Economics Bulletin

Volume 31, Issue 4

Happiness and Environmental Degradation: What Determines Happiness?

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Abstract

There is much interest among Economists using both theoretical and empirical approaches regarding subjective measures of well being. The present study is an attempt in this direction and it examines if there is a relationship between happiness of people and environmental degradation. We did analysis using log-linear method for the panel of 21 countries for the period 1970-2005, and also analyzed sensitivity of the results. We found that environmental degradation matters for the happiness of the people, and as environment degradation increases, their happiness decreases. Further, economic growth is found to have a positive and significant impact on the happiness of the people, whereas wage inequality and cost of living had a negative and significant impact. However, the impact of openness was inconclusive.

I wish to acknowledge an anonymous referee for the suggestions to improve the earlier version of the paper. Of course, any error that remains is my responsibility.The usual disclaimer applies.

Citation: Aviral Kumar Tiwari, (2011) "Happiness and Environmental Degradation: What Determines Happiness?", *Economics Bulletin*, Vol. 31 No. 4 pp. 3192-3210.

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Submitted: July 20, 2011. **Published:** November 22, 2011.

1. Introduction

The last decade has seen the emergence of a new research area in economic literature that looks into ensuring significant improvements in ensuring material wellbeing and sustaining subjective well-being of the people. Subjective well-being is characterized by three important aspects: an individual's self-reported satisfaction with life, the determinants of happiness for an individual and their link with an individuals' behavior. This contributes, in particular, through three ways. One, it helps to understand the factors contributing to individual's self-reported satisfaction or well-being, or what we call here 'happiness'. Second, it also evaluates the impact of macroeconomics policies on an individual satisfaction (Layard, 2005; Frey and Stutzer, 2002). Third, it determines the changes that are required to ensure the significant improvement and sustainence of the material well-being of the people. Development of the most of economic models is based on the presumption that utility is the direct function of consumption, and consumption in turn is the direct function of income (in fact, some assume utility to be equivalent to consumption) and therefore, income is taken as an appropriate measure of the well-being of the people.[1] However, ecological economists are against this measure of well-being of people, and were inspired by the works of Scitovsky (1976), Hirsch (1976), and Easterlin (1974). This is due the fact that these variables are unable to incorporate the subjective indicators of well-being as measures of utility or happiness of life that must include other variables, such as pollution, noise, health, and family characteristics, so that they may be used more effectively in policy valuation. On a similar line, Oswald (1997) says, "The relevance of economic performance is that it may be a means to an end. That end is not the consumption of beef burgers, nor the accumulation of television sets, nor the vanquishing of some high level of interest rates, but rather the enrichment of mankind's feeling of well-being. Economic things matter only in so far as they make people happier". This shows that these issues are getting attention of the economists and policy makers[2] and the branch of happiness economics has attracted the attention of empirical researchers in recent years (MacKerron, *forthcoming*).

Further, the connections between the environment and human psychology have been studied for quite some time (Kellert and Wilson, 1983), but the relationship between measures of subjective well-being and environmental degradation is a relatively new area of research.[3] There are countable studies examining the relationship between well-being or happiness and environmental factors or environmental degradation. Rangel (2003) documented a positive relationship between economic security and concern for preserving environmental quality for future generations. Welsch (2002) examined the trade-off between prosperity and environmental quality for a representative individual by using measures of self-reported well-being. Frey and Stutzer (2002, p.183) argue that happier people may be more likely to exhibit positive attitude

[1] See Blanchflower and Oswald (2005), Veenhoven (2007), Tukker et al. (2008) who argued that the variables such as gross domestic product (GDP) has been used as an indicator of happiness of a progressive and healthy society.

[2] Following the conference on the need for developing new measures of development beyond GDP organized by European parliament, OECD, WWF and European commission, the European commission released an EU road map for developing new measures of development. As a continuation of this, the British government announced that it is considering using an indicator of well being.

[3] Carbonell and Gowdy (2007) is the first study to the best of our knowledge in the area of studying the relationship between measures of subjective well-being and environmental attitudes of people and other studies have also analyzed the same context however, there is no such study the context we made an attempt.

towards the environment. Concern about the environment may have negative as well as positive impacts on the well-being. For example, Welsch (2002) found a negative relationship between well-being and the level of nitrogen dioxide, a pollutant directly detrimental to human health. Carbonell and Gowdy (2007) tested the relationship between subjective measures of well-being and individual environmental attitudes regarding ozone pollution and species extinction by using an ordered probit model. They used data from the British Household Panel Survey and found a negative coefficient for concern about ozone pollution on individual's well-being and a positive for concern about species extinction.

With this background, the present paper examines the impact of environmental degradation on happiness of the people. To the best of our knowledge, there is no such study that utilizes cross-country data and uses the new constructed index of happiness along with environmental degradation. The use of this index makes this study distinct from others, as happiness is measured by numerical values in the new index vis-à-vis other studies wherein happiness is a categorical measurement. Further, we have also incorporated macroeconomic variables in order to examine the role of material and subjective measures of well-being in the determination of the happiness of the nations. Further, sensitivity of the results is also analyzed by incorporating an additional macroeconomic variable in the model.

The remaining of the paper is structured as follows: Section 2 discusses about selection of variables and describes the model and data set used, Section 3 discusses the results showing the relationship between happiness and material and subjective measures that determines it, while Section 4 concludes.

2. Variables selection, measurement, happiness function and econometric issues

There are quite a few definitions that define happiness. For example, Veenhoven (1989) defines happiness as 'the degree to which an individual evaluates the overall quality of his or her life-as-a-whole positively'. Diener et al. (1997 pp. 25) says that "… a person is said to have high [subjective well-being] if she or he experiences life satisfaction and frequent joy and only infrequently experiences unpleasant emotions such as sadness or anger. Contrariwise, a person is said to have low [subjective wellbeing] if she or he is dissatisfied with life, experience little joy and affection and frequently feels negative emotions such as anger or anxiety". However, in the present context, we follow the concept of happiness as discussed in the report of the Happy Planet Index (HPI) 2.0.[4] The view of HPI is based on two axioms. Firstly, that happy and healthy lives are sought-after around the world; Secondly, that it should not be a privilege of the current generation that future generations should also be able to pursue happy, healthy lives. The HPI sees happiness as depending on Happy life years and the ecological footprint. In particular, it adds the concept of human well-being to the UN definition of sustainable development. HPI, in essence, is an efficiency measure: the degree to which long and happy lives (life satisfaction and

[4] The first Happy Planet Index (HPI) was launched by NEF (The New Economics Foundation) in July 2006 to help steer us along this path. It presented a completely new indicator to guide societies, one that measures the ecological efficiency with which happy and healthy lives are supported. The HPI 2.0 takes advantage of new and improved data for 143 countries around the world, to determine which countries are closest to achieving sustainable well-being. It also looks back over time to see how we've been faring over the last 45 years – and looks forward to see where we need to get to.

life expectancy are multiplied together to calculate happy life years) are achieved per unit of environmental impact and calculated as:

$$HPI \sim \frac{\text{Happy Life Years}}{\text{Ecological Footprint}} \quad (1)$$

The use of this index is relatively novel in the present context, because the happiness measure being used in other studies is based on the world survey of happiness. Therefore, happiness measures are categorical data in those studies (as in the surveys individual are asked to rank their well-being status for example 1 for very happy and 4 for not all happy or vice versa). However, the new measure of happiness combines the categorical data with the natural unit and hence imposes some more complicated econometric issues for estimation (we discuss these issues below in the same section). Next, to identify the variables that determines happiness, we examine 'livability theory' (Hagerty 1997), which says that people make judgments on their life satisfaction based on the degree to which universal human needs are met. This implies that economic factors such as living standards, income, education, job opportunities, purchasing power and life security may play significant role in the formation of the general perceptions of an individual's satisfaction with life. Further, it is general belief that people in rich countries are expected to be happier than people in poor countries but that may not be true following the ideas of ecological economics if environmental degradation is taken into account as a measure of the happiness. This view are supported by Easterlin (1995) which found that some of the economically more developed countries in the world scored lesser in terms of happiness compared to certain less developed countries. Similarly, Easterlin (1995, 2001) also states that people with more income tend to be happier than those with lesser income only up to a certain point of time. However, over an extended period, perceptions about happiness will not change, although income levels increased substantially. Recent research in the field of economic development has found some support on behalf of Easterlin's claims[5] (Veenhoven 2000; Tukker et al. 2008). Hence, economic development may only serve to fulfill the basic life needs for people. That is why, in the long-run, increase in wealth may not result in increased life satisfaction and greater happiness. Gerdtham and Johannesson (1997) have analysed the relationship between happiness and a set of socioeconomic variables and found that happiness is positively related with income and education and negatively related with unemployment, urbanisation, being single and male gender. A contradictory view is that happiness is a relative phenomenon, dependent on the living conditions in which an individual has to survive (Veenhoven, 1991). There may not be any fixed benchmark for a person to feel happy. This logic of happiness formation has been advocated by the 'comparison theory' which states that happiness does not depend on real quality of life, and it holds that changes in living conditions have short-term effect on happiness perceptions of individuals, and people tend to be happier after difficult times (Veenhoven, 1991; Hagerty 1997). Therefore, in our analysis we used gross domestic product per capita (GDPPC). Further, Consumer price index (CPI) is an economic indicator, which may be used as measure for comparisons (Easterlin, 1995; Kahneman and Krueger, 2006) and cost of living. Hagerty (1997) conducted a 25-year time series analysis of 8

[5] Easterlin paradox can be explained with Maslow's need hierarchy theory, which states that individuals first try to satisfy lower order needs such as food, shelter and security, and once they are satisfied with these, they urge for higher level needs such as recognition, fame and self-actualization.

countries to examine the relationship between GDP and CPI change on happiness levels. His study supports both livability and comparison theory. The researchers who advocate comparison theory hold the view that happiness perceptions are formed not through objective evaluation of need gratification but through constant comparison with relative standards, which change with time. Hence, we used CPI also in our analysis.

Further, from the environmental point of view, the impact of the growing menace of global warming on the overall life expectancy and life satisfaction of people has been analyzed (Welsch 2006). A cross-national study by Welsch (2006) of ten European nations showed that air pollution had a significant influence on the subjective wellbeing of nations. Given the alarming rate at which the natural resources of nations are being depleted, the ecological balance of the world is hinging on a very delicate thread (Tukker et al. 2008). Adding to that, the ever increasing emission of greenhouse gases have added to the growing issue of environmental pollution. Therefore, as an indicator of environmental degradation, the per capita carbon emission is used in our study.

Further, number of studies have examined and show that race towards globalization has brought prosperity of nations (measured in GDPPC) in one hand, and increased social problems on the other (see for comprehensive review Tiwari (2010), Tiwari and Aruna (2011) and references therein, among others). Hence, in order to incorporate multidimensional characteristics of globalization, we used KFO Index of Globalization (i.e., Globalization Index, GI) developed by Dreher (2006) as indicator of globalization (normally used indicator in numerous studies is (exports-imports)/GDP) which is unable to incorporate multidimensional characteristics of globalization).

Next, we also incorporated Food Production Index (FPI, hereafter), as net availability of the rich food is very important for the long and healthy life and mental development of the people. In addition, as a final step, we analyzed the sensitivity of results of our model by including the Wage Inequality THEIL measure (WITI, hereafter), which is presumed to create social problems (Tiwari 2010) and Tiwari and Aruna (2011). Hence, high WITI is associated with lower level of happiness. Our study period is 1970-2005, and we used a balanced sample for our analysis.

After identification of the variables, we develop a hypothetical model based on micro-foundation wherein an individual is presumed to maximize his/her happiness subject to budget constraints. In conventional theory, utility depends on tangible goods and services and leisure. An individual is then observed to prefer one bundle of goods to another. Given that all the choices made between alternatives satisfy a certain criteria of reasonableness, a utility function that will explain an individual's preferences between different bundles of goods can be inferred from behavior. However, it is often the case that people are not as well informed about their choices as is axiomatically assumed in revealed preference theory, or that they discount the future in an excessive, inconsistent manner.[6] In such case, the subjective approach to utility

[6] The approach, which relies on expressed preferences rather than on revealed choices, is particularly well suited to answering questions in areas where a revealed preferences approach provides limited information. Indeed, it often uncovers discrepancies between expressed and revealed preferences. Revealed preferences cannot fully gauge the welfare effects of particular policies or institutional

wherein utility is measured in terms of happiness offers economists a fruitful complementary path to study an individual's well-being. This is because subjective well-being is a much broader concept than decision utility. It also includes 'experienced' utility, which is based on an individual's experiences of consumption or life events in the past, as well as 'procedural' utility or the utility derived from the mere act of engaging in an activity preferred by the individual. Many also consider it as the ultimate goal of human life. Further, the concept of subjective well-being allows us to gain a better insight into human well-being. This creates a basis for explicitly testing fundamental assumptions and propositions in economic theory.

Developing a utility function is therefore a very complex task, however we offer a very simple model here and show some difficulties associated with the estimation in the cross-country framework of the happiness function. Let us assume utility is a function of happiness (H) and other economic activities (EA) which includes all others macroeconomic variables as discussed above. By assuming a static environment, we can write the utility function as [7]

$$U = U(EA, H) \quad (2).$$

Further, let us assume that

$$\partial U / \partial H > 0, \text{ and } \partial U / \partial EA > 0. \quad (3)$$

Note that the second inequality condition associated with EA variables implies that EA includes only those variables of which utility can be increasing function. Now if we assume the utility as the only function of happiness we can write the utility function as

$$U = U(H), \text{ so that } dU / dH > 0. \quad (4)$$

There is crucial difference between equation 3 and 4 as in equation 3 utility is increasing function of H if EA is held constant (equation 4 uses partial derivatives) and in equation 4 utility is increasing function of H and nothing is left constant (as equation 4 uses total derivatives). Further, let us assume that both H and EA are not directly purchased but have to be produced by each individual according to household production functions, using market goods, time, and other inputs. These production functions are

$$H = F(x, h_h, E), \text{ and } EA = G(y, h_{EA}, E), \quad (5)$$

where x and y refer to inputs of various goods, the h's are household time inputs, and E refers to environmental variables. These environmental inputs include environmental degradation, the H or EA of other individuals (to allow for social interactions), and command over technology that affects production of H and EA. Budget constraints are the third building block of the analysis.

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arrangements which individuals are powerless to change. Examples of these include the welfare effects of inequality, environmental degradation, and macroeconomic policies such as inflation and unemployment.

[7] Development of the utility function is based on the comments made by Gary S. Becker and Luis Rayo in the study of Stevenson and Wolfers (2008).

The goods constraint is

$$p_x x + p_y y = wl + R = I, \quad (6)$$

where the p's are market prices, w is the wage rate, l is hours worked ($l = 1 - h_h - h_{EA}$), and R is nonwage income. This equation can be manipulated to give the "full-income" budget constraint

$$\pi_{EA} EA + \pi_h H = w + R = S, \quad (7)$$

where the π's are average shadow prices of producing H and EA, and S is full income that is independent of the allocation of time between the market and household sectors. These shadow prices depend on the prices of the goods inputs (the p's), the wage rate (w), and the productivity of household production, which depends on the various individual-specific variables and environmental degradation which affects the health (E). This analysis of household production indicates that the production of happiness has important personal components as well as objective market components, such as income, success and long and healthy life. Now assume that individuals maximize their utility, subject to their budget constraints and household production functions. If the utility function is that given by equation 1, the resulting Hicks demand function for H is

$$H = H(U, \pi_{EA}, \pi_h) = H(U, p_x, p_y, w, E) \quad (8)$$

An increase in H would necessarily correspond to an increase in U only if the π's, or the p's, w, and E, are held constant. Also note that a rise in the individual's nonwage income R (with no change in prices) increases U, and this rise increases H as well, provided happiness is a normal good. Contrary, if the utility function is given by equation 4, the Hicks demand function for H is simply the inverse of the utility function in that equation:

$$H = U^{-1}(U) \quad (9)$$

In this case, which is the usual one in the happiness literature; there is a one-to-one correspondence between happiness and utility. Now we augment our Hicks demand of happiness of equation 9 and discuss some econometric issues associated with the estimation of the function particularly in the cross-section data. Let the augmented happiness function as follows:

$$H = H(GDPPC, GI, CPI, FPI, CO_2) \quad (10)$$

In equation 10, we replaced CPI in place of p_x, p_y and w, E is replaced by CO_2 emissions percapita and further, we added GDPPC, FPI and GI as additional variables as determinants of happiness. Further, it is important to note that the augmented functional form in equation 10 is the simplest form of the Cobb-Douglas type equation (following the idea of Cobb-Douglas type utility equation). For OLS estimation, it requires transformation into the log-linear form. Here, the coefficients associated with GDPPC, FPI are expected to be positive; the coefficients associated with CPI and CO_2 are expected to be negative, and coefficient of GI remains ambiguous as it has multidimensional characteristics. Therefore, the above equation represents the direct impact of our variables of interest. However, it may not always be the case, given the interlinkages in the variables. For instance, assume that following functional forms (11 to 13) holds good.

$$GDPPC = f(GI, CPI, CO_2) \quad (11)$$

$$CO_2 = F(GDPPC, GI) \quad (12)$$

$$GI = g(GDPPC, FPI, CPI) \quad (13)$$

Thus, almost each variables affects happiness of individuals indirectly too.[8] Further, if the functional form had non-linear representation, the model would become more complex (which is beyond the scope of this paper and can be future area of research). In such a case, we cannot predict the sign of the associated coefficients. Another issue relates to the estimation procedure. Earlier studies in this area were based on the happiness surveys, wherein the dependent variable was a categorical variable and therefore, most of the studies have used the ordered probit or ordered logit for estimation. Further, issues related to the estimation for the case when happiness is based on 10-point scale of the global happiness survey and drawing inference from those had been discussed in Bertrand and Mullanaithan (2001) and Frey and Stutzer (2002). However, in this study we assume the Cobb-Douglas type equation for the happiness function 10 - and as Ferrer-i-Carbonell and Frijters (2004) show, qualitatively similar results can still be obtained using ordinary least squares when happiness is based on 10-point scale. Therefore, we used OLS estimation technique in our case. Further, by using the new happiness index, we overcome the limitations of the earlier studies up to some extent, since it combines individuals averaged responses with macroeconomic variables i.e., it merges categorical units with natural units and therefore use of log-linear specification in our model is justifiable.[9] Further, advantage of using the log-linear specification model is that it provides Variable Marginal Rate of Substitutions (VMRS) between the variables entering into the happiness function vis-à-vis the Constant Marginal Rate of Substitutions (CMRS) under the case of the additive form of utility function. In addition to that, we used panel data estimation techniques based on the Micro-econometric happiness equations[10], which in some instances were proved to be sounder way of analysis (Van

[8] For example, are people more satisfied with their life because of their economic conditions, or do happy people assess their economic conditions more favorably? The problem of reversed causality may also exist at the individual level in the relationship between marriage and happiness: does marriage make people happy, or are intrinsically happier people more likely to find a partner and get married?

[9] Nevertheless, there are limitations to econometric inferences at the cross-section. For example, our results may be unreliable if individuals' subjective responses are dominated by personal latent psychological differences (i.e., inborn genetic predispositions). The idea is that cross-section equations will be biased whenever unobserved personality traits (such as neuroticism or self-esteem) are correlated with observable socio-economic factors (unemployment or education) and subjective well-being responses. As a result, we should always treat interpretation of cross-sectional estimates with care.

[10] Micro-econometric happiness equations have the standard form: $w_{it} = \alpha + \beta x_{it} + \varepsilon_{it}$, where w is the reported well-being of individual i at time t, and x is a vector of known variables including socio-demographic and socioeconomic characteristics. Unobserved characteristics and measurement errors are captured in the error term.are other studies in this area which had estimated happiness equation.

Praag and Ferrer-i-Carbonell, 2004).[11] Panel data models largely have three types of representations: First, a pooled Ordinary Least Squire (OLS) regression; second is the panel model with random effects, and third is panel model with fixed effects.[12] We specify the evaluation of a pooled OLS regression derived from the logarithmic transformation of the Cobb-Douglas type happiness equation that includes variables of equation 10 as follows:

$$\ln(HPI_{it}) = \beta_0 + \beta_1 \ln(GDPPC_{it}) + \beta_2 \ln(CPI_{it}) + \beta_3 \ln(GI_{it}) + \beta_4 \ln(CO_{2it}) + \beta_5 \ln(FPI_{it}) + \varepsilon_{it} \quad (14)$$

where *i* denotes country, *t* denotes time and remainder ε_{it} is the error term which is assumed to be white noise and varies over both country and time, and each variable is in logarithmic form. However, heterogeneity of the countries under consideration for analysis can influence measurements of the estimated parameters, which is not included in the above panel model. Therefore, by incorporating countries' unobservable individual effects in equation (14), the model to be estimated is as follows:

$$\ln(HPI_{it}) = \beta_0 + \beta_1 \ln(GDPPC_{it}) + \beta_2 \ln(CPI_{it}) + \beta_3 \ln(GI_{it}) + \beta_4 \ln(CO_{2it}) + \beta_5 \ln(FPI_{it}) + w_{it} \quad (15)$$

where $w_{it} = \mu_i + \varepsilon_{it}$, with μ_i being countries' unobservable individual effects. The difference between a polled OLS regression and a model considering unobservable individual effects, lies precisely in μ_i. When we consider the random-effect model, equation (15) will be same. However, in that case, μ_i is presumed have the property of zero mean, independent of individual observation error term ε_{it}, has constant variances σ_ε^2, and is independent of the explanatory variables. We also analyzed the model in which two-way error components are present. Therefore, by expanding equation (15) to incorporate the two-way error component model, the equation becomes as follows:

$$\ln(HPI_{it}) = \beta_0 + \beta_1 \ln(GDPPC_{it}) + \beta_2 \ln(CPI_{it}) + \beta_3 \ln(GI_{it}) + \beta_4 \ln(CO_{2it}) + \beta_5 \ln(FPI_{it}) + u_{it} \quad (16)$$

where $u_{it} = w_{it} + \lambda_t = \mu_i + \lambda_t + \varepsilon_{it}$, μ_i denotes the unobservable individual effect, λ_t denotes the unobservable time effect, and ε_{it} is the remainder stochastic disturbance term. Note that λ_t is individual-invariant and it accounts for any time-specific effect that is not included in the regression. For example, it could account for strike-year effects that disrupt production; oil-embargo effects that disrupt the supply of oil and affect its price; surgeon general reports on the ill-effects of smoking; or government laws restricting smoking in public places, all of which could affect consumption behavior. If μ_i and λ_t are assumed to be fixed parameters to be

[11] Of course, use of panel data techniques has its own limitation in the case of estimation of happiness function and therefore, careful inference is required.
[12] Definition of the variables and their source is given in Table 2 of Appendix 1.

estimated, and the reminder disturbance is stochastic with $\varepsilon_{it} \sim IID(0, \sigma_{\varepsilon}^2)$, then equation (15) represents a two-way fixed effect error component model.[13]

3. Estimation and empirical results

First, we analysed the descriptive statistics of the variables and results show that none of the analysed variables have log normal distribution and there is no problem of the severe multicollinearity among the variables (please see Table 1 in Appendix 2).[14] In the next step, we analysed various specifications of panel data models and the results are presented in Table 1.

[13] In the case of a time-fixed effect model, λ_t is a time-varying intercept that captures all of the variables that affect the dependent variable and vary over time but are constant cross-sectionally, and the opposite holds in case of a time random-effect model.

[14] It is important to mention that though we do not have evidence of severe multicollinearity between the variables analyzed, but correlation is somewhat higher in few cases and hence provide evidence of near multicollinearity. However, care should be taken in analyzing the correlation matrix presented in Table 1 of Appendix 1, since it is computed by ignoring the panel structure of the data used in analysis.

Table 1: Regression results

Panel data Models: Dependent variable GDP per capita						
Independent variables	Model 1 CS-FE	Model 2 CS-RE	Model 3 Two way FE	Model 4 Two way RE	Model 5 CS-FE PR-RE	Model 6 CS-RE PR-FE
$Ln(CO_2)$	-0.149177*** (-8.55634)	-0.155109*** (-9.05096)	-0.104276*** (-5.05101)	-0.154690*** (-8.9922)	-0.149177*** (-8.893902)	-0.108259*** (-5.364212)
Ln(GDPPC)	0.171776*** (7.40276)	0.165138*** (7.21446)	0.142186*** (4.77962)	0.165615*** (7.2097)	0.171776*** (7.694813)	0.131144*** (4.509474)
Ln(CPI)	0.007212* (1.8151)	0.006965* (1.766246)	-0.003464 (-0.7930)	0.006982* (1.7649)	0.007212* (1.88669)	-0.004204 (-0.970326)
Ln(FPI)	-0.096351*** (-3.47697)	-0.088306*** (-3.21303)	-0.161369*** (-5.6651)	-0.088882*** (-3.2238)	-0.096351*** (-3.61415)	-0.153968*** (-5.455642)
Ln(GI)	0.061402 (1.402293)	0.069321 (1.62255)	0.018421 (0.37560)	0.068768 (1.6026)	0.061402 (1.4576)	0.02355 (0.496946)
Constant	2.500253*** (17.9172)	2.507101*** (17.68808)	3.201764*** (10.3407)	2.506553*** (17.6013)	2.500253*** (18.62409)	3.263083*** (10.95926)
Model summary						
R^2	0.820414	0.229825	0.841757	0.230208	0.820414	0.318951
Wald chi^2	----	223.80***	---	-----	-----	-----
F-test	133.396***	44.7609***	61.616***	44.8577***	133.396***	8.371274***
Lagrangian multiplier test	---	5796.47***	----	----	----	----
Hausman test	---	12.89**	---	0.000	68.5397***	10.5901*
Fixed effect (F-test)-CS	$F_{(20, 730)}$ = 108.21***	---	$F_{(20, 695)}$ = 113.05***	---	$F_{(20, 730)}$ = 108.209944***	$F_{(35, 715)}$ = 2.661926***
Fixed effect (F-test)-PE	----	----	$F_{(20, 695)}$ = 2.678***	----	----	----
Fixed effect (F-test)-PE and CS	-----	-----	$F_{(55, 695)}$ = 44.219***	----	------	----
Countries included	21	21	21	21	21	21
Total panel observations	756	756	756	756	756	756
Notes: 1. The Hausman test has χ2 distribution and tests the null hypothesis that unobservable individual effects are not correlated with the explanatory variables, against the null hypothesis of correlation between unobservable individual effects and the explanatory variables. 2. The Wald test has χ2 distribution and tests the null hypothesis of insignificance as a whole of the parameters of the explanatory variables, against the alternative hypothesis of significance as a whole of the parameters of the explanatory variables. 3. The F-test has normal distribution N(0,1) and tests the null hypothesis of insignificance as a whole of the estimated parameters, against the alternative hypothesis of significance as a whole of the estimated parameters. 4. ***, **, and *denote significance at 1, 5 and 10 % level of significance, respectively. 5. EF, CS, SD denotes fixed-effect, cross-section and standard deviation, respectively. 6. [----] denotes results are not computed. 7. LM is the Breusch and Pagan Lagrangian multiplier test for random effects.						
Source: Author's calculation						

It is evident from model 1 of Table 1 that CO_2 emissions and FPI have negative impact on the happiness of the people, whereas GDPPC and CPI have a positive impact. Further, openness is found to be insignificant. F-test of fixed effects is highly significant showing that cross-country effects play a significant role. Results of model 2, which is analyzed with presumption that cross-country effects are random, show the similar results reported in model 1 i.e., when cross-country effects are presumed fixed. However, Hausman test is significant which show preference towards fixed effect model. Therefore, in model 3 we present the results that presumes two-way fixed effect i.e., cross-country and time effect are presumed fixed. In this case, also we have similar results except that CPI is become insignificant. Fixed effects test for country, time and their joint effect are significant, and hence model 3 better gives a better fit. This is also confirmed by the high value of R^2. Further, model 4 presumes both country and time effect to be random. Results of model 4 confirm the findings of one-way fixed and random effect model; the Hausman tests of country, time and joint are highly insignificant and therefore show that the random effect model is significant. Since both two-way fixed and random effect models are being preferred, we analyzed two additional models wherein we took the first country effect as fixed and period effect as random and in next case we presume country effect to be random and the period effect as fixed. Both the models show similar results, except that there was a difference in the significance of CPI. Therefore, from Table 1 we conclude that material and subjective measure matters in bringing happiness. However, policies that are promoting openness of nations had been insignificant in bringing happiness among people.

Further, to test the robustness of the results we include an additional variable, which measures wage inequality. The results of the sensitivity analysis are reported in Table 2.

Table 2: Regression results of sensitivity analysis

Panel data Models: Dependent variable GDP per capita			
Independent variables	Model 1	Model 2	Model 3
	FE	RE	Two way FE
$Ln(CO_2)$	-0.123063*** (-5.93743)	-0.133519*** (-6.588774)	-0.04387* (-1.77737)
Ln(GDPPC)	0.179967*** (6.15128)	0.168849*** (5.89849)	0.125848*** (3.49055)
Ln(CPI)	0.002065 (0.465395)	0.001638 (0.37410)	-0.013033*** (-2.69185)
Ln(FPI)	-0.096674*** (-2.95958)	-0.082078*** (-2.54766)	-0.196167*** (-5.87206)
Ln(GI)	0.12194*** (2.23067)	0.130640*** (2.48698)	0.052944 (0.86968)
WITI	-0.039724*** (-3.7976)	-0.035317*** (-3.45141)	-0.024006*** (-2.19693)
Constant	1.977919*** (11.6061)	2.018296*** (11.78222)	3.174388*** (8.58595)
Model summary			
Adjusted-R^2	0.842723	0.231194	0.864816
F-test	125.739***	30.16964	66.31996
Hausman test		19.2295***	
Fixed effect (F-test)	$F_{(19, 557)}$ = 105.857***	---	$F_{(19, 525)}$ = 110.57914***
Fixed effect (F-test)-PE	---	---	$F_{(32, 525)}$ = 3.844707***
Fixed effect (F-test)-PE and CS	---	---	$F_{(32, 525)}$ = 48.29451***
Countries included	21	21	21
Total panel observations	756	756	756
Notes: 1. The Hausman test has χ2 distribution and tests the null hypothesis that unobservable individual effects are not correlated with the explanatory variables, against the null hypothesis of correlation between unobservable individual effects and the explanatory variables. 2. The F-test has normal distribution N(0,1) and tests the null hypothesis of insignificance as a whole of the estimated parameters, against the alternative hypothesis of significance as a whole of the estimated parameters. 4. ***, **, and *denote significance at 1, 5 and 10 % level of significance, respectively. 5. EF, CS, SD denotes fixed-effect, cross-section and standard deviation, respectively. 6. [----] denotes results are not computed.			
Source: Author's calculation			

Results of model 1 in Table 2, which presumes country effect as fixed, shows that CO_2 emissions, FPI and WITI have significant negative on the happiness of the people. Here, GDPPC and GI had a positive and significant impact while the impact of CPI is insignificant. Model 2 which took country effects as random also reported the same results. However, model 3 which presumes both country and period effects as fixed had somewhat different results. In case of model 3, openness became insignificant, while other findings were the same. This is a very interesting finding, and is contrary to the presumption is that FPI is negatively significant. Such a result can come in instances where people feel happy when they spend more on fast food and luxuries, than on a balanced diet. Therefore, increase in the consumption of food production might be having negative impact. Since Adjusted-R^2 is higher in model 3 vis-à-vis all other models, and country, time and joint fixed effect are highly significant therefore, we conclude from model 3 that environmental degradation and wage inequality affects negatively the happiness of people and economic growth positively, whereas the effect of openness is insignificant, though positive. Finally, results of model 3 are preferred on the ground of minimum value of Akaike information criterion and Schwarz information criterion.

4. Conclusions

There is a growing body of theoretical and empirical work in economics which has raised questions on the traditional assumptions that interpersonal comparisons of utility can and should be avoided and that the level of consumption of market goods is a close approximation to a social welfare function. Even the most conservative interpretations of the relationship between income and well-being indicate that well-being is not determined by consumption alone (Blanchflower and Oswald, 2004; Keely, 2005).

Therefore, the present study is an attempt to examine the relationship between happiness of people and pollution and to identify whether material measure matters in the self-reported well-being of the people or happiness of the people. For the analysis, we used data from 21 countries for the period 1970-2005. We adopted balanced panel data techniques in a log linear framework. We also analyzed sensitivity of the results with the inclusion of an additional variable and the results were found to be sensitive.[15] However, our overall observation shows that environmental degradation matters for the happiness of the people, and as environmental degradation increases, happiness decreases. Further, GDPPC is found to have a positive and significant results in all cases on the happiness of the people. Wage inequality also has a negative and significant impact on the happiness of the people. Though the impact of openness is shown to be positive in all cases and significant as well, it becomes insignificant in our final model. And finally, the cost of living index is also found to have a negative impact on the happiness of people. This indicates that environmental and macroeconomic policies aimed at solving environmental issues and minimizing the wage disparity and inflation would increase the happiness among the people. Further research in the area can look into the development of a more complex happiness function as discussed in the section 2 and inclusion of some more socio-economic, cultural and political variables in the estimation.

[15] When an additional variable is included, our data become unbalanced panel, as wage inequality data for entire duration was not available.

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Appendix 1

Table 1: List of countries analyzed

Austria	Greece	Korea	Portugal
Australia	Iceland	Mexico	Spain
Denmark	Ireland	Netherlands	Sweden
Finland	Italy	New Zealand	Switzerland
France	Japan	Norway	United Kingdom
			United States of America

Table 2: Variables and their sources

Variable	Source
HPI	Happy Planet Index 2009, National Economic Federations (nef)
Consumer price index (2005 = 100)	World Bank online data-set, World Development Indicators (WDI) from 1960 to 2010
CO2 emissions (metric tons per capita)	World Bank online data-set, Aggregate Governance Indicators, 1996-2009
Food production index (1999-2001 = 100)	World Bank online data-set, Aggregate Governance Indicators, 1996-2009
KOF Index of Globalization	Dreher, Axel, 2006, Does Globalization Affect Growth? Empirical Evidence from a new Index, *Applied Economics* 38, 10: 1091-1110. Updated in: Dreher, Axel; Noel Gaston and Pim Martens, 2008, *Measuring Globalization - Gauging its Consequence*, New York: Springer.
GDP per Capita, in 1990 GK$	The Conference Board
Wage inequality index	UTIP-UNIDO Wage Inequality THEIL Measure

Appendix 2

Table 1: Descriptive statistics and Pearson co-relation

Descriptive statistics						
	Ln(HPI)	Ln(CO_2)	Ln(GDPPC)	Ln(CPI)	Ln(FPI)	Ln(GI)
Mean	3.686754	2.050053	9.534276	3.627163	4.475468	4.228269
Median	3.714153	2.044094	9.604596	4.113513	4.543295	4.300479
Maximum	4.116359	3.128860	10.33662	4.637551	4.779123	4.542548
Minimum	3.160118	0.520829	7.681253	-3.864275	3.663562	3.297905
Std. Dev.	0.172692	0.450671	0.417745	1.340638	0.195705	0.233962
Skewness	-0.527875	-0.384717	-1.126775	-2.953151	-1.411015	-1.113652
Kurtosis	2.975323	4.029242	4.661831	13.69384	4.974170	4.104962
Jarque-Bera	35.12940	52.01815	246.9655	4701.143	373.6278	194.7274
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	756	756	756	756	756	756
Pearson co-relation						
	Ln(HPI)	Ln(CO_2)	Ln(GDPPC)	Ln(CPI)	Ln(FPI)	Ln(GI)
Ln(HPI)	1					
Ln(CO_2)	-0.46286984	1				
Ln(GDPPC)	-0.20877660	0.6914930407	1			
Ln(CPI)	-0.02462436	0.43936566636	0.64194611544	1		
Ln(FPI)	0.060893580	0.26943592575	0.62835336821	0.55465770928	1	
Ln(GI)	0.059350189	0.34293359812	0.67907042700	0.58487232214	0.45734255826	1

Table 2: Results of OLS model

Dependent Variable: LNHPI
Method: Panel Least Squares
Sample: 1970 2005
Periods included: 36
Cross-sections included: 21
Total panel (balanced) observations: 756

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Ln(CO_2)	-0.195529	0.017763	-11.00795	0.0000
Ln(GDPPC)	-0.063572	0.027694	-2.295530	0.0220
Ln(CPI)	0.011468	0.005598	2.048721	0.0408
Ln(FPI)	0.127768	0.038069	3.356210	0.0008
Ln(GI)	0.162738	0.033292	4.888153	0.0000
Constant	3.392193	0.181542	18.68541	0.0000

R-squared	0.288004	Mean dependent var	3.686754
Adjusted R-squared	0.283257	S.D. dependent var	0.172692
S.E. of regression	0.146203	Akaike info criterion	-0.999743
Sum squared resid	16.03139	Schwarz criterion	-0.963012
Log likelihood	383.9027	Hannan-Quinn criter.	-0.985595
F-statistic	60.67530	Durbin-Watson stat	0.065359
Prob(F-statistic)	0.000000		

Table 3: Results of OLS model of sensitivity analysis

Dependent Variable: LNHPI
Method: Panel Least Squares
Sample (adjusted): 1970 2002
Periods included: 33
Cross-sections included: 20
Total panel (unbalanced) observations: 583

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Ln(CO_2)	-0.153738	0.022269	-6.903637	0.0000
Ln(GDPPC)	-0.160394	0.035492	-4.519211	0.0000
Ln(CPI)	0.003795	0.006034	0.629030	0.5296
Ln(FPI)	0.230407	0.041761	5.517336	0.0000
Ln(GI)	0.195441	0.037426	5.222031	0.0000
WITI	-0.006087	0.010090	-0.603252	0.5466
Constant	3.631286	0.222709	16.30509	0.0000

R-squared	0.305957	Mean dependent var	3.677444
Adjusted R-squared	0.298727	S.D. dependent var	0.177429
S.E. of regression	0.148582	Akaike info criterion	-0.963422
Sum squared resid	12.71617	Schwarz criterion	-0.910973
Log likelihood	287.8374	Hannan-Quinn criter.	-0.942978
F-statistic	42.31997	Durbin-Watson stat	0.076026
Prob(F-statistic)	0.000000		