up with Tokyo.

*JEL classification*: R15, D62

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

## 1 Introduction

The purpose of this study is to investigate whether consumption externalities exist between the regions of Japan. It is thought that such externalities cause excessive anxiety about

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regional disparities, and thus result in an overestimate of the need for interregional redistribution. Therefore, it is important to verify the existence of any such consumption externalities between regions, because in Japan there is considerable concern about regional disparity.

Economic disparity between rural and urban regions in Japan has been regarded as an issue to be solved. Most recently, the government of Japan referred to such a regional disparity in the *Annual Report* for 2004[1].

Who is concerned about this issue? According to a questionnaire survey by *The Nikkei* (Japan's economic newspaper), it is the residents in rural areas. The survey produced the following results. To the question, asking 'What do you think about the economic disparity between regions?' 76% of respondents in rural districts and 64% of respondents in urban districts answer that 'I think rural regions are declining, whereas urban regions are prospering'. Moreover, to the question 'How do you evaluate such disparity?' 51% of respondents in rural districts answer that 'It is a serious problem that should be solved immediately'. However, only 39% of respondents in urban districts give this answer[2].

Residents in rural areas of Japan do not face the absolute poverty observed in developing countries. Why, therefore, do they conclude that regional disparities should be resolved? Intuitively, it may be that their well-being is reduced by relative deprivation. Since rural residents can obtain various types of information about urban life, they become aware of regional disparities, and they may realize that in comparison with urban life, they are relatively deprived. For example, about 36% of information and communication enterprises, including broadcasting and publishers, are located in Tokyo, although only 10% of the population reside there[3]. It seems that various types of information about Tokyo are circulated to all the other regions of Japan.

The classic literature on consumer behavior, such as Veblen (1899) and Duesenberry (1949), suggests that individuals seek to keep their own states superior, or at least equal to that of others. Sometimes, such behavior results in yearnings or jealousy. This involves

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

[2] *The Nikkei* 24 December 2007. Urban districts are defined as cities with a population over, or around, one million people. Rural districts are towns and villages with a population under 10,000.

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

consumption externalities, which are defined as the welfare effects caused by other individual's consumption[4].

Is the above-mentioned anxiety about regional disparities in Japan caused by consumption externalities? To answer this question, we investigate whether consumption externalities are found between the regions of Japan. Unfortunately, we cannot estimate the utility function whose formula is assumed in standard consumer theories. Thus, we apply a factor analysis of subjective well-being (hereafter SWB). In fact, this is appropriate, given our intention to examine the relationship between SWB and the consumption of others.

A SWB analysis is normally based on a survey of life satisfaction. The results of previous researches show that an individual evaluates life satisfaction by reference to various standards. Helliwell (2002) and Bjornskov et al. (2008) are the most recent seminal papers in this field.

According to their review of previous literature, the relevant factors can be divided into the individual level and the country level. As individual level determinants, socioeconomic status, higher level of education, marriage and having children increase life satisfaction, whereas being unemployed has a strong negative influence on individual well-being. On the other hand, life satisfaction broadly decreases until people reach the mid-40s and increases thereafter. Religiosity or spirituality seem to be significant factors in well-being. At the country level, macroeconomic factors such as national income, volatility of growth and the inflation rate are relevant. In addition, such institutional and political factors as democracy and the structure of government, and such cultural factors as 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 the circumstances of other people. Easterlin(1995) pointed out that raising the incomes of all does not increase the happiness of all, whereas people with higher incomes are happier at any 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, much of the literature provides the evidence that individual well-being is negatively influenced by the income of the reference group, using Netherlands' data (van

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

de Stadt et al., 1985), German Socio-economic Panel (Ferrer-i-Carbonnell, 2005), British Household Panel Survey (Clark and Oswald, 1996), United States data (MacDonald and Douthitt, 1992; Daly and Wilson, 2006) and so on. In addition, such comparisons of income are 'upwards': in other words, people whose incomes are lower than the reference level express their dissatisfaction strongly (Ferrer-i-Carbonnell, 2005; Daly and Wilson, 2006).

On the other hand, Kines et al. (2007) show that the incomes of the spatial neighborhood do not influence life satisfaction, and thus refute a relative deprivation hypothesis. However, Kingdon and Knight (2007) point out that the influence of the neighborhood depends on the spatial or social distance between individual and neighbor. Diener and Biswas-Diener (2002) and Senik (2005) survey the literature in this field.

From the perspective of the SWB analysis mentioned above, we will be able indirectly to 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 others.

Although it is common in the prior literature to employ individual well-being data, we use regionally grouped data, which is summarized as the proportion of respondents, given the limitations of data availability. Thus, we perform an additional estimation in order to complement the robustness of our analysis: a regression analysis of the suicide rate. SWB data are obtained in the form of 12 regional units, whereas the suicide rate is published in the form of 47 prefecture units. Committing suicide can be considered an expression of extreme dissatisfaction with one's current life, in accordance with Helliwell (2004) and Daly and Wilson (2006). Thus, in our regression analysis, for instance, if the suicide rate is positively correlated with consumption in the other region, we can confirm that negative consumption externalities will be found between the regions of Japan.

The remainder of this paper is organized as follows. The next section discusses a theoretical model that explains our intuition. Section 3 describes the framework of empirical analysis and the data set. Section 4 provides the estimation results and discusses them. Section 5 presents some concluding remarks.

## 2 Analytical Framework

Although we use the grouped data of region, our intuition is based on the behavior of individuals. 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 conduct two types of empirical analyses, one with SWB data and one with suicide rate statistics. According to Daly and Wilson (2006), a random utility model is appropriate for the estimation of such data.

### 2.1 Revealing life satisfaction

Standard SWB data represent 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 for some reason, even if she/he has maximized utility. Thus, we cannot directly estimate the utility function using SWB data based on the standard consumer theory. On the other hand, in a 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 the utility function, assuming that the individual reveals her/his life satisfaction. Therefore, the regression analysis of SWB in such a model enables us to conjecture as to which factors are important to individual utility.

Suppose a two-region model in which individuals reside, and assume that the markets in each region are geographically divided. The mobility of individuals between markets is imperfect, because of the high travel cost of going shopping, or commuting. Individuals residing in each region consume private goods and enjoy an exogenous living environment, such as public goods. Assuming the classic conditions for the well-behaving function are fulfilled, the utility function for individual $i$ residing in region $j$ is shown as;

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

where $c_i^j$ is a vector of private goods consumption, and $g^j$ represents the level of the living environment of region $j$. The first component $u(\ )$ is a deterministic partial utility, and $\delta_i^j$ is

the random term that represents a preference for region $j$ or the characteristics of individual $i$.

Assume that an individual can inform her/himself of the circumstances in the other region, and thus expects the utility that would obtain if she/he resided there[5]. With superscript $k$, which denotes the other region, which is 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 $\delta_i^j$ in equation (1) illustrates an individual's preference for the other region, and thus equation (2) has no random term. Suppose that an individual cannot choose the most preferable variety of private goods because of the high travel cost, although she/he is informed through various media that the private goods that she/he wants to purchase are sold in region $k$.

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

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

Regarding the above-mentioned matters, which answer is chosen by the respondent depends on the difference between the deterministic components in equations (1) and (2) and the size of the random term $\delta_i^j$. Thus, we can induce an individual's answer 'I'm satisfied' as

[5] Strictly speaking, individual $i$ can be thought to compare own circumstances with those of others in the same region. However, we ignore such behavior in this 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 experience, to keep our analysis simple we do not focus on this possibility.

the following probability:

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

Then we need to fit the above model of individual behavior to the regional level for estimation with the aggregated group data. Denote the value with subscripts $j$ and $k$ as the aggregated value of region $j$ and $k$, respectively. The proportion of individuals answering 'I'm satisfied' in region $j$ ($\pi_j$) 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 $c_k$ represent the average level of consumption in region $j$ and $k$ respectively, and $\delta_j$ is the random term of region $j$, which consists of $\delta_i^j$s.

In the context of a random utility model, we define consumption externalities as a significant correlation between $\pi_j$ and $c_k$ or $g_k$, whereas in the standard theory they are explained as the marginal utility of the reference consumption. Thus, it is expected that, if there exist jealousy types of externalities between regions, $\pi_j$ negatively correlates with $c_k$ or $g_k$. This means that people become dissatisfied as the average circumstances in the other region improve. On the other hand, in the case of admiration $\pi_j$ positively correlates with $c_k$ or $g_k$.

## 2.2 Committing suicide

To make our results more robust, we examine the other analysis using the larger sample of suicide rate. For this estimation, it seems to be appropriate to modify equation (1) slightly, as follows:

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

where $\theta_i$ is also a 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 $\Theta$ is the threshold of $\theta_i$, and assume $\Theta$ is a function of the relative value of the 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 a bearable

limitation for individual as

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

This means that relative deprivation raises the minimum utility and therefore 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 follows:

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

Similar to the model that reveals 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 $\theta_j$ is the random term of region $j$, which consists of $\theta_i^j$s.

Although the above case reveals 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 exist, and negatively correlates with $c_k$ or $g_k$ in the case of admiration.

The remaining issue of our analysis is how to verify whether individuals 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, the marginal rate of substitution between

consumption and leisure is defined as rising as the reference consumption increases, if individual is keeping up with the Joneses, and as reducing as the reference consumption increases, if individual is running away from the Joneses.

In such a model, it is appropriate to estimate the reaction function to the increase in the reference consumption. However, our theoretical model is not competent to examine such a regression analysis. Hence, we suppose individual's choice between current and future consumption, but it is obviously not described in our model. We consider the relationship between people's preference for current consumption and life satisfaction, using other results from the survey of life satisfaction.

# 3 Econometric implementation

## 3.1 Econometric formulation

We next explain how to investigate these models using an econometric procedure. As we could not use individual data, we employ the panel data of regions. According to standard econometric analysis[6], a logit model is suitable for grouped data such as we employ. Thus, we assume that equations (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. $\epsilon_{jt}$ is a disturbance that represents the random term in equations (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 seems likely that the economic, or social, condition of a region interacts with that of its neighboring regions. As such, it seems reasonable to include the correlation of the disturbances across regions,. which is shown as

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

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

Under this cross-sectional, or contemporaneous, correlation of the disturbances, we were unable to employ OLS estimators. It is known that GLS procedure is reasonable for such a 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, particularly in the case of panel data with relatively fewer periods 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 conduct feasible GLS using the Parks method. Thus, we use OLS estimators and *panel-corrected standard errors* (PCSEs) to take account of the cross-sectional correlation, following the recommendation by Beck and Katz (1995)[7].

Whether we assume the group specific term that denotes fixed or random effect in our model is also a technical issue. Although it may be needed to allow our statistics to have regional specific effects, it is possible that the estimators would be biased by short period observations if we apply the model including such a specific term. Thus, we do not employ the model with regional specific effect in this paper.

### 3.2 Where is region $k$?

While we assume that 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 the reference region is for a regression analysis. We define the following three references.

The first is the simple average of the society excluding 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 $c_{jk}^{WAV} = \mathbf{W}_j^{WAV} c_k$, in which $\mathbf{W}_j^{WAV}$

[7] According to Beck and Katz (1995) and Frees (2004), PCSE are robust to the cases of non-spherical disturbances, particularly heteroscedasticity, concerned with our analysis. Thus we do not intend to apply an alternative procedure that takes account of non-spherical disturbances.

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 that the reference is weighted towards urban regions: that is, people compare their own state with that of urban residents. The last is the value of Tokyo denoted as $c_{jk}^{TOK} = c_{Tokyo}$. The economic statistics of Tokyo are simply involved in the estimation equations of every region as the reference, excluding the equation of Tokyo and South-Kanto, which is explained later.

## 3.3 Data setting

### 3.3.1 *Dependent variables*

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

It should be noted that this 12 regions grouping has been employed in this survey since 1991, although the survey itself was not conducted in 1998 and 2000. Thus, we can use only 13 period observations, from 1991 to 2005, excluding 1998 and 2000. On the other hand, we can also obtain other data sets that are employed at prefecture level as explanatory variables. Thus we employ the weighted average values with the share of population of each prefecture in each regional group, to estimate the regression of revealing life satisfaction.

*Suicide rate* (SRATE). This is shown as the proportion of deaths in the prefecture population caused by suicide. These data are published in *the Vital Statistics* compiled by the Ministry of Health, Labor and Welfare. Since we can obtain these data at prefecture level, we do not calculate the weighted average of each explanatory variable in the regression analysis of committing suicide. To make the results of the regression of suicide consistent with those of

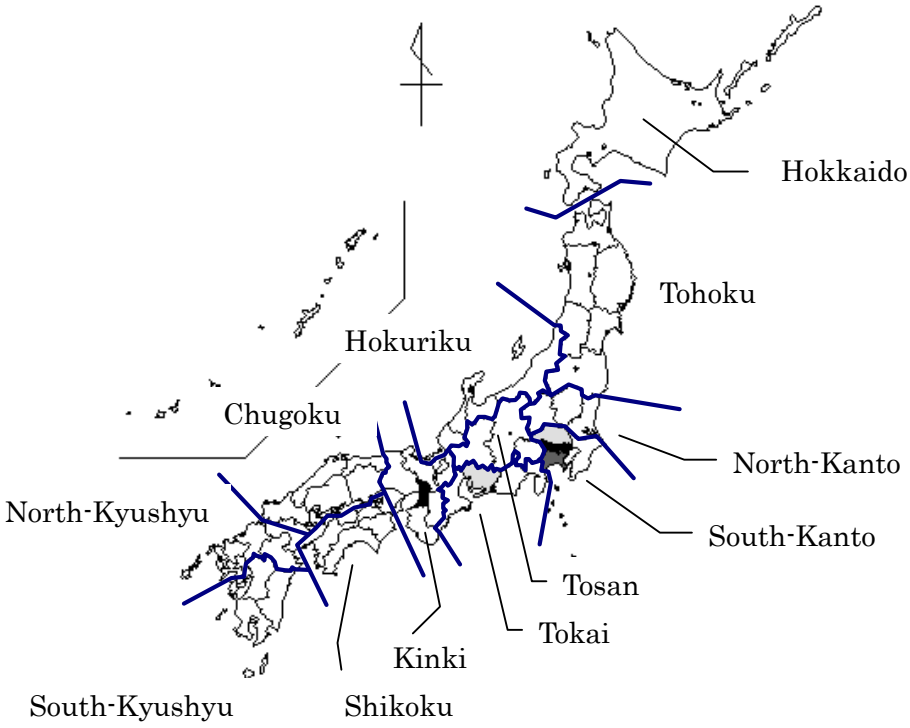


Figure 1: Regional group of prefectures

the regression of SWB, we employ the data from 1991 to 2005.

### 3.3.2 *Explanatory variables as the arguments of utility function*

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

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

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

*Price index* (PRI).

In the case of the indirect utility approach, we need price data as well as income for regression. We employ *the Consumer Price Index* at regional level, which takes account of the price disparities between regions, with the standard value represented by the price level of Tokyo in 2005. We denote the price of the reference region in the same way as consumption and income.

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

These are the substitute variables for the level of the living environment. Government spending figures are published in the *Annual Report on Prefectural Accounts*. The data on the public capital stock is calculated from the fixed capital formation of the public sector in the Prefectural Account, and the previous capital stock data, as 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 and income.

### 3.3.3 *Other control variables*

Then we explain the control variables that represent the characteristics of each region, which they are obviously not included in the utility function in the theoretical model in the previous section. According to the previous literature on SWB analysis, we presume four types of regional characteristics: economic, social, geographic and demographic factors.

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

Although, in the previous literature, the unemployment rate is used to indicate reduced well-being, we use instead the active job openings-to applicants' ratio as a substitute variable for the unemployment rate, because of insufficient periods of observation of the unemployment rate at prefectural level. These data sets are published in *the Annual Report of Labor Market*, the Ministry of Health, Labor and Welfare. Moreover, according to the previous literature, it is well known that the inflation rate significantly influences well-being.

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

These variables represent geographic factors. Population density conceivably influences individual evaluation of the living environment in the region. For example, a higher population density may lead to a higher crime rate, or conversely to more convenience. These data are

selected 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 average temperature, which is familiar in the previous SWB literature[8]. These statistics are published in *the Annual Report of Meteorological Phenomena*, by the Japan meteorological agency.

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

*Proportion of educated people* (EDU).

These variables illustrate the social or cultural characteristics of region2. The proportions of unmarried women and men are calculated as the proportion of unmarried people aged between 45 and 54 years old to the total population of the same age, using statistics from *the Population Census* and *the Annual Report on Current Population Estimation*. Similarly, the proportion of educated people is defined as the proportion of workers that has graduated from university to all workers over 15 years old. Basic statistics are published in *the Employment Status Survey*, by the Ministry of Internal Affairs and Communications. Since these surveys have a three or five year interval, we need to estimate the values of the uncovered years before our analysis.

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

Finally, we consider demographic characteristics. The gender ratio is defined as the proportion of men to women. The proportions of old people and young people represent the share of persons over 65 years old and less than 15 years old, respectively. It is obvious from many literatures that the gender ratio reduces life satisfaction, and that the regression of SWB is described as a U-shape curve with a respondent's age.

# 4 Estimation results

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

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

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

Moreover, we considered the property of disturbances, using estimation residuals of simple OLS. According to a simple t-test for covariance of residuals, around 15% of covariance in the case of SWB was significant at 0.1 levels, as was, on the other hand, around 45% of covariance in the case of suicide. Thus, contemporaneous correlation between prefectures will 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, using the Q test suggested by Ljung and Box (1979), we found autocorrelation for around 17% of regions, and around 28% of prefectures, at 0.1 significant level. However, we did not take account of autocorrelation because these Q statistics seem to have been biased by the small sample[10]. At the end of our statistical examination of the statistics, we verified a relationship between revealing life satisfaction and committing suicide. The correlation coefficient between SWB and suicide rate was –0.61. Thus, we can expect that the results of the regression of suicide rate and SWB will frequently have the opposite sign.

### 4.1 Revealing life satisfaction

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

Although 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 withdrawals from a bank account, people would not feel life satisfaction if a deficit is necessary to maintain or increase their consumption.

According to the coefficients of the references, consumption and income in Tokyo have a significantly negative influence on SWB. Thus, an increase in consumption or income in Tokyo creates dissatisfaction in people who reside in regions other than Tokyo. A question arises as to why average and weighted average consumption or income have positive (or no) effects, despite the remarks by Easterlin (1995). One reason is that people may not find it

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

easy to establish the *average* level, obviously. The other reason may be that people seem to consider the average as the state of the economy of Japan as a whole. If that is so, people would consider an increase in average consumption (or income) desirable. On the other hand, an increase in consumption or income in Tokyo clearly reduces the SWB of people who reside in regions other than Tokyo. Thus, we should consider also the existence of the jealousy type of consumption externalities between Tokyo and the other regions.

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

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

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

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 improve people's well-being in Japan.

It seems that two geographic factors are not significant due to the large differences in geographic conditions within regions. In particular, the prefecture on one side of the mountains is very different from the prefecture on the other side in terms of weather conditions, even though both prefectures exist in the same regional group.

### 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 in the above-mentioned expectation, almost all the coefficients in table 3 have the opposite sign to the results in table 2.

Both consumption and income in own region show a significantly negative relation with the suicide rate. This means that enrichment prevents people from committing suicide. On

the other hand, an increase in consumption (or income) in Tokyo positively affects the suicide rate in the other prefectures. Combining this with the above-mentioned regression results of SWB, we can verify by the larger sample that people are concerned about an increase in the economic disparity between Tokyo and own prefecture. Thus, we at least recognize the existence of consumption externalities that are defined as a negative influence of the circumstances in Tokyo on life satisfaction in other prefectures.

The coefficients of public goods are inconsistent with the results of SWB. In particular, public capital stock again correlates positively with the dependent variable. The coefficient of government spending also shows the same sign as that of SWB regression. This seems inappropriate for the statistics of government spending and public capital stock employed at the level of public goods.

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

The coefficients of geographic factors may seem to suggest that population density has an adverse influence on people's lives, by, for example, worsening public safety. On the other hand, the longer duration of sunshine seems to make people happy.

The proportion of unmarried people shows a result that is inconsistent with that of SWB. However, considering sample size and the preciseness of the samples, it seems appropriate to say that bachelors tend to be more disappointed with their lives than single women are.

Other cultural and demographic factors show the same influences as in the previous literature. In particular, a positive relation between the suicide rate and the proportion of old people seems to represent the serious situation of an ageing society.

### 4.3 Are they keeping up with Tokyo?

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

According to the definition of consumption externalities in standard theory, as mentioned

in section 2, it seems appropriate to estimate the reaction function of the other regions to the increase in consumption in Tokyo. However, our theoretical model is not competent to conduct 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 PCC). If it is obvious that lower SWB brings higher PCC, we will be able to deduce that the other regions are keeping up with Tokyo.

For this 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 the utility approach (direct or indirect) and reference (average, weighted average and Tokyo). The 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 the direct utility approach. On the other hand, INC, PRI and the reference income are included in the case of the indirect utility approach.

From the result of OLS, it is known that uncontrolled SWB negatively correlates with PCC, but is 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 a direct utility approach, controlled SWB significantly shows a negative correlation with PCC. In particular, taking consumption in Tokyo, the correlation becomes most significant.

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

increase their current consumption in order to keep up with Tokyo, when consumption in Tokyo increases.

## 5 Concluding Remarks

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

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

These results tell us that the anxiety about economic disparity between regions of Japan is caused by negative consumption externalities. Thus we suggest that a policy of interregional redistribution should be carefully designed, to ensure that such a policy does not become harmful to the efficiency or growth of the entire economy.

The remaining issues about our paper are as follows. Although we focused on the effect of the circumstances in Tokyo only, there are also other huge cities such as Osaka and Nagoya. Thus, we need to modify the calculation of the reference variable in order to study the effects of other metropolitan areas. In addition, we should examine a more suitable statistic that represents the level or the quality of the living environment, rather than government spending and public capital stock, as in our paper. In particular, government spending, which

is computed by the prefectural account, may not prove an appropriate proxy for public goods. These concerns will be the future extension of our paper.

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Table 1. Descriptive statistics

| | Data description | 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.