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HEALTH PERCEPTION IMPACT ON HAPPINESS : IN GENDER RELATIVE PERSPECTIVE

Abstract:

The paper attempts to identify the relationship between health perception and happiness in gender relative perspective. Even there are large volume of research, devoted to analyze gender happiness disparity, most of them neglected health aspect. Moreover, although it sounds quite obvious that happiness and health perception are correlated, it's rather clear that happiness disparity can be explained by health disparity. The results, based on World Value Survey panel data and IV regression, verifies that health perception gender ratio has positive impact on gender happiness ratio, which implies that relatively better health perception can improve corresponding gender's relative happiness. It can be interpreted as balanced health perception between gender will lessen the gender happiness disparity.

Keywords:

happiness; health perception; gender happiness disparity

JEL Classification: I14, I31, J16

1. Introduction

Is there a difference between genders in happiness? This is an interesting question. Although there exist many different aspects such as age, country and time to analyze the happiness disparity, gender is the most well studied and intriguing perspective. Moreover, as happiness is now a main source of country evaluation, happiness on gender issue is also an important thing to look at. Therefore, well balanced gender happiness (happiness ratio equal to 1) is the most desirable status in this paper regardless of absolute level of happiness in both genders.

If happiness disparity does exist, then what may explain this gender gap? There are many researches on this subject in the aspects of gender role and gender inequality, but mostly ignored the health aspect. Health is essential part of human life and happiness. Moreover, happiness and subjective health perception are strongly connected to each other. According to Blazer and Houpt (1979), personal feeling or mood can affect to their health perception. Additionally, many different advanced research results verified that health perception can affect to happiness. Likewise, happiness and health perception have significant impact on each other. The paper, going one step further, analyzes this relationship in gender relative perspective. In this regard, found many studies about perceived health on gender, however, the results are quite opposite through countries and research purpose.

This paper attempts to measure the impact of health perception on happiness in gender relative way. The analysis process will be based on World Value Survey data, which provide personal value assessment result through 100 countries from 1981 to 2014. The variables, used in analysis, are presented as women status, relative to men, to follow the socio-economic normal sense of male standard. Therefore, the ratio term variable is not only represents the women's relative status, but also the gender disparity level.

To represent the gender relative status as ratio term, manipulate World Value Survey individual data into age by country group level aggregated data. After that, divide the cohort into male and female, then calculate ratio; female divided by male. Scattered patterns of the data, happiness ratio and health ratio, present the positive correlation, especially when both ratios are less than 1.

There are two steps to estimate pure health ratio impact on happiness ratio; baseline estimation and IV estimation. Baseline estimation is on the basis of panel model, which include fixed effect, and contain many other happiness ratio control variables. Moreover, weighted regression is added, to reflect each cohort's happiness disparity level. IV estimation benchmark baseline model, fixed effect and weighted regression, but differs in method. In IV regression, use BMI ratio and its square as IV, control the reverse effect, happiness impact on health perception. Next, conduct the subgroup estimation to observe the health perception impact changing by subgroups

Final result is significant in 95% confidence level and has positive sign. Therefore, the result verifies that health perception disparity can explain or cause the happiness disparity. There are two implications in this finding. First, in happiness perspective, as happiness disparity by gender has been explained by health perception disparity, it has opened the possibility that happiness disparity on various standards can be explained. Second, in health perception aspect, the finding clarifies health perception impact on happiness in gender relative perspective. In other words, health perception can affect to happiness not only in absolute way, but also in gender relative way. The paper analyzed happiness gender disparity in economic framework and shed light on power of health perception on happiness in distinctive way.

2. Economics of Happiness

Happiness has been a main study subject in philosophy and psychology for many years. However, economists are just recently explore this area since standard economics treat happiness as consumer's utility and focus only on maximizing it within budget constraint. Standard economics measure utility by revealed choice of consumption and have evolved in a very quantitative way (Graham, 2005). In contrast, happiness economics measure welfare through survey response and try to verify the elements of it. The advantage of happiness economics is we can investigate the relationship between happiness and various socio-economic variables including social values. According to this, we can find policy implication in many different aspects, and it's fairly applicable in our real world.

There have been many attempts to study on gender and happiness after economists stepped into this area and brought many different points of view on this subject. Some researches report that there exist gap between male and female in response of happiness and the other sides argue that there is no statistically significant happiness gender gap.

Mencarini and Sironi (2010) assert gender plays a very important role on individual's well-being. They conducted the research based on gender inequality and women's happiness. They find large share of housework negatively affect women's happiness especially who works over 30 hours per week. This implies that women have to take dual burden in this modern era since the role of gender on housework still yet to be modernized and that makes women unhappier than men. However, Vieira (2011) observed that, generally, women have higher happiness level than men around the world and tried to explain the phenomenon in female right and inequality perspective. Though, paradoxically, country where women's right is not well has higher female happiness level than the other countries.

There are also studies about the happiness gender gap variation through time. In Stevenson and Wolfers (2009)'s paper, women's happiness has been declined relative to men. Women's happiness was higher than men around 1970s but now it's reverse. Rudolf and Kang (2015) find even men remain on a higher happiness level

than women during marriage; men are readily more impacted by life events like divorce, death of a spouse and unemployment. According to adaption model, women are better at adapting to various events. Similarly, Arrosa and Gandelman (2013) argue women are respond to happiness determinants in a much favorable way than men do.

On the contrary, Francis (1998) clearly expresses that there is no difference in happiness between two genders. He conducted research by using The Oxford Happiness Inventory and the short form Revised Eysenck Personality Questionnaire as tool of measuring happiness. 121 male and 335 female students in Wales were responded to the survey. According to Francis, reported data could prove that there is no significant difference between the mean scores of males and females on the Oxford Happiness Inventory. Myers (2000) also pointed out male and female has similar response pattern to happiness and unhappiness. Likewise, the results are quite controversial whether there are plenty of researches on gender and happiness issue. Moreover, most of them are use only socio-economic variables as explanatory variable. However, this paper approaches to gender happiness gap in health aspect.

Gerdtham and Johannesson (2001) prove that health has statistically significant positive effect on happiness. The paper investigated happiness in socio-economic aspect and used health as controlled variable. They did the research in sample of 5000 Swedish adult individual. The results clarifies that probability of being happy is 60% when individual is healthy, otherwise it’s only 42%. Crivelli and Lucchini(2016) published the book named of Happiness and health. In the chapter 17 of this book, they constructed analysis to verify the causal relationship between happiness and health by using panel data and panel data model. They also applied a fixed effect model to check habituation channel and a GMM model to identify autoregressive of subject well-being. The model confirms that there exists strong association between well-being and health. In addition to that, both the FE and the GMM model prove that current health is a strong predictor of subjective well-being.

Blanchflower and Oswald (2008) used hypertension as representative of health. They tried to explain the difference in happiness level between nations by hypertension. They investigated 16 europe countries and find out happier nations report lower levels of hypertension than the other nations. They assert that health can be the part of national well-being index.

Carol Graham (2008) claims health is recognized to be one of the most important correlates of well-being. She also observed that subjective health status perception is more significant on happiness than physical health. Furthermore, Mahon and Yarcheski (2005) also figured out perceived health status has most powerful effect on happiness among three of health variables, perceived health status, wellness and clinical health.

Another line of researches have studied on whether there is no difference in perceived health status between male and female. Physical health difference upon gender is

rather clear, but personal assessment on his/her health status might be influenced by gender or not. Beck *et al*. (1996)'s research examined the relationships among gender and selected health status indicators. They collected a randomly selected rural Appalachian sample. The data were gathered through the Johnson County Health Survey and conducted through personal interviews with 207 females and 178 males representing 197 households. The research results demonstrate that female report poorer subjective health status than male even they belong to same household.

On the other hand, Bambra *et al*. (2009) find somewhat different result. They investigated relationship between gender and self-assessed health status based on socio-economic position in Europe. In some Europe countries like UK and Finland women were significantly more likely to report good health. However, in Denmark, Sweden, Norway, Holland, Italy, Spain and Portugal have a significantly higher proportion of women reported that their health status is not good.

However, Mencarini and Sironi (2010) mention that it is conventional wisdom in medical sociology and social epidemiology that in industrialized societies women have poorer health than men but higher male mortality rate.

In sum, the relationship between gender and subjective perceived health status is somewhat vague. However, we can expect that the relationship will be disclosed more precisely when it comes to a larger sample size, not limited in one country or one continent but global.

Here by, we can extract four implications from advance studies. First, gender happiness gap might exist or not. Second, health can be primary explanatory variable for happiness. Third, subjectively perceived health status has stronger effect on happiness than any other physical health variables. Fourth, perceived health can be affected by gender.

3. Data and Empirical Methods

3.1 Data

The analysis based on World Value Survey panel data. The World Value Survey (WVS) has foundation purpose to study social science in value perspective; value assessment changing and its impact on society and political life. The survey is conducted individual level and it contains the data which personal grading on values, socio-economic status and propensity on various social issues. WVS covers 100 countries which includes almost 90 percent of world population from poorest to richest since 1981. Presently, six waves have been conducted and completed: 8 countries were included in wave 1 (1981-1984), 18 in wave 2 (1990-1994), 54 in wave 3 (1995-1998), 40 in wave 4 (1999-2004), 58 in wave 5 (2005-2009) and 60 in wave 6 (2010-2014). This paper used all 6 waves and manipulates individual level data into aggregated data, age group level. Since the paper based on the concept, gender relative status, all variables are needed to be transformed into ratio term, female on

male. Mean value of gender is needed in this process since individual level responses cannot be used to calculate ratio. These ratio terms can be interpreted in two ways. First, it represents female status standardized by male status. Second, it implies gender balanced status, based on male.

Aggregated level data shrink sample size. Therefore, the data have to be aggregated as small level as possible. Therefore, subdivide one country data into 7 different age groups. Age group range is from 10 to 70. Group 70 contains the age seventies and above. All age groups have same portion in the whole sample. To sum up, this paper used World Value Survey data as aggregated level and all variables in ratio term to stand for gender relative status.

3.2 Variables and Descriptive Findings

Dependent variable is happiness ratio. Measuring happiness is conducted as follows; “Taking all things together, would you say you are very happy, rather happy, not very happy or not at all happy?”(Responses of “Missing; Unknown”, “Not asked in survey”, “No answer” and “Don’t know” are treated as missing data). Score the answers either 1 or 0; 1 is for the answers “Very happy” and “Rather happy”, and 0 is for “Not very happy” and “Not at all happy”. Categorizing the answers into happy or not happy is for maximizing the happiness ratio variation.

Alesina *et al.* (2004) rebut the critical viewpoint, happiness survey data is inappropriate for rigorous statistical. They summarize the arguments, based on previous researches, about advantage of using happiness data. According to Alesina *et al.* (2004) there are two reasonable grounds to use happiness data in the analysis. First, psychologists, who major in studying welfare and happiness, widely use the happiness survey data for their work. Second, many study results verify that happiness response can reflect internal happiness. In this regards, happiness ratio represents the meaning of women’s relative happiness and gender happiness disparity. Happiness ratio bigger or less than 1 implies imbalanced status of gender happiness.

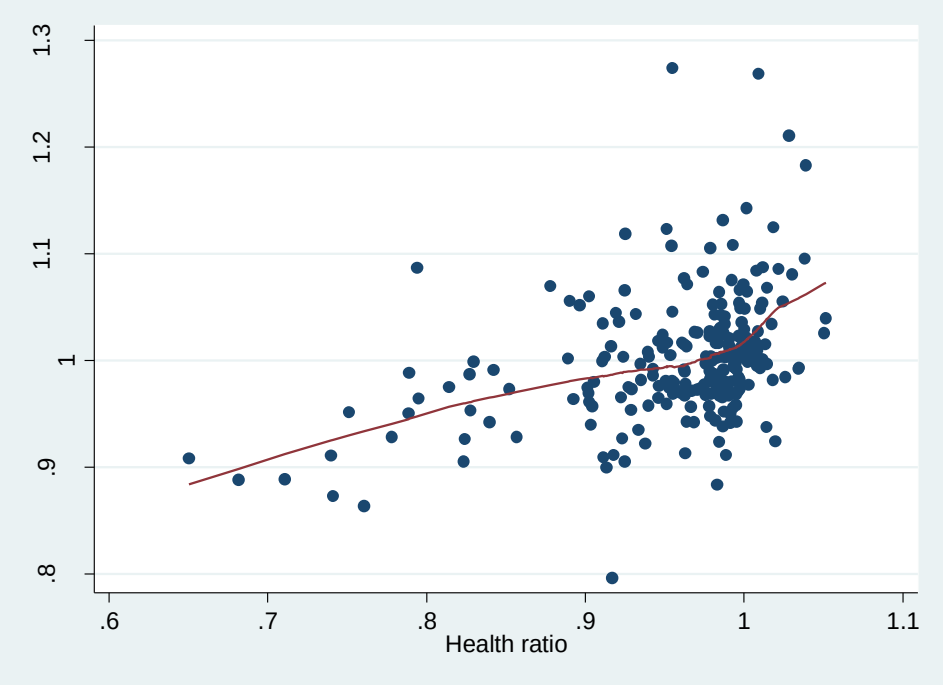
Main independent variable is health ratio. Perceived health status can be measured as follows; “All in all, how would you describe your state of health these days? Would you say it is very good, good, fair, and poor”. The data organizing process of health status is same as happiness; sort the answers into two groups, healthy or not healthy, and score them either 1 or 0. Health ratio variable also imply gender health perception disparity. If health ratio is bigger than 1, it means women perceive themselves relatively healthier than men, vice versa.

Table1. Summary statistics for Happiness ratio, Health ratio and Control variables

	Total Average	Ratio interval average				Total observations
		0.7-	0.7~1	1~1.3	1.3+	
Panel A: Happiness ratio						
Total	1.01	0.54	0.92	1.07	1.53	
		(22)	(742)	(790)	(43)	1597
Younger	1.02	0.70	0.94	1.07	1.47	
		(1)	(386)	(498)	(18)	903
Older	0.99	0.54	0.90	1.07	1.57	
		(21)	(356)	(292)	(25)	694
Panel B: Health ratio						
Total	0.90	0.52	0.89	1.08	1.52	
		(232)	(913)	(414)	(40)	1599
Younger	0.94	0.61	0.90	1.06	1.43	
		(33)	(611)	(252)	(7)	903
Older	0.84	0.51	0.86	1.10	1.53	
		(199)	(302)	(162)	(33)	696
Panel C: Control Variables						
Employment ratio	0.65	0.39	0.83	1.11	2.01	1,534
Religious ratio	1.22	0.46	0.93	1.12	1.66	1,546
Social ratio	1.05	0.46	0.85	1.13	1.84	1,364
Income ratio	0.95	0.44	0.85	1.13	1.96	1,488
Education ratio	0.99	0.55	0.86	1.11	1.60	1,480
Think ratio	1.04	0.52	0.93	1.09	1.47	1,560

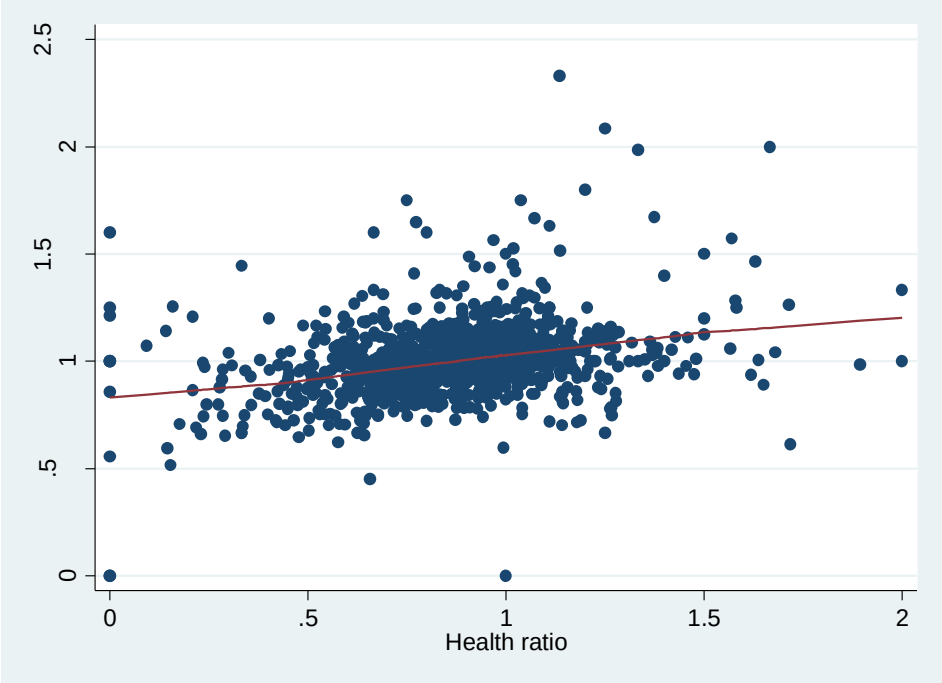
Notes: Ratio intervals have the range 'less than' or 'same or more' or both. Numbers that are represented as decimals are ratio average for corresponding ratio interval. Observation numbers for intervals are in parenthesis below (Control variable's observation numbers for each interval are not provided). All statistics are based on age by country group level aggregated data. Moreover, row name 'Younger' and 'Older' means groups that are divided by age; 'Younger' is 40s or younger and 'Older' is 50s or older. In panel C, not all control variables are included; only include the variables that are able to transformed as ratio term. Thus, average children number and marriage rate is not included the control variables list.

Figure 1. Relationship between happiness ratio and health ratio



Sources: World Value Survey longitudinal data

Figure 1_A. Country level



Sources: World Value Survey longitudinal data

Figure 1_B. Age by country group level

Notes: Figure 1 shows the data scatter points and weighted regression line between happiness ratio and health ratio. Figure A and B differ in data aggregated level. Both figures indicate that happiness ratio and health ratio are positively correlated.

In Figure 1, both A and B illustrate the relationship between happiness ratio and health ratio. Figure 1_A is based on country level cohort and figure 1_B is based on age group level cohort. The curve in the graph displays weighted regression curve of happiness ratio on health ratio. We can simply discover that happiness ratio has positive correlation with health ratio through the slope of the line. This positive correlation is also represented in Table 1. Table 1 provide the summary statistics for happiness ratio, health ratio and control variables, used in later regression part. Average ratios, changing through intervals, are almost same in panel A and B, regardless of division category in panel. This implies positive correlation between happiness ratio and health ratio.

In addition to that, spots are concentrated on near around 1 for both happiness and health ratio. This condensed point's pattern is also presented in Table 1 more clearly. In panel A and B, observation numbers in parenthesis show the data peak dispersion in interval 0.7 ~ 1 and 1 ~ 1.3 in total sections. This peak distribution around 1 for both ratios represent that happiness ratio 1 has highly correlated with health ratio 1.

Furthermore, we can find that this correlation seems stronger when health and happiness ratio is less than 1 through the dispersion of the points in Figure 1. The variation of the happiness ratio is higher when health ratio is bigger than 1 in both figure. This may imply that relative health perception impact on relative happiness is more explicit when women's relative health perception is unhealthier than men. In other words, if men assess themselves healthier than women, it plays more significant role on their happiness improvements, vice versa.

Therefore, descriptive findings give us some implications. First, happiness ratio is positively correlated with health ratio. Second, if health ratio is close to one, happiness ratio is also close to one with high possibility. Third, positive relationship pattern seems more explicit when both ratios are less than one.

3.3 Empirical Methods

3.3.1 Baseline estimation

In order to examine the pure impacts of the health ratio on the happiness ratio, happiness ratio is needed to be controlled by the other determinants factors. Furthermore, the estimation model has to be based on panel model, using fixed effect, since I took the advantage of cross country and time series variation from the panel data. The regression used age by country group level data. The baseline regression model is as follows:

$$Happiness\ ratio_{ijs} = \alpha + \beta\ Health\ ratio_{ijs} + X_{ijs}\Gamma + \delta_i + \delta_j + \delta_s + \epsilon_{ijs} \quad (1)$$

where $Happiness\ ratio_{ijs}$ is the standardize female happiness of age group, i, in period, j, living in country s. The vector X_{ijs} refers to control variables, set of variables at age group level that have previously been found to affect happiness. These include the

macro economic variables and personal characteristic variables; macro-economic variables are employment, social class, income and education, and personal character variables are age group, religious, thinking, average children number and marriage rate. All variables, except average children number and marriage rate, are in ratio term, which represents relative female status.

Ratio of employment, social class, income and education are implying female's current status standardized by male. These macro-economic ratio variables are unambiguous and quite understandable. Besides, among personal characteristic variables, variable names religious ratio and thinking ratio may not clear enough. Religious ratio represents the gender ratio of response, "I am a religious person". Moreover, thinking ratio is from a question "How often, if at all, do you think about the meaning and purpose of life?". The answers also classified into two groups 'often think' and 'rather think'. The ratio represents how often females think meaning of their lives relative to male. The other personal variables like age group, average children number and average marriage rate represents the cohort feature.

δ_i, δ_j and δ_s are dummy variables, each stands for age group i, wave j and country s. Dummy variables are included to filter out fixed effect. Age group dummies can be deleted if control variables include age group. Age group has its fixed effect on happiness. According to Blanchflower and Oswald (2008) paper 'Is well-being U-shaped over the life cycle?', happiness change through lives in approximately U-shape; lowest happiness level during middle age. Furthermore, happiness level can change through era, especially women's happiness. Same logic can be linked to country fixed effect. Vieira Lima, S. (2011) claims paradoxical feature of women's happiness across countries; countries where women's right are not well developed got higher rank on women's relative happiness and socio-economically developed countries present the feature of unhappier women. Likewise, these various habituation channels need to be check for accurate penal data analysis.

Additionally, as relative gender status can be represented in two ways, ratio term and difference term, there are four kinds of combinations of relative health and happiness relationships; happiness ratio & health ratio, happiness ratio & health difference, happiness difference & health ratio and happiness difference &health difference. Term 'difference' is subtraction male status from female status. Therefore, the regression coefficient, β, can be estimated in various way through those combinations. Furthermore, weighted regression can provide more precise results; weight on groups where happiness difference are significant, by using absolute t-value. If the absolute t-value is bigger, it implies that the difference is more statistically significant. This process will estimate the magnitude of health perception impact more accurately.

3.3.2 IV estimation

Most important thing that needs to be considered in the estimation is reverse causality problem between happiness and health. Though health can make people happy, happiness also can make people healthy. Causality relationship, main theme of this paper, is health perception impact on happiness in gender relative way. Therefore,

reverse effect must be controlled by an instrument variable (IV). If the result stays significant after using IV in the estimation, then we can say the impact of health ratio on happiness ratio has been verified.

There are 4 conditions to satisfy for ideal IV. First, it must be relevant to health ratio. Second, it has to be irrelevant to happiness ratio. (It is okay to be relevant to happiness ratio in case of indirect effect; effect on happiness though health ratio.) Third, it has feature of gender disparity. Fourth, it can represent age by country level cohort's characteristic. However, it's hard to satisfy all those four conditions due to data limitation problem. Therefore, loose the third and fourth conditions.

BMI can fulfill the first and second conditions. Conceptually, correlation between perceived health and BMI is highly reasonable and it does have correlation in real. Additionally, ratio term does not harm the relationship. Therefore, it satisfies the first condition. For second condition, according to Cornelisse-Vermaat *et al*. (2006), BMI has indirect effect on happiness via perceived health. This indirect route to happiness can satisfy second condition. However, it's hard to meet the third and fourth conditions. This is because; BMI gender disparity does not exist in most of the countries. Additionally, there is no BMI data of age by country level cohort's. The data contains each country's average BMI value for both genders, calculated as if all countries have same composition of age as the world population. Therefore, same country level data has to be assigned for corresponding 7 different age groups.

BMI index panel data is downloaded from gapmider web site. Gapmider provides the collection of various welfare and health index data from many different sources. MRC-HPA Centre for Environment and Health is the original source of BMI index in gapminder data site. It is yearly data from 1980 to 2008 for both genders in 200 countries. There is no BMI data for wave 6 period. I average the BMI index out for wave periods to match the data size.

After finding IV and its data, we need to construct the IV regression to wipe out reverse causality problem. IV regression method is 2SLS and on the basis of baseline estimation model. Therefore, fixed effect and weighted regression is also included. However, country fixed effect is not considered in IV regression since; health ratio variation on country is not significant enough to include its fixed effect.

Regression results will be shown in the subsequent section.

4. Empirical Findings

4.1 Baseline Estimation Results

Table 2 presents the results from baseline estimation by steps. There are 1599 cohorts in the whole sample over 1981-2014. As mentioned above, the relationship needs to be controlled by other factors to clarify the health ratio effect on happiness ratio. We can observe health ratio coefficient alteration through columns. This shows the robustness of health ratio effect. If the coefficient is barely changed by including other explanatory variables and fixed effect, the coefficient is fairly robust. The results are quite satisfactory in the sense: health ratio is significant in 99% confidence level

for all steps and quite robust. Column (1) presents result when happiness ratio is not controlled by other variables. Following the steps through column (2) to (6), we can observe that health ratio coefficient is stable as 0.2~0.21. However, it's increased by 0.11 on the weighted regression. In other words, relative health perception impact gets stronger when happiness gender disparity level is considered in estimation. Therefore, the most accurate baseline estimation result is in column (7)

The results in Table 2, by themselves, demonstrate interesting features. Happiness ratio increased by 0.2~0.3 when health ratio increased by 1 unit. This can be explained in two ways. If the health ratio is less than 1, (women felt unhealthier than men) enhanced women's relative health perception would improve their relative happiness (happiness ratio goes to 1). Therefore, in this situation, women's relatively better health perception will cause balanced gender happiness. However, if the health ratio is bigger than 1, health ratio increasing is no more than inducing gender happiness imbalance. Therefore, it's hard to say increasing health ratio is good for reducing happiness gender disparity. However, as we observed by Figure 1, this positive relation between health ratio and happiness ratio is clearer when health ratio is less than 1. Furthermore, since more than 70% of the data has the health ratio less than 1, we can expect that health ratio increasing can improve imbalanced happiness status.

The other control variables also have explanatory power on happiness ratio. Income ratio importance becomes insignificant when happiness gets controlled. Moreover, as women think more about the meaning of life than men, their relative happiness increase. Furthermore, the power and importance of thinking ratio is getting higher as the regression model becomes more rigorous. Having more children contribute to women's relative happiness improvement.

Table 3 presents the alternative estimation results. In this section, relative health status impact is tested in various ways. To observe further aspects of relative health status impact on relative happiness, change the term of variable and impose different weight. In this regards, we can measure how the coefficient change. Impact of health disparity can be magnified or attenuated by different term and different weighted regression. In Table 3, there are three regression weights, absolute t-value, sample size and square root of inverse p-value.

Table 2. Baseline Estimation

Dependent variable: Happiness Ratio

Control Variable	Cluster on Country					Cluster on Age group	
	No control	Full control	+Age FE	+ Wave FE	+Country FE	+Country FE	Weighted (t-value)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Health ratio	0.210***	0.206***	0.206***	0.204***	0.216***	0.216***	0.325***
	(0.030)	(0.030)	(0.031)	(0.031)	(0.037)	(0.029)	(0.064)
Age group		-0.001***					
		(0.000)					
Employment ratio		-0.011	-0.008	-0.008	0.005	0.005	0.016
		(0.010)	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)
Religious ratio		-0.002	-0.002	-0.001	-0.008	-0.008	-0.008
		(0.010)	(0.011)	(0.011)	(0.010)	(0.010)	(0.019)
Social class ratio		-0.002	-0.001	-0.001	-0.006	-0.006	-0.013*
		(0.011)	(0.011)	(0.011)	(0.011)	(0.009)	(0.014)
Income ratio		0.016**	0.015**	0.014**	0.013*	0.013*	0.013
		(0.009)	(0.009)	(0.009)	(0.008)	(0.010)	(0.015)
Education ratio		0.166	0.018	0.021	-0.04	-0.04	-0.067*
		(0.015)	(0.015)	(0.016)	(0.038)	(0.040)	(0.053)
Thinking ratio		0.063***	0.069***	0.07***	0.097***	0.097***	0.166***
		(0.033)	(0.033)	(0.033)	(0.040)	(0.021)	(0.040)
Children		0.02***	0.02***	0.019***	0.017***	0.017***	0.024***
		(0.007)	(0.008)	(0.008)	(0.008)	(0.007)	(0.010)
Marriage		-0.022	0.033	0.038	-0.001	-0.001	-0.001
		(0.025)	(0.043)	(0.042)	(0.057)	(0.025)	(0.049)
Observations	1597	1172	1172	1172	1172	1172	1158

Notes: Estimate Equation 1 by steps. Each cell reports only the coefficient and robust SE. In column (2), age group variable is included as control variable; columns (3)-(7) considered the age group effect on happiness ratio through fixed effect. T-value is in its absolute value. Robust SEs are in parentheses; single asterisk denotes statistical significance at the 90% level of confidence, double 95% and triple 99%.

Table 3. Alternative Estimation

T-value	Sample size	Sqrt (1/p-value)
Panel A: Health ratio		
Dep = Happiness ratio		
(1)	(2)	(3)
0.325***	0.243***	0.395***
(0.064)	(0.014)	(0.081)
Dep= Happiness difference		
(4)	(5)	(6)
0.188***	0.154***	0.214***
(0.044)	(0.014)	(0.043)
Panel B: Health difference		
Dep = Happiness Ratio		
(7)	(8)	(9)
0.567***	0.412***	0.622***
(0.084)	(0.025)	(0.103)
Dep= Happiness difference		
(10)	(11)	(12)
0.371***	0.29***	0.384***
(0.050)	(0.013)	(0.049)
1158	1172	1159

Notes: Change the variable terms and impose different regression weight to observe the coefficient variation. First row is weight, used in the regression. Relative health status has been represented as health ratio and health difference in each panel A and B. Similarly, dependent variable is also represented in two ways, ratio and difference. Term difference is subtraction male average status from female average status. T-value is in its absolute value. Sample size represents the number of people in one cohort. To prevent divergent, take root for inverse P-value. Bottom row is total observations number. Robust SEs are in parentheses; single asterisk denotes statistical significance at the 90% level of confidence, double 95% and triple 99%. All regression are cluster on age group.

T-value and square root of inverse p-value have same implication as weight on gender happiness difference level. T-value is in its absolute value since bigger absolute t-value has higher possibility to reject the null hypothesis which there is no difference between gender happiness. In the same vein, inverse p-value has the same meaning; small p-value refers to bigger happiness disparity. Therefore, to impose more weight on the cohort which gender happiness difference is significant, invert p-value. Square root term is to prevent divergent of inverse p-value, in case of p-value is almost same as zero. Sample size represents a cohort size, number of respondents in one cohort.

Results in Table 3 are all significant at 99% confidence level. This can verifies the robustness of relative health perception impact on relative happiness. However, the results has feature that all coefficients in panel B are bigger than the coefficients in panel A. This is because absolute value of health difference is much smaller than health ratio. This smaller absolute value of independent variable can intensify its impact. Furthermore, weighted regression by square root of inverse p-value has biggest coefficient among them, regardless of dependent and independent variables term. This is also matter of scale. Therefore, except the matter of scale, the coefficients are quite stable. This robustness check clarifies the relationship and power of relative health perception on relative happiness.

To sum up, we can learn three points from Table 2 and 3. First, relative health perception has statistically significant positive effect on relative happiness. Second, relative health variable impact is intensified when gender happiness difference is considered in estimation as weighted regression. Third, even the magnitude of coefficient can be affected by the data scale and regression weight, significance level and sign is not changed. Therefore, the positive relationship between health perception and happiness in gender disparity is significant and robust.

4.2 IV Estimation Results

Table 4 reports IV estimation results by steps. First stage and second stage refers to 2SLS in IV regression. All IV regression steps are based on panel model and weighted regression. As explained in part 3.3.2, country fixed effect is not included since the health ratio is not vary through countries. IV estimation results would be nullified if country fixed effect was considered in IV regression.

Odd numbered columns represent the first stage results. According to the them, BMI ratio has quadratic relationship with health ratio. As BMI ratio increase, health perception ratio decrease. However, it has lower bound since the health ratio changes through BMI ratio in U shape. This can be proven by BMI ratio and BMI ratio square coefficient result; BMI ratio has positive linear coefficient, but BMI ratio square has negative sign. Both coefficients are statistically significant in 99% confidence level. Therefore, endogeneity problem caused by reverse causality can be fixed. F-value and endogeneity test p-value will verify this.

Table 4. IV Estimation

IV= BMI Ratio and its square

First Stage Dep= Health ratio

Second Stage Dep= Happiness ratio

	Full control		+Age group FE		+Wave FE	
	First Stage (1)	Second Stage (2)	First Stage (3)	Second Stage (4)	First Stage (5)	Second Stage (6)
BMI Ratio	-22.25***		-22.165***		-20.864***	
	(4.775)		(4.776)		(4.783)	
BMI Ratio^2	10.504***		10.452***		9.841***	
	(2.305)		(2.305)		(2.308)	
Health Ratio		0.331**		0.344**		0.322**
		(0.146)		(0.143)		(0.154)
F-value	15.67		15.91		13.82	
Endo.Test (P-value)		0.794		0.896		0.804
Observations	780					

Notes: First stage and second stage represents the IV estimation process. The regression based on absolute t-value weighted regression. F-value is Cragg-Donald Wald F statistic. 'Endo.Test' represents the endogeneity test. Endogeneity test p-value is results of the test under null hypothesis, health ratio has endogeneity problem. SEs are in parentheses; single asterisk denotes statistical significance at the 90% level of confidence, double 95% and triple 99%.

F-values in corresponding columns are Cragg-Donald Wald F statistic test results under the null hypothesis, equation is weakly identified. Therefore, if f-value is big, it can reject the null hypothesis with high possibility. In Table 4, all f-values are over 10. This implies that health ratio can be identified through BMI instrument variables. Furthermore, f test's p-value, not reported in Table 4, is 0.0000 for all f-values. This clarifies that BMI ratio and BMI ratio square are the valid IV for this estimation.

Endogeneity test p-value is results of the test under null hypothesis, health ratio has endogeneity problem. It has been tested under Chi-square distribution. As the p-value gets higher, possibility of reject the null hypothesis getting higher. In Table 4, most of the p-value are over 0.6 which confirms that health ratio's endogeneity problem has been solved. Therefore, we can rely on the regression results of health ratio coefficient.

In even numbered columns, health ratio impact is reported. The impact gets stronger as fixed effects are added. Big difference between baseline estimation and IV estimation is significance level of health ratio. In Table 2, all coefficients of health ratio is statistically significant at 99% confidence level. However, in IV estimation, all coefficients are significant at 95% confidence level. This is because the IV regression, manage reverse effect. Nevertheless, the coefficient, it self, is almost same in both IV regression and baseline weighted regression.

Therefore, the ultimate impact of health ratio on happiness ratio is 0.322, the value in column (6). This refers to, on the average, gender happiness ratio increase by 0.322 as health perception gender ratio increase by 1 unit. However, as the result is interpreted in two ways in section 3.1, it does not always end up reducing happiness gender disparity. If health ratio was smaller than 1, health ratio increasing is balancing the gender happiness level. Otherwise, women's better health perception than men cause gender happiness gap.

Therefore, in sum up, health ratio increasing to 1 will cause happiness ratio 1, which represents most preferable status that has no happiness gender disparity. However, if health ratio is increased above 1, happiness gender disparity will be worse. Therefore, health ratio increasing is not always good. However, as most of the health ratio is less than 1, we can expect positive effect from health ratio increasing. To be more precisely, exist of health perception gender disparity affects to happiness gender disparity. This result can give us implication that health perception can improve happiness not only in absolute term, but also in relative term.

4.3. Subgroup Estimation Results

In Table 5, examine the health ratio effect on various subgroups. The subgroups are chosen by the results, statistically significant and consistent through panel A and B. Each subgroup has been divided into two groups, on the basis of the variables' mean value except age group. Younger group is who are younger or in their forties and older group is for fifties or older people. Estimation is based on baseline regression model, which include age, wave and country fixed effect and weight on absolute t-value.

The results in Table 5 are intriguing in the aspects of showing clear contrast in two subgroups. Column (2) and (3) presents the estimation results on the subgroups, which think meaning of life more or less often than the average. According to them, happiness ratio is impacted more by relative health perception if people rarely think meaning of life. On the contrary, 'often think' women's relative happiness is less impacted by their relative health perception. This kind of pattern can be observed by all subgroups; low class, low marriage rate, low female participation ratio and younger cohorts' relative happiness is readily more impacted by relative health perception. We can carefully conjecture from the results that people in higher class, married, working and older people are may not easily impacted by their health perception since most parts of their happiness is already controlled by those conditions.

Interestingly, age subgroup estimation results are quite opposite to what I expected. I thought older people are more sensitive to their health status, and therefore their perception might be critical to their happiness. However, older women's relative happiness is less impacted by their relative health perception, even their health ratio is far less than younger's (see Table1).

5. Concluding Remarks

The paper is started from curiosity whether there is no difference between two genders in happiness. This paper analyzes the gender happiness disparity in their health perception disparity aspect. Happiness difference is represented as gender happiness ratio (standardized on male) and health perception difference is also represented as gender health perception ratio. Those two data has pattern of positive correlation. In other words, if women perceived themselves unhealthier than men, they are unhappier than men. This pattern and correlation implies the causal relationship between gender health perception and gender happiness gap.

The results from baseline and IV regression, demonstrate that while the magnitude of the impact differs depending upon regression methods and subgroups, the aggregated effects are substantial. Health perception disparity affects to happiness disparity in 95% significance. In other words, decreasing gender health perception gap (health ratio goes to 1) contribute to balanced gender happiness (happiness ratio equal to 1), vice versa. The results give the possibility that happiness disparity is explained by other variables' disparity. Therefore, happiness disparity research can be conducted on many different perspectives such as age, income level and time and so on, based on this paper. In health perception aspects, the results find that health perception has impact on happiness in gender relative way also.

The important message of this finding is gender happiness gap problem can be alleviated by gender balanced health perception. These results can give political implication to country where one side of gender's relative happiness is significantly low. Health perception improvements policy such as health education program or periodic health examination for distinguishably unhappier gender would be helpful to diminish the happiness imbalance.

Table 5. Subgroup comparison

Dependent variable: Happiness Ratio

Subgroup	By thinking		By class		By marriage rate		By Employment ratio		By age group	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Often think	Rather think	High class	Low class	High marriage rate	Low marriage rate	High FLPR	Low FLPR	Younger	Older
Panel A: Health ratio	0.222***	0.406***	0.23***	0.343***	0.265***	0.382***	0.233***	0.334***	0.446***	0.262***
	(0.029)	(0.039)	(0.032)	(0.038)	(0.029)	(0.045)	(0.030)	(0.037)	(0.044)	(0.035)
observations	668	490	552	606	732	426	580	578	686	472
Panel B: Health difference	0.372***	0.731***	0.451***	0.623***	0.509***	0.574***	0.388***	0.638***	0.629***	0.475***
	(0.056)	(0.078)	(0.055)	(0.077)	(0.057)	(0.092)	(0.054)	(0.073)	(0.065)	(0.076)
observations	668	490	552	606	732	426	580	578	686	472

Notes: Each subgroup is divided into two groups on the basis of their mean value. FLPR stands for female labor participation ratio. FLPR is calculated as female employment rate(number of employed women/all women in the cohort) divided by male employment rate(number of employed men/ all men in the cohort). SEs are in parentheses; single asterisk denotes statistical significance at the 90% level of confidence, double 95% and triple 99%.

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