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Climate and Happiness in the Tropics

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Climate and Happiness in the Tropics

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Abstract

Despite the increasing number of studies on self-reported happiness, due to data availability, only a few studies from developing countries exist. Moreover, even though climate is among the most important input to human activities, only a handful of studies explicitly associate it with self-reported wellbeing. This paper combines a survey of 28,000 individuals representing 85% of Indonesian population and GIS data on local climate to establish a direct causation between climate variables (temperature and rainfalls) on individual subjective well-being. Despite our findings which suggest no-association between temperature and individual's happiness - which we argue due to low temperature variation in tropical country like Indonesia - we found that individual's happiness is negatively affected by rainfall. The relationship is statistically significant and robust to different model's specifications, including controlling for relevant socio-economic factors that may affect subjective wellbeing.

Keywords: climate change, subjective wellbeing, happiness, Indonesia

1 Introduction

Climate affects humans through a variety of channels. They affect the ecosystem (flora and fauna, biodiversity, forests' distribution and composition), the economy (availability of water, minerals and raw materials, agriculture, tourism, constructions, energy, infrastructures), population growth (via viruses, bacteria, diseases and health in general), migrations and, last but not least, individuals' psychology and the quality of life (Becchetti et al., 2007).

The relationship between climate and self reported happiness is interesting because of the much discussed threat of anthropogenically induced climate change. Differential patterns of warming along with a changed distribution of rainfall promises to alter dramatically the distribution of happiness between nations with some countries moving towards a preferred climate and others moving further away (Rehdanz & Maddison, 2005).

Due to the global warming problem, over the last decades there has been a growing body of literature on the environmental and economic consequences of climate change. The most recent notable example is the Stern Review (2006), which has produced a detailed analysis on how climate changes are expected to affect people around the world. According to the report a 2-5 °C rise in average global temperatures within the next fifty years would affect people through melting glaciers, rising sea levels, ocean acidification, declining crop yields, malnutrition, diseases and extinction of animal species. The Stern Review studies in great detail the consequences on water, food, health, environment and large-scale phenomena and extensively deals with the economics of climate changes looking at various aspects. The only exception is the economics of happiness which, in our opinion, deserves much more consideration (Becchetti et al., 2007).

There have been various studies linking climate and self-reported happiness. Rehdanz & Maddison (2005) analyzed a panel of 67 countries attempting to explain differences in self-reported levels of happiness by reference to amongst other things temperature and precipitation. They found that higher mean temperatures in the coldest month increase happiness, whereas higher mean temperatures in the hottest month decrease happiness. They also found that precipitation does not significantly affect happiness.

Becchetti et al. (2007) investigated the effects of climate on well-being by merging individual data on happiness from the the third and fourth waves of the World Value Survey (WVS) with climate

conditions of the WVS respondents' cities from the NOAA (National Oceanic & Atmospheric Administration of the US Department of Commerce) database. The findings show that life-satisfaction decreases with average maximum wind speed and number of foggy days, increases with the number of rainy days but decreases after a peak at around 110 days, and that it is surprisingly U-shaped with the temperature.

Brereton et al. (2008) studied the influence of space, such as climate, and place on individual well-being in Ireland. Using ordered probit regressions, the findings show that climate has a significant influence on well-being. Increases in the temperature has a positive and significant affect on well-being. Wind speed emerges negative and significant, while precipitation is found to have a slightly positive affect on life satisfaction.

Connolly (2013) examined the responsiveness of subjective well-being to climate and transitory weather conditions in the United States. Subjective well-being data from Princeton Affect and Time Survey (PATS) were supplemented by weather data to investigate the effect of precipitation and temperature. The results show that low temperatures increase happiness and reduce tiredness and stress, and high temperatures reduce happiness, consistent with the fact that the survey was conducted in the summer.

No similar study from developing countries, particularly Indonesia, exist (to the author's knowledge). This paper is not the first paper to analyze the determinants of subjective wellbeing in Indonesia. However, this will be the first attempt to look at its association and causal link between climatic variables and happiness in Indonesia and among the few in developing country or tropical country context.

The objectives of this paper is to investigate whether climate (in particular temperature and rainfall) has any influences on self-reported happiness in Indonesia. The paper is organized as follows. Section 2 discuss the methodology that include the data used and the model. Section 3 discuss the findings. Section 4 concludes.

2 Metodology

2.1 Econometric Models

Following previous related models like in Brereton et al. (2008) and Connolly (2012), this paper models happiness as a function of climate variable, represented by average annual temperature and rainfall, and socio-economic and demographic variables as control variables.

More formally, we model individual happiness as a latent variable model:

$$y_i^* = \alpha + \beta_1 t_i + \beta_2 r_i + \sum_j \gamma_j z_{ij} + \varepsilon_i,$$

where y_i^* is the unobserved level of (continuous) happiness of individual i , t_i is the average annual temperature and r_i is the average level of rainfall where individual i live and z_{ij} is a collection of socio-economic and demographic variable that may affects the happiness of individual i . The parameter to be estimated are α, β_1, β_2 and γ_j while ε_i is an i.i.d error term. We don't observe y_i^* yet observed only y_i where:

$$y_i = \begin{cases} 0 & \text{if } y_i^* \leq \mu_1 \\ 1 & \text{if } \mu_1 < y_i^* \leq \mu_2 \\ 2 & \text{if } y_i^* > \mu_2 \end{cases}$$

where μ_1 and μ_2 is unknown threshold to be estimated (Greene, 2003).

Dependent Variable

As mentioned above, the dependent variable in this research is individual self reported happiness. The variable is obtained from a survey that attempts to elicitate individual subjective well-being based on the answer to the following question: "Taken all things together how would you say things are these days?". Respondents could choose a category on a scale of one to four (1=very happy; 2=happy; 3=unhappy; 4=very unhappy). This variable is then recoded to three ordinal categories due to only negligible number of respondent answer of no 4.

Independent Variables

Precipitation and temperature

The precipitation and temperature variable used in this research is average mean of precipitation in 2007, that already matched with the sub-district location of each respondent of IFLS4.

Household Expenditure

This variable provides information of total expenditure by household.

Household Wealth

This variable provides information of total value of household assets and taken into logarithmic form.

Age

This variable contains information of age of respondent in the time of interview.

Sex

This dummy variable contains information of the respondents' gender. This variable is coded as 1 if respondent's sex is male and 0 if respondent's sex is female.

Marital Status

This dummy variable coded as 1 if respondents is married and 0 otherwise (i.e., single, separated, divorced, and widowed).

Subjective Health Status

This dummy variable contains information of individual subjective health status based on the answer to the following question: "In general, how is your health?". The variable is coded as 1 if the respondents answer either "somewhat unhealthy" or "unhealthy" and coded as 0 otherwise (i.e., very healthy, somewhat healthy).

Education

This variable provides information about individual educational attainment. Divided into four categories: No education & primary, lower secondary/junior high school, upper secondary/senior high school, and university degree. The reference group is no education & primary.

2.2 Data: Indonesia Family Life Survey

Data on subjective well-being, socio-economic and socio-demographic used in this research is gathered from Indonesian Family Life Survey (IFLS). It is a continuing longitudinal socioeconomic and health survey based on a sample of households representing about 83% of the Indonesian population living in 13 of the nation's 26 provinces in 1993. The survey collects data

on individual respondents, their families, their households, the communities in which they live, and the health and education facilities they use.

The first wave of the IFLS (IFLS1) was conducted in 1993, contained detailed information of more than 22,000 individual from 7,224 household. Four years later, IFLS2 sought to reinterview the same respondents. A follow-up survey (IFLS2+) was conducted in 1998 with 25% of the sample to measure the immediate impact of the economic and political crisis in Indonesia. The next wave, IFLS3, was fielded on the full sample in 2000. IFLS4 was conducted in 2007 on the same 1993 households and their splitoffs; 13,535 households and 44,103 individuals in 15 provinces were interviewed.

The sampling provinces of IFLS4 was covering North Sumatera, West Sumatera, Lampung, South Sumatera, Bangka Belitung, Jakarta, West Java, Central Java, East Java, Jogjakarta, Banten, South Kalimantan, South Sulawesi, West Nusa Tenggara and Bangka Belitung.

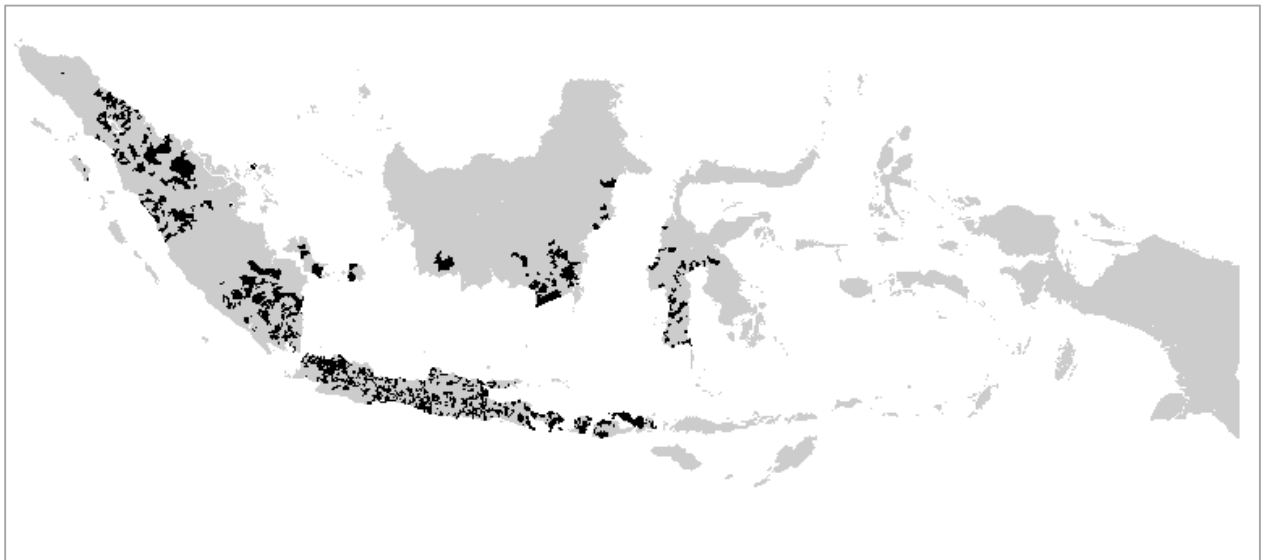


Figure 1 Map of IFLS 4 Respondents

The figure above shows the sub-district area of IFLS 4 respondents in Indonesia. What makes this data set particularly well suited for this research is that it can be merged with detailed geographical information as we know the sub-district area in which the respondent lives. This information allows the author to match the survey data spatially to a national map of Indonesia using GIS.

This research only used the fourth wave of the Indonesia Family Life Survey (IFLS4), which is collected in 2007, due to the availability of self-reported happiness variable in the cross section dataset.

2.3 Data: The Climatic Research Unit Global Climate Dataset

The climate variable used in this research is from The Climatic Research Unit of University of East Anglia (UEA). The Climatic Research Unit (CRU) is widely recognised as one of the world's leading institutions concerned with the study of natural and anthropogenic climate change. The various datasets are provided on the CRU website for all to use.

This research used a global gridded precipitation from CRU TS 3.22 datasets that provides monthly estimates on a 0.5x0.5 degree scale. For the analysis, average annual precipitation is calculated from the monthly estimates precipitation in 2007, which is matched with the IFLS4 dataset that collected in 2007. The raster data of precipitation and then matched with the coverage location of IFLS4 respondents per sub-district .

The precipitation data is obtained from the CRU TS 3.22 dataset as the Network Common Data Form (netCDF) file. The file is later extracted, masked, then exported to STATA in order to be merged with other IFLS 4 variables used in the models.

As Brereton et al., (2008) explain, that to capture accurately the influence of environmental and location specific variables on individual well-being requires variables to be measured at a high level of disaggregation i.e. at the level which individuals experience their environment. However, when specific individual or household GeoCodes (X, Y coordinates) are unknown, as in the case of the IFLS survey data used in this research, neighbourhood areas must be used as the reference point when creating environmental variables. The typical method of doing this is to use the mathematically centroid of the area in question. Thus, this research used the centroid of the respondents' sub-district area as the geo-referenced point of a respondents' location.

The GIS application, ArcMap 9.3 was used to compile, analyze, and visualize the precipitation raster data in this research. Figure 2 shows the calculated average annual precipitation in 2007.

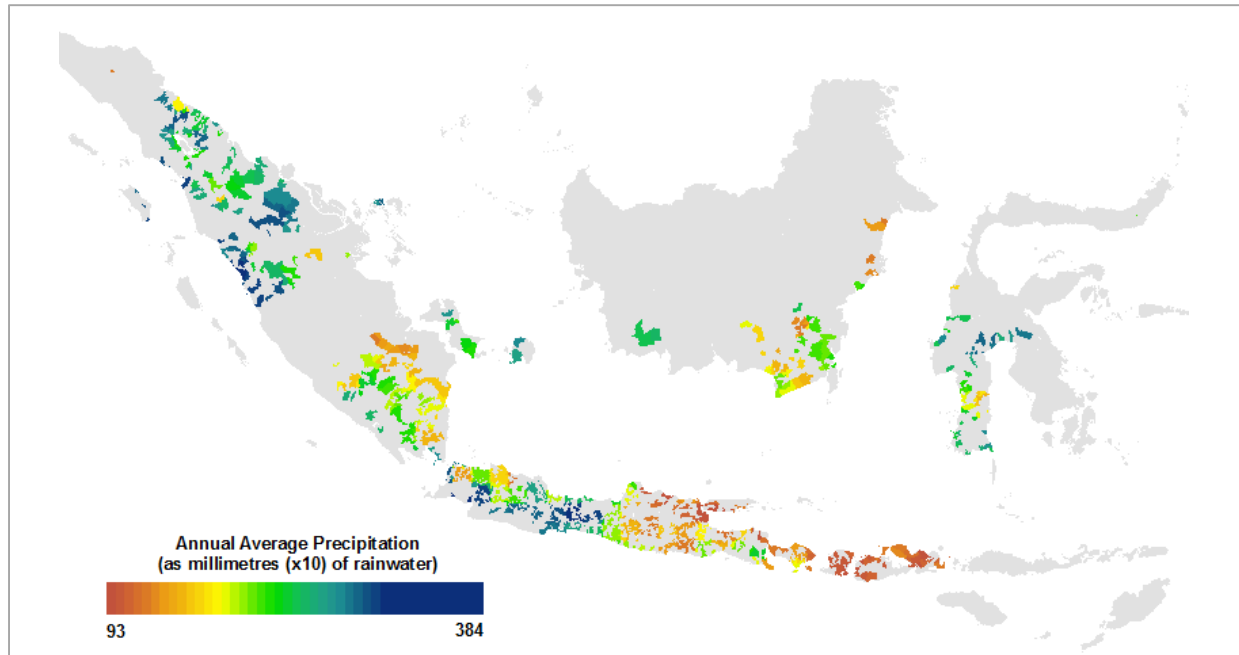


Figure 2 Average Annual Precipitation 2007

The descriptive statistics of the variables used in the model can be seen from Table 1 below.

Table 1. Descriptive statistics of variables used in the model

	Mean	Std. Dev.	Minimum	Maximum
Happiness	0.977	0.385	0	2
Precipitation	209	53.4	92.7	384
Age	36.9	15.6	14	100
Male (1=Yes, 0=Otherwise)	0.476	0.499	0	1
Married (1=Yes, 0=Otherwise)	0.698	0.459	0	1
Per capita expenditure (Thousand Rupiahs)	559	538	27.7	13,614
Household wealth (Million Rupiahs)	81.8	157	0.01	3,232
Health Status (1=unhealthy, 0=healthy)	0.141	0.348	0	1
Junior Secondary (1=Yes, 0=Otherwise)	0.197	0.398	0	1
Senior Secondary (1=Yes, 0=Otherwise)	0.274	0.446	0	1
Tertiary (1=Yes, 0=Otherwise)	0.095	0.293	0	1

3 Results and discussions

Table 2 reports the result of the Maximum Likelihood estimation of the ordered-probit model with 4 different specifications: (1) With only precipitation as regressor (2) With only temperature as regressor (3) With precipitation and also other socio-economic determinants of happiness (4) temperature with all control variables. As, normally, climate variables are pre-determined (or exogenous), we also want to check the sensitivity of climate variables to the inclusion of other factors directly associated with self-reported happiness.

Before looking at the effect of climate variables, we first look at whether the sign of the parameter of standard non-climate variables traditionally associated with happiness conform with our expectation and are significant under traditional level of statistical significance. Overall, the results suggest they do. They conform with the expectations and strongly significant as all of them are significant at 1% level. The OLS regressions (Table 3) show similar result.

We note, for example, that happiness declines as individuals grows older but increase after some point (i.e., non linearity). This is consistent with findings of other studies which, generally, finds a U-shaped relationship between age and happiness (e.g. Easterlin, 2006; Ferrer-i-Carbonell & Gowdy, 2007; Blanchflower & Oswald, 2008; Sohn, 2013). Being female and married is also found to increase self-reported happiness. Economic status, represented by per capita expenditure and assets also strongly associated with happiness. Education is also strong determinant of self-reported happiness. Moreover, looking at the magnitude of the coefficient, we found that the higher the level of education the higher the impact on happiness. For example, having a university education is affecting happiness roughly twice of having secondary education.

We found that temperature is not associated with happiness as we fail reject the hypothesis that that happiness is not affected by temperature under standard level of statistical significance in the two models that we specified. We argued that, unlike a global econometric model with country-variation of temperature, or sample which is Indonesia that is located near the equator, does not have much variation in the annual average temperature. The small variation is not enough to capture spatial variation of individual's reported happiness. In our data, for example, the average annual temperature range from 22.7 to 27.7 degree celcius.

Table 2. Ordered probit regression results

VARIABLES	Model 1	Model 2	Model 3	Model 4
Precipitation	-0.000993*** (0.000157)		-0.000901*** (0.000164)	
Temperature		0.0135 (0.00958)		-0.00550 (0.00994)
Age			-0.0381*** (0.00313)	-0.0385*** (0.00313)
Age-squared			0.000333*** (3.47e-05)	0.000337*** (3.46e-05)
Male (1=Yes, 0=Otherwise)			-0.0985*** (0.0169)	-0.0991*** (0.0169)
Married (1=Yes, 0=Otherwise)			0.394*** (0.0223)	0.396*** (0.0223)
Per capita expenditure (logarithm)			0.166*** (0.0141)	0.159*** (0.0140)
Household assets (logarithm)			0.0456*** (0.00565)	0.0483*** (0.00562)
Health status (1=unhealthy, 0=healthy)			-0.345*** (0.0262)	-0.358*** (0.0262)
Junior secondary (1=Yes, 0=Otherwise)			0.0709*** (0.0246)	0.0678*** (0.0246)
Senior secondary (1=Yes, 0=Otherwise)			0.165*** (0.0236)	0.161*** (0.0236)
Tertiary education (1=Yes, 0=Otherwise)			0.387*** (0.0336)	0.387*** (0.0336)
μ_1	-1.575*** (0.0347)	-1.009*** (0.253)	0.709*** (0.188)	0.702** (0.312)
μ_2	1.324*** (0.0340)	1.887*** (0.253)	3.763*** (0.190)	3.754*** (0.313)
Pseudo-R ²	0.0015	0.0001	0.0538	0.0527
No. of observations	29,055	29,055	28,231	28,231

*** 1%, ** 5%, * 10% level of significance, number in parantheses are standard errors

However, we found that rainfall, in contrast to temperature, affect happiness. We reject the null hypothesis of no-association in the two models we specified at 1% level of significance. In contrast to temperature which have only limited spatial variation, in Indonesia annual rainfall vary by space quite substantially. In our data, rainfall can be as low as 92.7 and as high as 383.8 per year. The sign of the estimated parameter suggests that too much rainfall is associated with a decline in individual's happiness.

4 Concluding remarks

Climate affects human daily activities and eventually our well-being and happiness. Global warming threaten our climatic environment adversely. Most of the attention, however, has been on how climatic variables affect indirectly human happiness through other means, such as loss in agriculture output, structural damages, sea level rise and so on. Not so much attention has been given to the real possibilities that climatic variable itself can directly affect human well-being.

Despite the increasing number of studies on self-reported happiness, due to data availability, only a few studies from developing countries exist. Moreover, eventhough climate is among the most important input to human activities, only a handfull of studies explicitly associate it with self-reported wellbeing. This paper combines a survey of representative sampling of Indonesian population and GIS data on local climate to establish a causation between climate variables (temperature and rainfalls) on individual subjective well-being adopting an oredered-probit regressions model.

Our estimation suggest that eventhough we found that that temperature is not associated with individual's happiness in Indonesia, we found that it is negatively affected by the level of rainfall. The relationship is statistically significant and robust to different model's spefications, including controlling for relevant socio-economic factors that may affect subjective wellbeing. We have shown that for the case of Indonesia with a unique climatic characteristics, changing climatic condition can have a real and direct impact on human well-being.

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