Do Losses Bite More than Gains? Evidence from a Panel Quantile Regression Analysis of Subjective Well-being in Japan

Zheng Fang
School of Humanities and Social Sciences,
Nanyang Technological University, Singapore
and
Yoko Niimi
Asian Growth Research Institute, Japan

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Zheng Fang
zhengfang@ntu.edu.sg
School of Humanities and Social Sciences, Nanyang Technological University, Singapore

Yoko Niimi
niimi@agi.or.jp
Asian Growth Research Institute, Japan

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Abstract

This paper conducts an empirical analysis of the distributional effects of the determinants of happiness by applying quantile regression techniques to panel data from the "Preference Parameters Study" of Osaka University, a nationally representative survey conducted in Japan. The key question examined in the paper is whether we observe an asymmetry between the effects of positive and negative changes on individual happiness, and if it exists, whether it is observed uniformly across the happiness distribution. Such an asymmetry is referred to as loss aversion in prospect theory. Loss aversion effects are analyzed with respect to relative income as well as expected future income changes. We find that feeling relatively poor has a greater negative effect on happiness than the positive effect of feeling relatively rich, i.e., losses bite more than gains. However, no evidence for loss aversion is detected with respect to expected future income changes as individual happiness is found to be more sensitive to gains than to losses, though the happiness of the least happy group is found to be affected more by losses than by equivalent gains.

Key words: Happiness, Japan, loss aversion, panel quantile regression, subjective well-being
JEL classifications: I31, C31

[1] The empirical work undertaken in this paper utilizes micro data from the Preference Parameters Study of Osaka University's 21st Century COE Program 'Behavioral Macrodynamics Based on Surveys and Experiments' and its Global COE project 'Human Behavior and Socioeconomic Dynamics.' We acknowledge the program/project's contributors—Yoshiro Tsutsui, Fumio Ohtake and Shinsuke Ikeda. We are also grateful to Charles Yuji Horioka for his invaluable comments. This work was supported by JSPS (Japan Society for the Promotion of Science) KAKENHI Grant Number 15H01950 and Post-doctorate research fund provided by School of Humanities and Social Sciences at Nanyang Technological University.

1. Introduction

Subjective well-being, such as happiness and life satisfaction, has increasingly become recognized as an important indicator to assess people's well-being in recent years (e.g., Layard, 2005; Stiglitz *et al*., 2009).[2] The field of economics is no exception and there have been an increasing number of both theoretical and empirical studies that analyze the determinants of happiness.[3] However, most existing studies have focused their analysis on the "average Joe's happiness" (Binder and Coad, 2011), simply analyzing the relationship between happiness and its determinants at the mean. While identifying the average effects of life events on one's happiness level can still provide useful insights, this would not provide a complete picture of the relationship over the whole distribution since coefficient estimates are averaged out when conventional regression techniques, such as ordinary least squares (OLS), are applied (Binder and Coad, 2011).

To explore an issue that had so far been overlooked in the happiness literature, the past few years have witnessed growing efforts in examining heterogeneous effects of various factors at different parts of the happiness distribution using quantile regressions (e.g., Binder and Coad, 2011; Yuan and Golpelwar, 2013; Fang and Sakellariou, 2015). Quantile regression techniques allow us to detect heterogeneity across the happiness distribution and identify important relationships between happiness and its determinants that may not be evident when focusing just on average effects. More recently, quantile regressions have been conducted in a panel data framework to account for unobserved time-invariant characteristics of individuals to analyze the determinants of subjective well-being (e.g., Binder and Coad, 2015; Fang, 2015; Gupta *et al*., 2015; Mahuteau and Zhu, 2015).

[2] As commonly done in happiness studies, the three terms─subjective well-being, happiness, and life satisfaction─are used interchangeably in this paper.

[3] See Frey and Stutzer (2002) and Clark *et al*. (2008) for a comprehensive survey of the literature on the determinants of happiness.

This growing strand of the happiness literature indeed provides evidence for heterogeneous effects at different quantiles of the happiness distribution, underscoring the importance of going beyond the average. Identifying such salient features of the determinants of subjective well-being is of particular interest from a policy perspective. With prior knowledge of heterogeneous effects, policy makers could avoid formulating measures that may have (unintentional) adverse effects on people belonging to certain sections of the well-being distribution. Moreover, if resources are limited, formulating measures that would target those who are at the lower end of the well-being distribution might be more efficient and quantile regressions can help identify factors that are most relevant to the well-being of targeted people in the distribution.

The present paper will explore the distributional effects of the determinants of happiness using panel data from the "Preference Parameters Study" of Osaka University, a nationally representative survey conducted in Japan. To the best of the authors' knowledge, this is the first attempt to analyze the distributional effects of the determinants of happiness not only in a panel but even in a cross-sectional framework using data on Japan. The key question this paper attempts to answer through a panel quantile regression analysis is whether we observe an asymmetry between the effects of positive and negative changes on individual happiness, and if it exists, whether such an asymmetry is uniform across the happiness distribution. In other words, the present paper aims to examine the possibility of loss aversion, the concept introduced by prospect theory (Kahneman and Tversky, 1979).[4] According to prospect theory, people derive utility from *gains* and *losses*, defined relative to a reference point, rather than from the absolute level of income or wealth (this is expressed as the value function by Kahneman and Tversky (1979)) and people tend to be more sensitive to losses (negative changes) than to gains (positive changes). The former refers to "reference

[4] See Barberis (2013) for a review and assessment of prospect theory and its applications since the publication of Kahneman and Tversky (1979).

dependence" while the latter refers to "loss aversion" in prospect theory, both of which are key properties of the theory (Tversky and Kahneman, 1991).

Reference dependence is highly relevant to the happiness literature and the important role played by relative income in determining the happiness level has been extensively examined in the literature (e.g., Clark *et al*., 2008). In contrast, research on loss aversion in the context of happiness remains relatively limited even though it could help deepen our understanding of a long discussed relationship between happiness and income. Among the few studies that exist, Ferrer-i-Carbonell (2005) examines the importance of income relative to the income of a reference group for individual happiness in Germany. She finds that relative income is as important as one's own income for individual happiness and that this comparison effect is asymmetric for West Germany as well as for the whole German sample. Such asymmetric effects imply that poorer individuals' happiness is negatively influenced by the fact that their income is lower than that of their reference group while richer individuals do not become happier from having an income above the average, supporting Dusenberry's (1949) argument that comparisons are mostly upwards (Ferrer-i-Carbonell, 2005). This is similar to loss aversion in the context of prospect theory although no explicit reference to the theory is made in Ferrer-i-Carbonell (2005).

Vendrik and Woltjer (2007), on the other hand, specifically test for whether the characteristics of the value function, such as concavity for gains, convexity for losses, and loss aversion posited in prospect theory, apply to the dependence of life satisfaction on relative income using data on Germany. They find significant concavity of life satisfaction in positive relative income, but also (unexpectedly) significant concavity of life satisfaction in negative relative income, suggesting the presence of significant loss aversion (in a wide sense and at least for larger losses) (Vendrik and Woltjer, 2007). While Ferrer-i-Carbonell (2005) and Vendrik and Woltjer (2007) examine loss aversion with respect to the effects of relative income, Di Tella *et al*. (2010) study the relevance of loss aversion to individual happiness with respect to the effects of expected income changes. Using data on Germany,

they obtain suggestive evidence for an asymmetry between gains and losses in income whereby individual happiness is found to be more sensitive to losses than to gains. Similarly, Boyce *et al*. (2013) also find evidence for loss aversion in both Germany and the United Kingdom (UK) for income changes.

While quantile regression techniques have been increasingly applied to happiness research, to the best of the authors' knowledge, there has not been any previous work that pays particular attention to loss aversion. This paper aims to extend the literature by examining the possibility of loss aversion not just at the mean but also across the happiness distribution. It will specifically assess the relevance of loss aversion to happiness with respect to relative income as well as to expected income changes. In other words, it will examine whether individual happiness is more responsive to feeling relatively poor and expected income losses (negative outcomes) than to feeling relatively rich and expected income gains (positive outcomes). It will also examine whether this tendency varies across the happiness distribution. Failing to account for loss aversion may overestimate the positive effect of income on subjective well-being (Boyce *et al*., 2013). The findings of the present analysis will therefore contribute to enhancing our understanding of the relationship between happiness and income and have important policy implications.

The rest of the paper is organized as follows: section 2 provides a review of the literature on the happiness of the Japanese as well as existing work that applies quantile regression techniques to analyzing the determinants of happiness. Section 3 describes the data, the empirical variables, and the econometric methodology used in this paper. Regression results are presented in Section 4. Section 5 summarizes the key findings and discusses their policy implications.

2. Literature review

2.1 Happiness studies on Japan

Happiness is a relatively new subject for research in the field of economics in Japan, but there has been a growing literature that examines issues related to people's happiness since the early 2000s. Kamesaka *et al*. (2010), for instance, look at how changes in people's life stage affect happiness by gender. Using data from the Preference Parameters Study, the same source that we use for the present analysis but for the 2005-2010 period, they find that, for both men and women, being unmarried and looking for a job reduce happiness while education, household income, and good health are positively associated with happiness.

Similarly, Shiroishi and Shiroishi (2007) assess how life events affect women's happiness. Their panel data analysis shows that household income, consumption, being married, the number of children, and the degree of husbands' participation in domestic work are positively associated with women's happiness while employment, particularly full-time employment, has a negative and significant effect on their happiness. Tsutsui *et al*. (2009) also find evidence for the disutility of employment among women and show that housewives with part-time jobs were less happy than full-time housewives based on data from the 2004 Preference Parameters Study.

Ohtake (2012) pays particular attention to the relationship between unemployment and happiness. Household income, financial assets, and expectations about future income growth are found to be positively associated with happiness. In contrast, being unemployed, unemployment experience, fear of unemployment, and sense of inequality have a negative and significant effect on happiness. Oshio and Urakawa (2014) also examine how perceived income inequality is associated with happiness. Using cross-sectional data, they find that perceived income inequality is negatively associated with happiness while both perceived income inequality and happiness are associated with income status, suggesting that income

inequality is more likely to become a social concern when the economy is contracting rather than when it is expanding. As for the effect of relative income on happiness, Oshio *et al*. (2011) find that relative income is significantly associated with happiness.

Despite the growing literature on the happiness of the Japanese in recent years, most studies look at the determinants of happiness at the mean and, to the best of the authors' knowledge, there has not been any previous study that has examined the determinants of the happiness distribution with the exception of Niimi (2015). Using the 2013 wave of the Preference Parameters Study, Niimi (2015) finds that household income has a negative and significant effect on happiness inequality, though people's perception of their relative standing in the income spectrum also matters for the dispersion of happiness. Moreover, the regression results show that the insecurity faced by people about their jobs and life after retirement is also a significant factor that contributes to the widening of happiness inequality. While this is useful, we could further deepen our understanding of the determinants of happiness if we explore the heterogeneous effects of various factors at different parts of the happiness distribution. This would allow us to identify salient features of happiness that may not be observed if we analyze the determinants of happiness only at the mean.

2.2 Happiness studies at quantiles

Since the work of Binder and Coad (2011), there have been an increasing number of happiness studies that go beyond average effects. Using cross-sectional data, Binder and Coad (2011) observe a decreasing effect of income, health, and social factors across the happiness distribution of the UK; Yuan and Golpelwar (2013) examine how the effects of social economic security, social inclusion, social cohesion, and social empowerment vary across the happiness distribution in China; and Fang and Sakellariou (2015) find that standard determinants matter more for less happy migrants in China. All these studies employ the traditional conditional quantile regression (Koenker and Bassett, 1978) except

for Fang and Sakellariou (2015) who apply unconditional quantile regressions recently developed by Firpo *et al*. (2009).

Panel data have the advantage of being able to account for unobservable individual-specific characteristics. How to conduct a quantile analysis using panel data has been extensively studied (for instance, Geraci and Bottai, 2007; Abrevaya and Dahl, 2008; Lamarche, 2010). The two most commonly used panel quantile methods in the happiness literature are Koenker (2004) and Canay (2011), but we find an increasing number of happiness studies employing Canay's (2011) method most recently. Using Koenker's (2004) method, Gupta *et al*. (2015) find that illness affects subjective well-being markedly differently across the distribution and that adaptation effects are more evident at the upper quartile. Using Canay's two-step estimator, Binder (2015) finds that the positive effect of volunteering on life satisfaction and mental well-being is decreasing over the distribution of happiness in the UK; Binder and Coad (2015) study to what extent the negative impacts of unemployment differ across the conditional subjective well-being distribution; Fang (2015) investigates the distributional effects of various factors on the happiness level of urban Chinese; Mahuteau and Zhu (2015) explore the heterogeneous effects of victimization on different quantiles of the subjective well-being distribution in Australia; and Samoilova and Vance (2015) explore the heterogeneous influence of children across the happiness distribution in Germany. The attractiveness of Canay (2011) over Koenker (2004) seems to be due mainly to its ease of implementation and the good properties of the estimator. In this paper, we also choose to use Canay's (2011) two-step estimator to conduct the quantile fixed effects analysis.

3. Data and methodology

3.1 Data

The data used for the present study come from the "Preference Parameters Study" of Osaka University. This survey was conducted annually in Japan during the 2003-2013 period by the 21st Century Center of Excellence Program "Behavioral Macrodynamics based on Surveys and Experiments" (2003-2008) and the Global Center of Excellence Project "Human Behavior and Socioeconomic Dynamics" (2008-2013) of Osaka University. It was undertaken with the aim of identifying whether or not the assumptions of conventional economics that people are rational and maximize utility are valid. The sample of individuals aged 20-69 was drawn to be nationally representative using two-stage stratified random sampling. The sample has a panel component, though fresh observations were added in 2004, 2006, and 2009 to overcome the problem of attrition.

It would have been ideal to use all of the waves of this survey for our quantile regression analysis. However, in order to avoid the attrition problem and to ensure that the key variables we would like to examine are available for every year, the present study will focus its analysis on the 2009-2013 period instead.[5] As the Japanese economy was hit by the global financial crisis, it will be of particular interest to examine this post-crisis period. Given that people's confidence in the economy is likely to have changed over time during this period, it would be interesting to analyze how such changes have affected the distribution of happiness in Japan.

In addition to basic information on respondents and their households such as household composition, consumption, income, and other socio-economic characteristics, this survey

[5] In the Preference Parameters Study, each wave of the survey did not include the same set of questions throughout the 2003-2013 period and the way questions were phrased changed over time for some questions.

collected unique information on respondents, including their subjective well-being (e.g., happiness, life satisfaction, and other emotional attributes), self-reported health status, and preference parameters (e.g., degree of time preference, altruism, and risk aversion). The survey also collected information on respondents' fear of becoming unemployed in the near future, their expectation about future income growth, and their perceived living standard relative to that of others. This dataset is therefore well-suited to examine the presence of loss aversion with respect to relative income and expected future income changes as outlined in Section 1. After excluding those individuals for whom at least one variable included in the econometric analysis is missing, the estimation sample consists of 18,390 observations for the 2009-2013 period.

3.2 Empirical variables

Dependent variable

The main variable of interest in this paper is the level of respondents' self-reported happiness. The happiness data were collected in the survey by asking respondents how happy they currently feel on a simple visual analogue scale ranging from 0 (very unhappy) to 10 (very happy). Table 1 reports the average happiness scores by year and gender, respectively, for the full sample. We find that after the global financial crisis, the average happiness level had decreased until 2011 but since then it has been increasing as the economy began to recover. On average, women feel significantly happier than men in all years, which is consistent with the findings in most other countries, though some studies report an absolute and relative decline in women's happiness during the past few decades in the United States and other advanced economies despite their improved lives (e.g., Blanchflower and Oswald, 2004; Stevenson and Wolfers, 2009).

Table 1: Average happiness by year and gender

Year	All		Female		Male		Gender difference	t-statistic
2009	6.555	(1.844)	6.652	(1.853)	6.462	(1.831)	0.190	3.393***
2010	6.456	(1.805)	6.625	(1.805)	6.293	(1.790)	0.332	5.699***
2011	6.419	(1.808)	6.567	(1.849)	6.285	(1.760)	0.282	4.679***
2012	6.479	(1.829)	6.688	(1.770)	6.284	(1.861)	0.404	6.488***
2013	6.523	(1.747)	6.695	(1.727)	6.363	(1.751)	0.332	5.450***
N	18,390		9,495		8,895			

Note: *** denote statistical significance at the 1% level. Standard deviations are in parentheses.
Source: Calculations based on data from the Preference Parameters Study (2009-2013).

Relative income variables

To assess the degree of loss aversion, we include two dummy variables that equal one if respondents perceive that other people's living standards are higher than their own or lower than their own, respectively. Relative income variables are commonly constructed by calculating the difference between one's own income and that of a reference group, which is usually defined in terms of age, gender, and educational attainment. However, there is no guarantee that people actually compare their living standards with such groups. In contrast, the data used for the present study contain unique information on how respondents perceive their living standards in comparison with those of others and this is likely to be a more accurate reflection of how respondents perceive their relative position in the income spectrum. Following the findings of existing work (e.g., Ferrer-i-Carbonell, 2005; and Vendrik and Woltjer, 2007), we would expect the negative effect of feeling relatively poor to be greater than the positive effect of feeling relatively rich on happiness.

Expected income change variables

We also look at the effect of respondents' expectations about their future income growth. To allow for asymmetries between positive and negative income changes, we relax the restriction that their coefficients are equal and include two variables that capture positive and negative income changes, respectively, a specification similar to that of Di Tella *et al*. (2010). Using information on respondents' expectations about their future income changes,

we create a variable (*expected positive income change*) that equals the percentage change that respondents expect to see in their future income if their expectations are positive and zero otherwise. Similarly, we create another variable (*expected negative income change*) that equals the percentage change that respondents expect to see in their future income if their expectations are negative and zero otherwise. We would again expect the negative effect of expected income losses to be greater than the positive effect of expected income gains.

Other explanatory variables

We include a set of explanatory variables that capture the demographic and socio-economic characteristics of respondents and their households, including respondents' age, gender, marital status, educational attainment, and household income. We also include a dummy variable that equals one if respondents have any children. In order to assess the effect of respondents' health status on the distribution of happiness, we include a variable that represents respondents' self-reported health status, whose values lie on a five point scale ranging from 1 (poor) to 5 (excellent).

As for the employment status of respondents, in addition to controlling for whether or not respondents are unemployed, we also take into account the security of respondents' employment by dividing employed people into two groups, regular job holders and irregular job holders.[6] Note that irregular employment, which tends to be low paid and insecure, has been growing in Japan over the last two decades. We also include a dummy variable that indicates whether or not respondents perceive a high risk of unemployment for themselves or their family members within the next two years.

[6] Irregular employees include those who are working as a part-time worker, temporary worker, fixed-term worker, or dispatched worker from a temporary agency. These irregular jobs tend to be low paid and insecure in comparison with regular (i.e., full-time) employment.

Table 2: Transition matrix of employment status

Employment		Regular job		Irregular job		Unemployed		Out of labor force	
Regular job	Obs. [Freq]	5,091	[88.76]	434	[7.57]	57	[0.99]	154	[2.68]
	Mean happiness (sd)	6.544	(1.681)	6.459	(1.899)	5.495	(2.550)	6.658	(1.771)
Irregular job	Obs. [Freq]	414	[9.91]	3,373	[80.73]	57	[1.36]	334	[7.99]
	Mean happiness (sd)	6.210	(1.807)	6.312	(1.830)	5.501	(2.175)	6.388	(1.756)
Unemployed	Obs. [Freq]	30	[11.95]	64	[25.50]	95	[37.85]	62	[24.70]
	Mean happiness (sd)	6.490	(1.868)	5.239	(2.362)	4.276	(1.946)	6.313	(1.850)
Out of labor force	Obs. [Freq]	134	[4.18]	388	[12.09]	61	[1.90]	2,625	[81.83]
	Mean happiness (sd)	6.815	(1.707)	6.487	(1.892)	5.419	(1.767)	6.767	(1.809)

Source: Calculations based on data from the Preference Parameters Study (2009-2013).

Table 2 shows the number of observations and associated frequencies that a person transits from one employment status in period $t-1$ (in the first column) to another employment status in the next period t (in the first row). The average happiness levels and standard deviations of people at period t in each element of the transition matrix are also reported. We observe that those who have found regular jobs after having been out of the labor force are the happiest group of people and those who have stayed unemployed consecutively are the least happy group.

Table 3: Transition matrix of likely becoming unemployed

Likely becoming unemployed		Yes		No	
Yes	Obs. [Freq]	663	[42.88]	883	[57.12]
	Mean happiness (sd)	5.716	(1.971)	6.106	(1.953)
No	Obs. [Freq]	919	[7.54]	11,270	[92.46]
	Mean happiness (sd)	5.918	(1.957)	6.576	(1.742)

Source: Calculations based on data from the Preference Parameters Study (2009-2013).

Similarly, we can also obtain the transition matrix for the *likely becoming unemployed* variable. As shown in Table 3, people who are no longer concerned about becoming unemployed have an average happiness score that is 0.39 more than the happiness score of people who consecutively worry about it (6.106-5.716). On the other hand, people who have recently become concerned about becoming unemployed are much less happy than people who do not have such concerns, and the differenced happiness score is about 0.66 (6.576-

5.918), almost twice the happiness gain from transiting from being worried to not being worried about future unemployment. This is consistent with the prospect theory proposed by Kahneman and Tversky (1979) that losses bite more than gains. By conducting a panel quantile regression analysis, we will examine in more detail whether or not losses (negative outcomes) matter more than gains (positive outcomes), i.e., whether or not we observe some degree of loss aversion.

3.3 Econometric methodology

We aim to investigate the heterogeneous effects of different determinants across the happiness distribution in Japan. The conditional quantile regression method developed by Koenker and Bassett (1978) and the unconditional quantile regression proposed by Firpo *et al*. (2009) can be employed to study distributional effects. The conditional quantile regression model can be expressed as follows:

$$\mathrm{H_i} = \mathrm{X_i}'\beta_\theta + \epsilon_{\theta i}, Q_\theta(\epsilon_{\theta i}|X_i) = 0 \quad (1)$$

where $\mathrm{H_i}$ is the dependent variable *happiness*, $\mathrm{X_i}$ is a vector of the explanatory variables described in the previous sub-section, and ε_i is the error term, which satisfies the assumption $Q_\theta(\varepsilon_{\theta i}|X_i) = 0$. The coefficient at the θ-th quantile, β_θ, measures how much the θ-th quantile of happiness will change when X increases by one unit, conditional on a set of values X.

The unconditional quantile regression model can be written as:

$$\mathrm{RIF}\ (\mathrm{H_i};\ \mathrm{Q_\theta}, \mathrm{F_H}) = \mathrm{Q_\theta} + \frac{\theta - \mathrm{I}(\mathrm{H_i} \le \mathrm{Q_\theta})}{\mathrm{f_H}(\mathrm{Q_\theta})} = \mathrm{X_i}'\beta_\theta + \epsilon_{\theta i} \qquad (2)$$

where the first equation is an expression of the re-centered influence function (RIF) of the unconditional quantile Q_θ of the dependent variable H_i. The notations $F_H(\cdot)$ and $f_H(\cdot)$ are density and probability distributions of *happiness*, and $I(\cdot)$ is the indicator function. The second equation is a linear specification of the unconditional quantile regression. Given everything else unchanged, the OLS estimate of β_θ has been shown to be a consistent estimate of the marginal effect on the unconditional quantile Q_θ of a small location shift in the explanatory variables X (Firpo *et al*., 2009).

In both quantile regression models, when θ moves from 0 to 1, the whole picture of how determinants affect the happiness distribution is obtained. However, due to omitted variable (such as preference, attitude, and psychological variables) bias, the results of the quantile regression method using cross-sectional data show at most the associations between happiness and the explanatory variables. In order to obtain causal relationships as well as distributional characteristics, we resort to the panel quantile regression method in the present study.

The quantile regression was first applied to a panel framework by Koenker (2004), and it has already been applied in happiness studies (Gupta *et al*., 2015). Since then, many researchers have studied and developed the panel quantile methodology and Canay (2011) is one of them. Canay (2011) proposed a simple two-step estimator. The first step is to estimate unobserved fixed effects using within estimators, and the second step is to replace the independent variable with an adjusted one and conduct standard conditional quantile regression. Specifically, consider the following happiness equation:

$$H_{it} = X_{it}'\beta_\theta + \alpha_i + \varepsilon_{it},\ E(\varepsilon_{it}|X_i, \alpha_i) = 0 \qquad (3)$$

where H_{it} represents the happiness level of individual i at time period t, X_{it} is a set of control variables as above, $\alpha_i$is a time-invariant individual fixed effect, and ε_{it} is the error term.

The first step of Canay's (2011) two-step panel quantile estimation is to obtain $\hat{\alpha}_i = \mathrm{E}_T\left[\mathrm{H_{it}} - \mathrm{X_{it}}'\widehat{\beta_\theta}\right]$, where $\widehat{\beta_\theta}$ is a $\sqrt{\mathrm{nT}}$-consistent estimator of β_θ obtained from the within estimation, and the second step is to obtain $\widehat{\beta_\theta} = \arg\min_{\beta \in R^k} \mathrm{E}_{nT}\left[\rho_\theta(\widehat{\mathrm{H}}_{\mathrm{it}} - \mathrm{X_{it}}'\theta)\right]$ where $\widehat{\mathrm{H}}_{\mathrm{it}} = \mathrm{H_{it}} - \hat{\alpha}_i$.

It has been proved that the two-step estimator is not only consistent but also asymptotically normally distributed under some regularity conditions (Canay, 2011). Monte-Carlo simulations also show that Canay's (2011) estimator is very close to Koenker's (2004). This easy two-step panel quantile estimation has gained wide attention in the happiness literature recently (see, for example, Binder, 2015; Binder and Coad, 2015; Fang, 2015; Mahuteau and Zhu, 2015; Samoilova and Vance, 2015). In this paper, we will employ Canay's (2011) two-step panel quantile estimation to analyze the distributional effects while controlling for unobserved time-invariant characteristics.

4. Results and discussions

Before examining the heterogeneous effects of various determinants on happiness levels, we first look at descriptive statistics of both the dependent variable *happiness* and independent variables used in the analysis. As shown in Table 4, the average happiness level of the full sample is 6.5 out of 10 and the average age is 45 years old. More than 70% of the respondents are married with children and more than 60% have good health or above. Almost half of the sample have graduated from junior college or above. About 29% of them have irregular jobs and 47% have regular jobs; in addition, about 11% are worried about themselves or their family members becoming unemployed within the next two years. Household income was expected to increase on average by 0.9% among those with positive expectations about their future income while it was expected to decrease by about 1.8% among those with negative expectations.

Table 4: Summary statistics for 2009-2013

Variables	All		Male		Female	
	Mean	S.D.	Mean	S.D.	Mean	S.D
Female	0.484	(0.500)	-		-	
Happiness	6.486	(1.807)	6.337	(1.800)	6.646	(1.801)
Age	44.664	(13.745)	44.745	(13.890)	44.577	(13.589)
Age squared/100	21.838	(12.773)	21.950	(12.943)	21.718	(12.589)
Having children	0.730	(0.444)	0.684	(0.465)	0.779	(0.415)
Marital status						
Never married	0.212	(0.409)	0.249	(0.432)	0.173	(0.378)
Married	0.736	(0.441)	0.721	(0.448)	0.753	(0.432)
Divorced/widowed	0.052	(0.221)	0.030	(0.171)	0.075	(0.263)
Health status						
Poor	0.074	(0.262)	0.072	(0.259)	0.077	(0.266)
Fair	0.309	(0.462)	0.319	(0.466)	0.298	(0.457)
Good	0.305	(0.460)	0.305	(0.461)	0.305	(0.460)
Very good	0.229	(0.420)	0.216	(0.412)	0.242	(0.428)
Excellent	0.083	(0.276)	0.087	(0.282)	0.079	(0.270)
Education status						
Secondary school	0.068	(0.251)	0.075	(0.263)	0.060	(0.237)
High school	0.450	(0.498)	0.435	(0.496)	0.467	(0.499)
Junior college	0.169	(0.375)	0.078	(0.268)	0.266	(0.442)
University/higher	0.313	(0.464)	0.412	(0.492)	0.207	(0.405)
Employment status						
Regular job	0.474	(0.499)	0.679	(0.467)	0.256	(0.436)
Irregular job	0.289	(0.453)	0.182	(0.386)	0.403	(0.490)
Unemployed	0.023	(0.148)	0.025	(0.157)	0.020	(0.139)
Out of labor force	0.215	(0.411)	0.114	(0.318)	0.322	(0.467)
Likely unemployed	0.106	(0.308)	0.113	(0.316)	0.098	(0.298)
Log household income	6.293	(0.618)	6.314	(0.602)	6.272	(0.634)
Relatively rich	0.105	(0.307)	0.115	(0.319)	0.094	(0.292)
Relatively poor	0.380	(0.485)	0.366	(0.482)	0.394	(0.489)
Expected positive hhincome change	0.905	(2.229)	0.929	(2.285)	0.881	(2.169)
Expected negative hhincome change	-1.790	(3.286)	-1.813	(3.330)	-1.766	(3.239)
Regions						
Hokkaido	0.046	(0.209)	0.044	(0.205)	0.047	(0.213)
Tohoku	0.061	(0.240)	0.066	(0.248)	0.057	(0.232)
Kanto	0.349	(0.477)	0.359	(0.480)	0.338	(0.473)
Koshinetsu	0.042	(0.200)	0.045	(0.207)	0.038	(0.192)

Variables		All		Male		Female	
	Hokuriku	0.024	(0.152)	0.023	(0.151)	0.024	(0.154)
	Tokai	0.126	(0.332)	0.123	(0.328)	0.129	(0.335)
	Kinki	0.160	(0.367)	0.156	(0.363)	0.165	(0.371)
	Chugoku	0.053	(0.224)	0.051	(0.220)	0.055	(0.229)
	Shikoku	0.030	(0.171)	0.030	(0.171)	0.030	(0.169)
	Kyushu	0.110	(0.312)	0.103	(0.303)	0.117	(0.321)
N		18,390		8,895		9,495	

Source: Calculations based on data from the Preference Parameters Study (2009-2013).

Looking at the summary statistics by gender, the female sample has a higher happiness level than the male sample on average, as expected. The share of people out of the labor force is much higher among females than it is among males. The proportion of men with a university education or above is 41% while the corresponding proportion for women is much smaller at only 21%. Interestingly, compared to men, more women feel that their standard of living is lower than that of other people around them and fewer women feel that their standard of living is higher. In terms of expectations about future positive income changes, women are again found to be more pessimistic than men.

In the following sub-sections, we will first explore the relationships between various factors and happiness using fixed effect panel regressions. Since men and women tend to perceive happiness differently, we repeat the regressions by gender. We will then focus on discussions of heterogeneous effects across the happiness distribution.

4.1 Panel regressions

The regression results of the fixed effect model for the full sample are shown in Table 5, and as this table shows, there is a U-shaped relationship between age and happiness; happiness is significantly and positively associated with marriage, having good health, and household income, and negatively related with having poor health and being unemployed.

These are all standard findings in the happiness literature (Dolan *et al*., 2008).[7] Having children seems to have little effect on the happiness level of the Japanese. Tsutsui *et al*. (2009) and Sano and Ohtake (2007) also report an insignificant effect of having children on happiness among the Japanese, though a positive effect is reported for having children aged 6 or lower in the latter study. Contrary to our expectations, people with irregular jobs are not less happy in comparison with those with regular jobs although the coefficient is not significant. The possibility of oneself or his/her spouse becoming unemployed in the near future is observed to have a similar effect as being unemployed.

As far as the effect of relative living standards is concerned, feeling relatively rich does not affect happiness significantly but feeling relatively poor has a negative and significant effect on happiness. This is consistent with the findings of previous studies (e.g., Ferrer-i-Carbonell, 2005; Vendrik and Woltjer, 2007) and suggests the presence of loss aversion. In contrast, positive expectations about future income growth are found to have a greater effect on happiness than negative expectations, suggesting that individual happiness is more sensitive to gains than to losses. This contrasts with the findings of previous studies that find the evidence for loss aversion in the effects of future income changes (e.g., De Tella *et al*., 2010).

Looking at the fixed effect regression results by gender, we find that the signs of the coefficient estimates for the male sample are mostly consistent with those for the full sample. However, for the female sample, no U-shaped relationship between age and happiness is observed, which is consistent with the findings of Kamesaka *et al*. (2010). Moreover, it is found that while married men are much happier than never-married men, married women are less happy than their never-married counterparts although the coefficient is not

[7] OLS results from the pooled regression are shown in Table A1. Compared to the fixed effects results, most coefficients (such as that of health, household income, relative poor/rich, and expected positive/negative household income changes) are found to be overestimated. Education and regional dummies are not considered in the fixed effects model due to lack of variation over time.

significant. Similar findings are also obtained by Sano and Ohtake (2007) whose analysis shows a positive effect of marriage for men but an insignificant effect for women.

Table 5: Fixed effect regression results

	All		Male		Female	
	Coefficient	Robust SE	Coefficient	Robust SE	Coefficient	Robust SE
Age	-0.062***	(0.023)	-0.115***	(0.033)	-0.012	(0.032)
Age squared/100	0.050**	(0.024)	0.097***	(0.034)	0.006	(0.034)
Having children	-0.111	(0.091)	-0.228*	(0.118)	0.042	(0.144)
Married	0.324***	(0.107)	0.729***	(0.150)	-0.158	(0.154)
Divorced/widowed	-0.050	(0.149)	0.011	(0.239)	-0.260	(0.192)
Health_poor	-0.299***	(0.050)	-0.308***	(0.071)	-0.282***	(0.072)
Health_fair	-0.059**	(0.028)	-0.097**	(0.039)	-0.010	(0.040)
Health_very good	0.090***	(0.030)	0.069	(0.043)	0.117***	(0.042)
Health_excellent	0.266***	(0.048)	0.249***	(0.066)	0.277***	(0.069)
Irregular job	0.027	(0.043)	0.025	(0.061)	0.072	(0.063)
Unemployed	-0.231***	(0.087)	-0.406***	(0.121)	-0.025	(0.127)
Out of labor force	-0.101*	(0.052)	-0.298***	(0.081)	0.046	(0.071)
Likely unemployed	-0.222***	(0.037)	-0.237***	(0.052)	-0.210***	(0.052)
Log household income	0.165***	(0.029)	0.154***	(0.043)	0.177***	(0.040)
Relatively rich	-0.017	(0.042)	-0.094*	(0.057)	0.090	(0.064)
Relatively poor	-0.184***	(0.029)	-0.208***	(0.040)	-0.162***	(0.042)
Expected positive hhincome change	0.024***	(0.005)	0.029***	(0.007)	0.019***	(0.007)
Expected negative hhincome change	0.014***	(0.003)	0.014***	(0.005)	0.014***	(0.005)
constant	7.102***	(0.552)	8.168***	(0.792)	6.081***	(0.770)
N	18,390		8,895		9,495	
F-statistics	5.595		5.505		5.517	

Note: ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.
Source: Estimation based on data from the Preference Parameters Study (2009-2013).

Our estimation results show that work status does not significantly affect women's happiness either. Sano and Ohtake (2007) similarly report that while unemployment reduces men's happiness, there is no significant relationship between happiness and unemployment in the female sample. Given that husbands still tend to be the primary breadwinner of their

households in Japan, it might be possible that women's happiness is affected by husbands' income instead. To verify this, we restrict the sample to those who are married and replace the variable *logarithm of household income* with two variables *logarithm of personal income and logarithm of spouse's income*. It is interesting to find that for the married male sample, the wife's income significantly lowers men's happiness; however, for the married female sample, the husband's income increases women's happiness (see panel (1) and (2) in the Table A2). While research on the effect of spousal income on happiness remains limited, Sohn (2015) similarly finds that wives' happiness is positively associated with husbands' income and that the effect was six times greater than the effect of their own income in the case of Indonesian couples.

As found for the full sample, we find feeling relatively poor to have a greater effect on happiness than feeling relatively rich for both the male and female samples. In addition, as in the case of the full sample, contrary to our expectations, expected positive income changes affect individual happiness more than expected negative income changes for both men and women.

4.2 Panel quantile regressions for the full sample

Will different determinants affect the happiness level of people at different points in the distribution of happiness differently? To explore this question, Table 6 presents the results of panel quantile regressions for the full sample at 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles, respectively, and provides a complete picture of how different determinants affect happiness levels. For example, having children, which was found to hardly impact happiness in the last sub-section, now shows a negative effect on most people except for those at the top quantile of the happiness distribution. The heterogeneous effect of having children on happiness is veiled in the results at the mean. The negative effect of having children on happiness may be reflected in the low fertility rate observed in Japan. Moreover, it is found that being unemployed has almost ten times' the effect on the unhappiest 10%

than on the happiest 10% and the perceived risk of oneself or one's family members becoming unemployed in the near future also affects the unhappiest 10% much more than the happiest 10%. Similarly, poor health, feeling relatively poor, and expected negative household income changes all have monotonically decreasing effects as we move up the distribution of happiness. These findings suggest that the happiness level of those who are least happy is affected more by negative factors than that of less unhappy people.

Table 6: Panel quantile regression results

	10th	25th	50th	75th	90th
Age	-0.049***	-0.064***	-0.062***	-0.066***	-0.063***
	(0.010)	(0.007)	(0.000)	(0.006)	(0.009)
Age squared/100	0.043***	0.053***	0.050***	0.050***	0.044***
	(0.010)	(0.007)	(0.000)	(0.006)	(0.009)
Having children	-0.224***	-0.181***	-0.111***	-0.113***	0.065
	(0.072)	(0.049)	(0.001)	(0.042)	(0.057)
Married	0.371***	0.415***	0.324***	0.372***	0.224***
	(0.089)	(0.061)	(0.001)	(0.053)	(0.071)
Divorced/widowed	-0.090	0.094	-0.051***	-0.033	-0.024
	(0.110)	(0.072)	(0.001)	(0.059)	(0.085)
Health_poor	-0.573***	-0.435***	-0.298***	-0.236***	-0.056
	(0.062)	(0.045)	(0.001)	(0.035)	(0.053)
Health_fair	-0.120***	-0.065**	-0.059***	-0.017	0.010
	(0.039)	(0.028)	(0.000)	(0.023)	(0.034)
Health_very good	0.102**	0.119***	0.091***	0.102***	0.058
	(0.044)	(0.032)	(0.000)	(0.026)	(0.037)
Health_excellent	0.218***	0.273***	0.266***	0.326***	0.322***
	(0.069)	(0.050)	(0.001)	(0.044)	(0.062)
Irregular job	0.016	0.021	0.026***	0.058**	0.065**
	(0.038)	(0.027)	(0.000)	(0.023)	(0.033)
Unemployed	-0.412***	-0.278***	-0.232***	-0.231***	-0.059
	(0.127)	(0.089)	(0.001)	(0.075)	(0.102)
Out of labor force	-0.134***	-0.057*	-0.101***	-0.077***	-0.066*
	(0.044)	(0.032)	(0.000)	(0.025)	(0.037)
Likely unemployed	-0.346***	-0.272***	-0.210***	-0.170***	-0.167***
	(0.054)	(0.037)	(0.000)	(0.031)	(0.041)
Log household income	0.239***	0.213***	0.166***	0.130***	0.080***
	(0.029)	(0.021)	(0.000)	(0.018)	(0.026)
Relatively rich	0.099*	0.008	-0.017***	-0.048	-0.081*
	(0.054)	(0.042)	(0.000)	(0.031)	(0.043)
Relatively poor	-0.267***	-0.215***	-0.184***	-0.158***	-0.119***

	10th	25th	50th	75th	90th
	(0.035)	(0.026)	(0.000)	(0.021)	(0.031)
Expected positive hhincome change	0.018**	0.025***	0.024***	0.023***	0.025***
	(0.008)	(0.005)	(0.000)	(0.005)	(0.006)
Expected negative hhincome change	0.024***	0.015***	0.014***	0.009***	0.003
	(0.005)	(0.003)	(0.000)	(0.003)	(0.004)
Constant	5.332***	6.354***	7.101***	7.882***	8.656***
	(0.290)	(0.200)	(0.002)	(0.167)	(0.252)
N	18,390	18,390	18,390	18,390	18,390

Note: Robust standard errors are in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.
Source: Estimation based on data from the Preference Parameters Study (2009-2013).

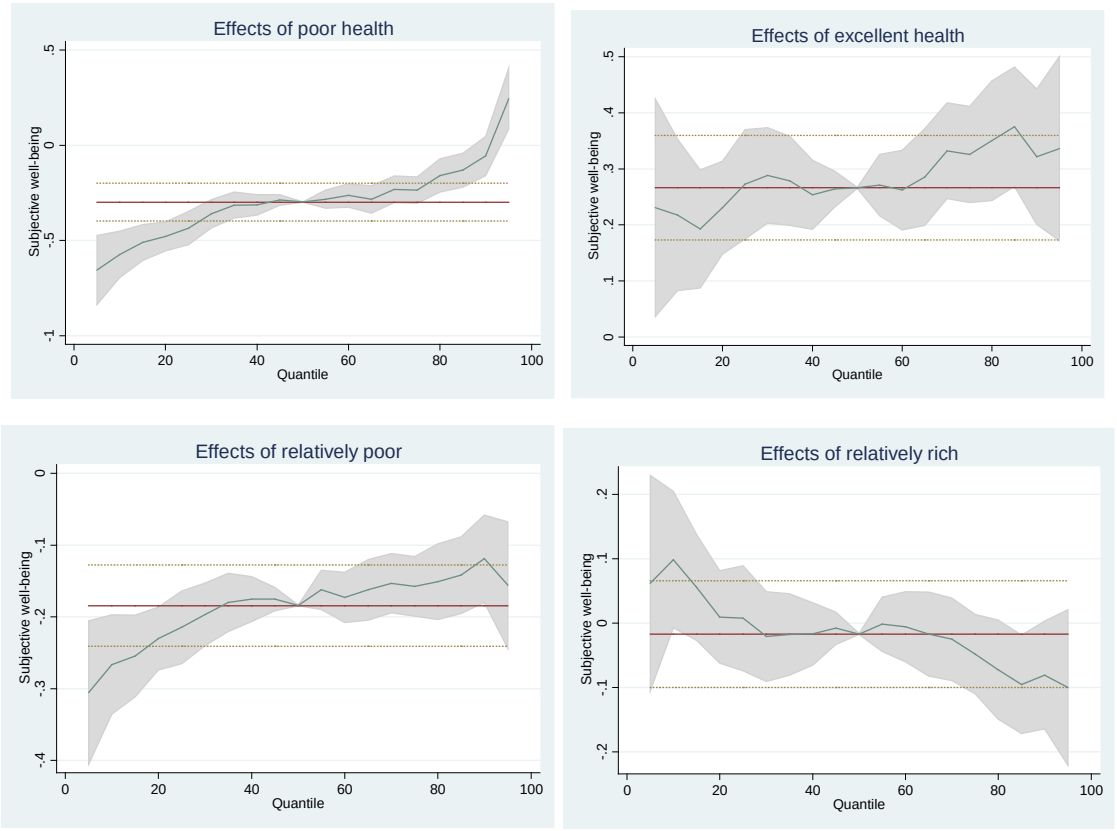
While we did not detect the presence of loss aversion with respect to expected income changes in the results at the mean, the quantile regression results provide evidence for loss aversion among the bottom quantile of the happiness distribution. The least happy people are found to be more sensitive to losses than to gains as predicted by prospect theory. Although it is not related to income, the negative effect of poor health on happiness is also greater than the positive effect of excellent health for relatively unhappy people, which was not evident in the results at the mean. Lastly, loss aversion with respect to relative income is found uniformly across the happiness distribution.

The heterogeneous effects across the happiness distribution can be clearly seen in Figure 1.[8] Poor health has a monotonically decreasing negative effect as we move up the happiness distribution while excellent health seems to have a constant positive effect on the happiness of most Japanese (except for those at the two ends of the distribution). Moreover, poor health tends to lower the happiness of the least happy group of people by 0.65 points but excellent health only increases their happiness by 0.23 points. The results that negative outcomes matter more than positive outcomes in affecting people's happiness are reverted only for people at the upper part of the happiness distribution. Looking at the plots for relatively poor and relatively rich, a similar trend is observed, with the negative effect of

[8] The plots for the effects of other variables are available from the authors upon request.

feeling relatively poor dominating the positive effect of feeling relatively rich. The happiest group of people even feels unhappy about their superiority. As for expected income changes, as in the case of health status, negative expectations about future income have a monotonically decreasing negative effect across the happiness distribution whereas positive expectations about future income have a constant positive effect on happiness.

Figure 1: Distributional effects of selected variables on happiness



Note: The shaded area shows the 95% confidence bands.
Source: Estimation based on data from the Preference Parameters Study (2009-2013).

4.3 Panel quantile regressions by gender

Table 7 and Table 8 show coefficient estimates for the panel quantile regression model by gender. Having children reduces the happiness of men, especially those at the lower half of the happiness distribution, but increases the happiness of women at the upper half of the distribution. Marriage has a positive and significant effect on men that decreases over the distribution of happiness but has a negative effect on women with no observable trend over the distribution. Being unemployed also negatively affects men only and the effects decline across the happiness distribution. While being out of the labor force negatively affects men, it has a positive effect on women (significant only for the 25th and 50th quantiles). This again seems to reflect the breadwinning role men tend to play in Japanese households. Household income affects both men and women in a similar way and has a monotonically decreasing positive effect as we move up the happiness distribution.

In order to look at gender differences more closely, we run regressions on the limited sample of married people and use personal income and spouse's income instead of household income (see Table A2 (3)). It is found that personal income has a significant and positive effect for married men, though the effect decreases as we move up the happiness

distribution; the wife's income has a decreasing negative impact on her husband's happiness while her husband's income has a decreasing positive impact on the wife's happiness across the distribution. This suggests that the least happy group of women rely more on their spouse's economic status while the happiest women are more independent. Furthermore, as in the case of the full sample, the negative effect of poor health on happiness is found to be greater than the positive effect of excellent health for the bottom three quantiles of the happiness distribution for both men and women.

Table 7: Panel quantile regression results for male

	10th	25th	50th	75th	90th
Age	-0.112***	-0.130***	-0.115***	-0.111***	-0.090***
	(0.012)	(0.009)	(0.000)	(0.010)	(0.013)
Age squared/100	0.099***	0.113***	0.096***	0.091***	0.065***
	(0.012)	(0.009)	(0.000)	(0.010)	(0.013)
Having children	-0.384***	-0.261***	-0.228***	-0.213***	-0.079
	(0.076)	(0.064)	(0.000)	(0.067)	(0.085)
Married	0.873***	0.778***	0.729***	0.737***	0.600***
	(0.094)	(0.079)	(0.000)	(0.084)	(0.109)
Divorced/widowed	-0.081	0.113	0.011***	0.024	-0.018
	(0.133)	(0.102)	(0.001)	(0.103)	(0.135)
Health_poor	-0.526***	-0.443***	-0.308***	-0.188***	-0.082
	(0.077)	(0.060)	(0.000)	(0.061)	(0.073)
Health_fair	-0.159***	-0.106***	-0.097***	-0.058	-0.044
	(0.048)	(0.038)	(0.000)	(0.039)	(0.046)
Health_very good	0.110**	0.096**	0.069***	0.098**	0.034
	(0.054)	(0.045)	(0.000)	(0.046)	(0.053)
Health_excellent	0.153*	0.182***	0.249***	0.311***	0.356***
	(0.080)	(0.065)	(0.000)	(0.073)	(0.086)
Irregular job	0.071	0.016	0.025***	0.041	0.013
	(0.051)	(0.043)	(0.000)	(0.048)	(0.052)
Unemployed	-0.806***	-0.501***	-0.406***	-0.468***	-0.192
	(0.120)	(0.117)	(0.001)	(0.124)	(0.187)
Out of labor force	-0.321***	-0.261***	-0.298***	-0.320***	-0.188**
	(0.076)	(0.059)	(0.000)	(0.062)	(0.075)
Likely unemployed	-0.344***	-0.270***	-0.237***	-0.189***	-0.237***
	(0.066)	(0.051)	(0.000)	(0.053)	(0.063)
Log household income	0.256***	0.215***	0.154***	0.103***	0.067**
	(0.035)	(0.030)	(0.000)	(0.031)	(0.034)
Relatively rich	-0.084	-0.122**	-0.094***	-0.088*	-0.136**

	10th	25th	50th	75th	90th
	(0.064)	(0.056)	(0.000)	(0.050)	(0.055)
Relatively poor	-0.328***	-0.226***	-0.208***	-0.178***	-0.112**
	(0.043)	(0.035)	(0.000)	(0.037)	(0.045)
Expected positive	0.017**	0.032***	0.029***	0.029***	0.029***
hhincome change	(0.009)	(0.007)	(0.000)	(0.008)	(0.010)
Expected negative	0.024***	0.020***	0.014***	0.009**	-0.003
hhincome change	(0.006)	(0.005)	(0.000)	(0.005)	(0.005)
Constant	6.477***	7.657***	8.167***	8.863***	9.149***
	(0.382)	(0.292)	(0.002)	(0.308)	(0.382)
N	8,895	8,895	8,895	8,895	8,895

Note: Robust standard errors are in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.
Source: Estimation based on data from the Preference Parameters Study (2009-2013).

Table 8: Panel quantile regression results for female

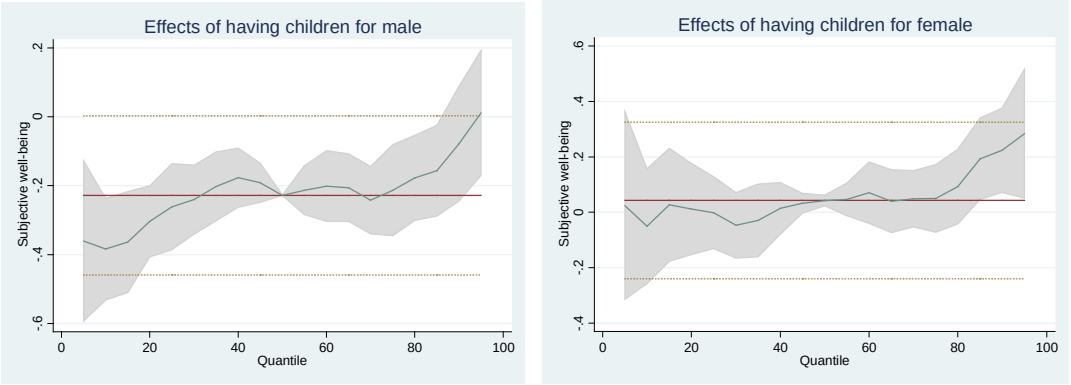
	10th	25th	50th	75th	90th
Age	0.017	-0.010	-0.012***	-0.018**	-0.040***
	(0.012)	(0.009)	(0.001)	(0.008)	(0.010)
Age squared/100	-0.017	0.004	0.005***	0.008	0.026***
	(0.012)	(0.009)	(0.001)	(0.008)	(0.010)
Having children	-0.050	-0.001	0.042***	0.050	0.223***
	(0.106)	(0.066)	(0.010)	(0.062)	(0.077)
Married	-0.182	-0.079	-0.163***	-0.109	-0.186**
	(0.127)	(0.082)	(0.012)	(0.077)	(0.094)
Divorced/widowed	-0.319**	-0.116	-0.272***	-0.270***	-0.227**
	(0.152)	(0.094)	(0.013)	(0.083)	(0.102)
Health_poor	-0.523***	-0.427***	-0.282***	-0.275***	0.004
	(0.077)	(0.056)	(0.008)	(0.049)	(0.064)
Health_fair	-0.034	-0.021	-0.014***	0.018	0.065
	(0.049)	(0.035)	(0.005)	(0.032)	(0.040)
Health_very good	0.163***	0.153***	0.118***	0.121***	0.102**
	(0.054)	(0.040)	(0.006)	(0.036)	(0.044)
Health_excellent	0.269***	0.366***	0.270***	0.326***	0.335***
	(0.090)	(0.064)	(0.010)	(0.061)	(0.080)
Irregular job	0.049	0.052	0.064***	0.085**	0.113**
	(0.054)	(0.039)	(0.006)	(0.036)	(0.045)
Unemployed	-0.006	-0.030	-0.045**	-0.048	0.043
	(0.151)	(0.116)	(0.018)	(0.108)	(0.134)
Out of labor force	0.030	0.076*	0.038***	0.043	0.036
	(0.055)	(0.043)	(0.006)	(0.039)	(0.048)
Likely unemployed	-0.428***	-0.265***	-0.170***	-0.160***	-0.115**
	(0.073)	(0.047)	(0.007)	(0.041)	(0.051)

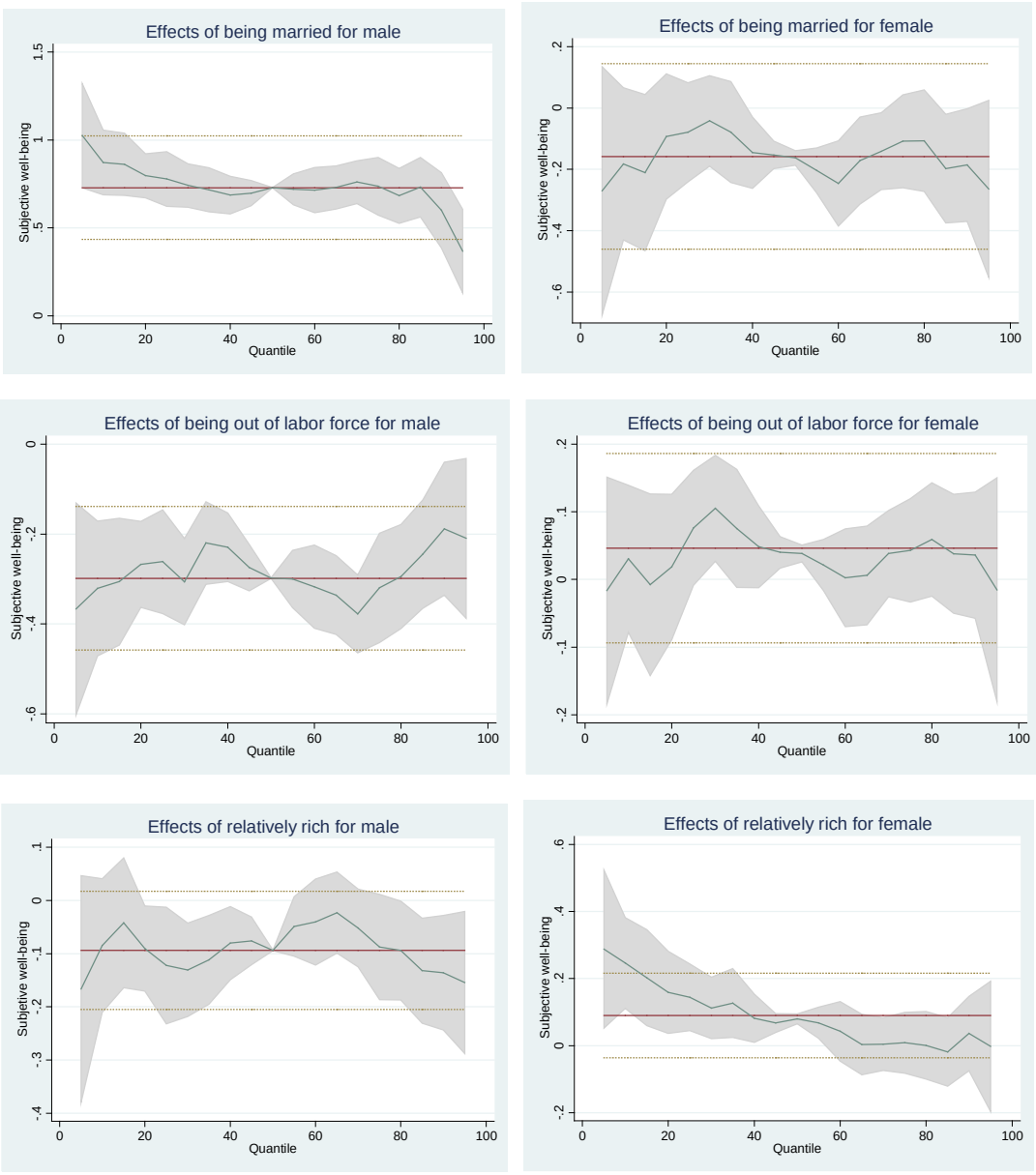
	10th	25th	50th	75th	90th
Log household income	0.260***	0.192***	0.179***	0.149***	0.083***
	(0.035)	(0.026)	(0.004)	(0.025)	(0.031)
Relatively rich	0.246***	0.144***	0.080***	0.009	0.036
	(0.069)	(0.051)	(0.008)	(0.046)	(0.057)
Relatively poor	-0.219***	-0.214***	-0.159***	-0.127***	-0.112***
	(0.043)	(0.033)	(0.005)	(0.029)	(0.036)
Expected positive hhincome change	0.022*	0.020***	0.018***	0.019***	0.026***
	(0.011)	(0.007)	(0.001)	(0.006)	(0.008)
Expected negative hhincome change	0.016***	0.014***	0.013***	0.009**	0.007
	(0.006)	(0.005)	(0.001)	(0.004)	(0.005)
Constant	3.862***	5.429***	6.074***	6.862***	8.266***
	(0.340)	(0.248)	(0.036)	(0.229)	(0.291)
N	9,495	9,495	9,495	9,495	9,495

Note: Robust standard errors are in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.
Source: Estimation based on data from the Preference Parameters Study (2009-2013).

Figure 2 shows the distributional effects of selected variables for the male and female samples. It underscores the fact that these variables, *having children*, *married*, *out of labor force*, and *feeling relative rich*, affect men and women markedly differently, as discussed above.

Figure 2: Distributional effects of selected variables on happiness by gender





Note: The shaded area shows the 95% confidence bands.
Source: Estimation based on data from the Preference Parameters Study (2009-2013).

As far as the findings for loss aversion are concerned, the quantile regression results provide a slightly different picture for men and women. In the case of the male sample, loss aversion is evident with respect to relative income and the size of loss aversion is greatest for the least happy men. Unexpectedly, feeling richer does not seem to make men any

happier and even has a negative and significant effect on the happiness of some quantile groups. With respect to expected changes in household income, loss aversion is found for the bottom quantile group while happiness seems to be more responsive to gains than to losses for the rest of the happiness distribution. The different tendency that the least happy men exhibit from that of the rest of the male sample would be overlooked if we simply analyze the determinants of happiness at the mean.

As for women, as in the case of men, we find the presence of loss aversion with respect to relative income for women except that the positive effect of feeling relatively rich has a greater effect on happiness than the negative effect of feeling relatively poor for the least happy women. Finally, we do not find any evidence for loss aversion with respect to expected income changes for women and women's happiness seems to be more sensitive to gains than to losses uniformly across the happiness distribution.

5. Conclusions

Happiness research within the discipline of economics has made significant progress, both theoretically and empirically, in past decades. However, it is only in recent years that empirical studies have gone beyond average effects when analyzing the determinants of happiness. This paper investigated the distributional effects of the determinants of happiness of the Japanese for the first time, to the best of the authors' knowledge, by applying quantile regression techniques to panel data from the "Preference Parameters Study" of Osaka University, a nationally representative survey conducted in Japan. It paid particular attention to the question of whether we observe an asymmetry between the effects of positive and negative changes on individual happiness, and if it exists, whether it is observed uniformly across the happiness distribution. Such asymmetry is referred to as loss aversion in prospect theory.

A comparison between fixed effect panel regression results and panel quantile regression results has underscored the importance of examining the determinants of happiness not just at the mean but also along the happiness distribution. The key findings of our analysis are that marriage has a monotonically decreasing positive effect only on men's happiness; having children has a negative and significant effect on the happiness of men except for the top quantile of the happiness distribution but has a positive effect on the happiness of relatively happy women; household income has a monotonically decreasing positive effect on the happiness of both men and women; being unemployed and being out of the labor force negatively affects men's happiness whereas such significant effects were absent in the female sample; and fear of oneself or one's family members becoming unemployed in the near future is negatively associated with the happiness of both men and women. We also find that the negative effect of poor health is greater than the positive effect of excellent health for the bottom three quantiles of the happiness distribution for both men and women.

As far as the presence of loss aversion is concerned, our regression analysis provides evidence for loss aversion with respect to relative income for both men and women (except for the bottom quantile in the female sample). Feeling relatively poor makes people unhappy to a greater extent than feeling relatively rich makes people happier, i.e., losses bite more than gains, as suggested by prospect theory. In the case of men, feeling relatively rich is actually found to have even a negative effect on their happiness. With respect to expectations about future income growth, quantile regression results provide evidence for loss aversion only among the least happy men while its presence was not detected for other men or women. The results therefore suggest that, except for the least happy group in the full and male samples, individual happiness is more responsive to income gains than to income losses.

The findings of this paper have important policy implications. The fact that most of the negative outcomes (e.g., poor health, unemployment, being out of the labor force, and fear of becoming unemployed) have a monotonically decreasing negative effect on happiness as we move up the happiness distribution suggests that measures that address these negative

aspects would not only increase the happiness level of all but also would increase the happiness level of the least happy group disproportionately. This would, in turn, contribute to reducing the inequality of happiness or well-being in society. Moreover, evidence for the presence of loss aversion with respect to relative income for most people underscores the importance of increasing the incomes of poorer people and of reducing the sense of unfairness in society. Note also that, contrary to our expectations, we did not detect any evidence for loss aversion in expected future income changes, except for the least happy group in the full and male samples. This suggests that positive expectations about future income growth would generally be effective in increasing individual happiness, but for the least happy group, measures that prevent future income losses, as opposed to those that would enhance future income, would have a greater effect on their happiness.

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Appendix

Table A1: Pooled regression results

	All		Male		Female	
	Coefficient	Robust SE	Coefficient	Robust SE	Coefficient	Robust SE
Female	0.331***	(0.036)				
Age	-0.050***	(0.010)	-0.076***	(0.014)	-0.018	(0.015)
Age squared/100	0.049***	(0.010)	0.071***	(0.014)	0.019	(0.015)
Having children	0.056	(0.056)	0.020	(0.076)	0.097	(0.082)
Married	0.824***	(0.075)	1.172***	(0.100)	0.408***	(0.114)
Divorced/widowed	0.281***	(0.093)	0.275*	(0.152)	0.064	(0.123)
Health_poor	-0.511***	(0.067)	-0.461***	(0.099)	-0.580***	(0.090)
Health_fair	-0.062*	(0.037)	-0.051	(0.052)	-0.082	(0.050)
Health_very good	0.382***	(0.045)	0.346***	(0.060)	0.395***	(0.064)
Health_excellent	0.734***	(0.067)	0.766***	(0.098)	0.658***	(0.089)
High school	0.189***	(0.060)	0.275***	(0.085)	0.074	(0.082)
Junior college	0.283***	(0.070)	0.108	(0.118)	0.276***	(0.090)
University and above	0.427***	(0.066)	0.457***	(0.088)	0.354***	(0.102)
Irregular job	-0.091**	(0.041)	-0.017	(0.067)	-0.044	(0.059)
Unemployed	-0.658***	(0.137)	-0.753***	(0.206)	-0.469***	(0.156)
Out of labor force	0.033	(0.052)	0.035	(0.083)	0.143*	(0.077)
Likely unemployed	-0.391***	(0.055)	-0.487***	(0.078)	-0.263***	(0.072)
Log household income	0.345***	(0.032)	0.310***	(0.043)	0.375***	(0.048)
Relatively rich	0.193***	(0.050)	0.200***	(0.071)	0.192***	(0.066)
Relatively poor	-0.598***	(0.039)	-0.556***	(0.051)	-0.634***	(0.058)
Expected positive hhincome change	0.057***	(0.008)	0.057***	(0.012)	0.054***	(0.010)
Expected negative hhincome change	0.023***	(0.005)	0.018***	(0.007)	0.031***	(0.008)
Hokkaido	0.153	(0.133)	0.389***	(0.117)	-0.085	(0.236)
Tohoku	0.116*	(0.063)	-0.003	(0.093)	0.221***	(0.083)
Koshinetsu	-0.075	(0.067)	-0.104	(0.099)	-0.026	(0.089)
Hokuriku	0.062	(0.083)	0.173	(0.108)	-0.020	(0.125)
Tokai	-0.043	(0.051)	-0.189***	(0.068)	0.115	(0.075)
Kinki	0.195***	(0.044)	0.102	(0.066)	0.265***	(0.058)
Chugoku	-0.023	(0.064)	-0.038	(0.089)	-0.026	(0.091)
Shikoku	-0.078	(0.088)	-0.283**	(0.132)	0.117	(0.114)
Kyushu	0.218***	(0.053)	0.261***	(0.082)	0.188***	(0.069)
Constant	4.524***	(0.261)	5.164***	(0.396)	4.215***	(0.347)
N	18,390		8,895		9,495	

Note: ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.
Source: Estimation based on data from the Preference Parameters Study (2009-2013).

Table A2: Spouse's income effects

	Male	(N=6,032)	Female	(N=6,176)
	Coefficient	Robust SE	Coefficient	Robust SE
(1) Pooled OLS regression				
Log income	0.028***	(0.010)	-0.011*	(0.007)
Log income of spouse	-0.012***	(0.004)	0.048***	(0.009)
(2) Fixed effects regression				
Log income	0.024**	(0.010)	-0.003	(0.006)
Log income of spouse	-0.015***	(0.005)	0.005	(0.008)
(3) Panel quantile regressions				
10^{th} : Log income	0.041***	(0.008)	-0.003	(0.007)
Log income of spouse	-0.019***	(0.003)	0.016*	(0.009)
25^{th} : Log income	0.023***	(0.005)	-0.006	(0.004)
Log income of spouse	-0.015***	(0.002)	0.008	(0.005)
50^{th} : Log income	0.024***	(0.000)	-0.003***	(0.000)
Log income of spouse	-0.015***	(0.000)	0.005***	(0.000)
75^{th} : Log income	0.023***	(0.007)	0.001	(0.004)
Log income of spouse	-0.013***	(0.003)	0.005	(0.005)
90^{th} : Log income	0.014*	(0.007)	0.000	(0.005)
Log income of spouse	-0.012**	(0.004)	-0.016*	(0.008)

Note: ***, **, * denote significance at the 1%, 5% and 10% levels, respectively.
Source: Estimation based on data from the Preference Parameters Study (2009-2013).