Relationship between Well-Being and Recycling Rates:

Evidence from Life Satisfaction Approach in Britain

Eleftherios Giovanis

1. IMT Institute for Advanced Studies, Piazza S. Ponziano 6, 55100 Lucca, Italy
2. Department of Economics, Royal Holloway University of London, Egham, TW20 0EX England

giovanis95@gmail.com

Abstract

This study explores the relationship between self-reported well being and recycling rates. The estimates are based on Britain using data from the British Household Panel Survey (BHPS). The effects of recycling rates on individuals' happiness are estimated. Two approaches are followed. The first approach refers to panel Probit-OLS. The second approach is the latent class generalized ordered Probit. The results support that a significant positive relationship between self-reported well-being and recycling is presented.

JEL Codes: C23; C26; D60; H41; Q51

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1. Introduction

Recycling has traditionally occurred because it has been economically viable. From the 1970s onwards, however, the perception in modern rich societies has been that we should recycle even more, something that is expressed by existing or proposed solid waste legislation. Recycling reduces the need for raw materials such as metals, forests and oil and so reduces the impact on the environment. Recycling saves energy, reduces raw material extraction and combats climate change. The vast majority of studies have found that recycling our rubbish is better for the environment rather than incinerating or landfilling it (Waste and Resources Action Programme, 2006; Department for Environment, Food and Rural Affairs, 2006). Virgin materials need to be refined and processed to create products, requiring vast amounts of energy and the use of polluting chemicals further causing the destruction of habitats. For example, making one tonne of aluminium needs 4 tonnes of chemicals and 8 tonnes of bauxite-the mineral ore, and it takes 95 per cent less energy[1] to make a recycled aluminium can than it does to make one from virgin materials.

Solid wastes facilities and landfill fires emit air pollutants, when waste is not recycled, including Carbon Monoxide (CO), Carbon Dioxide (CO_2) Hydrocarbons (HC), Particulate Matter (PM), Nitrogen Oxides (NO_x) and Sulfur Dioxide (SO_2). Recycling can potentially cut down these emissions. Most of the UK's waste is currently buried in landfill sites, which release climate change gases and pollute the soil and water. Additionally, the process of recycling and composting, from kerbside collection to the sorting and reprocessing of recyclables, creates more jobs than incineration and landfill (Renner 1991; Gray et al., 2004).

More generally, economists have long worried about accounting for pollution (see Leontief, 1970 for an early example). To value the environment, two popular methods exist:

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[1] http://www.alupro.org.uk

revealed preference and stated preference. The first method relies on hedonic price analysis or the travel cost approach while the stated preference approach, based on contingent valuation surveys, directly elucidate the environmental value from question. Both methods have been widely used in practice (Carson et al. 2003).

Instead this paper relies on life satisfaction approach (LSA). The approach offers several advantages over other valuation techniques in the case where a direct question about the public good is not available. For example, the approach does not rely on housing markets being in equilibrium- an assumption underpinning the hedonic property pricing method- nor does it ask individuals to directly value the public good or bad in question, as is the case in contingent valuation. Instead, individuals are asked to evaluate their general life satisfaction. This is perceived to be less cognitively demanding, as specific knowledge of the good is not required and respondents are not asked to perform the unfamiliar task of placing a monetary value on a public good. This approach entails the inclusion of non-market goods as explanatory variables within micro-econometric functions of life satisfaction along with income and other covariates. (Frey et al., 2010). Therefore, the LSA approach does not require awareness of causal relationships- but simply assumes that recycling leads to change in life satisfaction. LSE is thus closely related to hedonic pricing but relies on life satisfaction rather than house price to evaluate how individuals value their environment. More precisely, LSA does not rely on the ability of the respondents to account and consider all the relevant consequences of a change in the provision of a public good. This paper proposes an econometric model to understand and describe how the recycling rates are associated to well-being. Unfortunately, because of the recycling prices data unavailability, only the recycling rates are included in the analysis.

The contribution of this paper is the examination of the relationship between self reported well-being and recycling rates using micro-level panel data controlling for various factors, as demographic, regional and meteorological. Secondly, two methods are applied; Probit-OLS with fixed effects and the the Latent class generalized ordered probit model are employed. There are several key advantages of using these estimates. Firstly it is possible to control for the local authority district-specific, time invariant characteristics. Secondly, estimating a latent class ordered probit model we model also for slope heterogeneity. The estimates account for the total sample of BHPS as well as for non-movers and movers within Great Britain.

2. Literature review

There are numerous studies on happiness economics. There is the general belief that data on subjective well-being are valid and can be informative (Di Tella et al., 2003; Pischke, 2011). Research studies on happiness have identified various personal, demographic and socio-economic factors of happiness that explain observed happiness patterns. Some of the most important personal and demographic characteristics which affect happiness are age, sex, marital status, the size of the household and the education level. Economic conditions like income, unemployment have also a strong impact on people's subjective well-being (Clark and Oswald, 1994; Easterlin, 2001).

The most relevant study to our research is by Welsch and Kohling (2010). More specifically, the authors used a sample of 23,623 individuals in 27 countries in the time period 1994–1999 using many of the variables used in our analysis, which are described in next section. They found a significant positive and linear relationship between recycling and life satisfaction. However, in this study a much large sample is examined using only data for Great Britain, as well as, we account for slope heterogeneity. Additionally, in this study a panel data is used which allows us to identify the model from changes in the pollution level using it as an instrument within individuals rather than between individuals. This reduces the possible endogeneity bias in the estimates since unobservable characteristics of the neighbourhood that may be correlated with pollution, recycling rates and life satisfaction are eliminated in a fixed effect model.

Shen and Saijo (2007) examined the individual environmental concerns about recycling and environmental quality in Shanghai based on a field survey conducted in November 2006. They found that high income and high education classes are significantly more concerned about recycling. Therefore, higher level of environmental quality and recycling could be associated with higher levels of self-reported well-being. Also young people are more concerned with waste and recycling issues and they are willing to sacrifice more life convenience for additional environmental quality including waste management and recycling issues. Schubeler et al. (1996) present a conceptual framework for waste management and recycling suggesting that the interaction between waste handling procedures and public health conditions is influenced by climatic conditions and characteristics of local natural and ecological systems Also, environment health conditions may also be indirectly affected through the pollution of ground and surface water by leachates from disposal sites. Air pollution is often caused by open burning at dumps and foul odours and wind-blown litter are common. As health status and conditions are used as determinants of happiness a relationship also between recycling and well-being might be presented.

3. Theoretical Framework

3.1 Theoretical Model

There are two serious failures that arise in the management of solid waste. The first relates to the negative externalities in the individual decision-making over waste generation and disposal. When individuals decide on how much to consume and what to consume, they might not take into account how much waste they produce. Because the external costs of waste generation, such as air pollution, are ignored by individuals, more waste is produced and disposed of than is socially optimal. The second serious failure relates to the ways in which waste collection services are typically financed. Usually, individuals pay for waste disposal in lump sums through general taxes or flat payments to local governments or private collectors. Hence, waste disposal costs are not fully reflected in the prices households face at the margin. In addition, individuals still face zero prices for additional waste produced thus tend to produce and dispose of more waste than if they were to pay for the additional garbage according to its social marginal cost.

Addressing the issue of municipal solid waste is an important policy objective and one which is becoming increasingly challenging to address. On the one hand, while the awareness of the external effects of waste generation is increasing, there is resistance by society to the development of new landfills and incineration facilities. On the other hand, solid waste generation has grown significantly over the last decades as a result of higher incomes, more intensive use of packaging materials and disposable goods, and increased purchases of durable material goods.

Next we present the theoretical model. Assuming that some individuals may wish to limit the amount of waste generated and sent to a landfills or incinerators the utility function is:

$$U[Z(X), G(S, X), l] \tag{1}$$

Z indicates the commodity produced using inputs X, G is the amount of garbage for disposal, which is a function of inputs X and time spent for separating the recyclables, S and is a function of labour spent recycling some portion of the refuse generated by inputs X and l is the amount of leisure consumed. The marginal utilities are assumed to be U_Z , $U_l > 0$ and $U_G \leq 0$. The last term is an inequality because garbage generation will impact the utility of some people negatively while it will not affect others. Next the use of inputs X generates trash T and it is a function, $T(X)$, where $T_X > 0$. Trash may be separated into garbage disposal or recycling and the production of recyclables R is a function of the total time spent separating recyclables S and the amount of inputs X available for recycling:

$$R = R(S, X) \tag{2}$$

The amount of garbage is total trash less the recyclables and it is defined as:

$$G(S, X) = T(X) - R(S, X) \tag{3}$$

We assume that the budget constraint is constituted by household's full income consisted of wage and non-wage income and it is:

$$wH + V = px + fG(S, X) \tag{4}$$

, where w is the wage, V is the non-wage income, H indicates the total hours worked, p is the price for X and f is the unit cost of garbage disposal. The household's time constraint is:

$$A = H + l + S \tag{5}$$

, where A is the total time available. Substituting (2) and (3) into utility function (1) and the budget constraint (4) the model is formulated in such a way that the variables of interest are S, X and l. The optimization problem becomes:

$$L = U[Z(X), G(S, X), l] + \lambda_1 (wH + V - px - f[\mathrm{T(X)} - \mathrm{P}(S, X)] + \lambda_2 (D - H - l - S) \tag{6}$$

The first order conditions are:

$$\frac{\partial L}{\partial X} = U_Z Z_X + U_G (T_X - R_X) - \lambda_1 [(p + f(T_X - R_X)] \le 0 \tag{7}$$

$$\frac{\partial L}{\partial S} = -U_G R_S - \lambda_1 f R_S) \leq 0 \tag{8}$$

$$\frac{\partial L}{\partial l} = U_l - \lambda_2 \leq 0 \tag{9}$$

, where λ_1 and λ_2 denote the shadow values of income and time respectively. Furthermore, Kuhn-Tucker conditions are requires because some consumers do not recycle. Equation (7) shows the optimum input level of X which is affected by the utility of the input and the potential disutility of the garbage produced, in the case that U_G <0. Equation (8) shows the optimum choice for S which is the time spent in recyclables preparation for inputs X. Finally, equation (9) shows the optimum choice for leisure. More specifically, at an interior solution the marginal utility of leisure is equated with the shadow value of time.

3.2 Granger Causality

In this section also the Granger causality methodology test is presented. The main interest here is to examine if an inverse causality between well-being and recycling rates is present, which might cause endogeneity bias. A time-stationary VAR model adapted to a panel context as in Holtz-Eakin et al. (1988) of the following form is estimated:

$$HP_{ijt} = \alpha + \sum_{\kappa=1}^{p} \beta_{jk} rec\_rate_{jt-k} + \sum_{\kappa=1}^{p} \gamma_{ijk} HP_{ijt-k} + \mu_i + l_j + \theta_t + v_{ijt} \tag{10}$$

Relation (10) examines if recycling rates cause happiness. It is common in Granger-causality studies to test whether causation runs in both directions. So although the main focus of this paper is on testing whether recycling rates cause happiness and if so, with which sign, also the following equation is estimated:

$$rec\_rate_{jt} = \alpha + \sum_{\kappa=1}^{p} \beta_{jk} rec\_rate_{jt-k} + \sum_{\kappa=1}^{p} \gamma_{ijk} HP_{ijt-k} + \mu_i + l_j + \theta_t + u_{ijt} \qquad (11)$$

Based on relation (11) the causality from happiness to recycling rates is explored. In order to test for Granger-causality between well-being and recycling rates, it is necessary that the two time series are stationary. Based on Akaike (AIC) and Schwarz (SC) information criteria, as well as, based on the statistical significance of the coefficients, the optimum lag length for (10)-(11) chosen is 1. Equations (10)-(11) are estimated using system GMM proposed by Blundell and Bond (1998). From table 1 it becomes clear that recycling rates with one lag is statistically significant and cause happiness. On the other hand, happiness does not cause recycling. More over, the Sargan test accepts the over-identifying restrictions in the GMM estimations. In table 1 the Granger causality test results are reported.

4. 4. Econometric framework

4.1. Fixed effects model

Happiness and life satisfaction can serve as an empirically valid and adequate approximation of individual welfare, in a way to evaluate directly the public goods. Additionally, by measuring the marginal utility of public good or recycling rates in that case, the trade-off ratio between income and the air pollution can be calculated. Therefore, the individual's reported happiness or life satisfaction levels can be treated as proxy utility data. However this seems to be a very strong assumption that is not supported. One way of limiting this problem is to use panel data, so that the comparison is within individual over time, making it more likely that it is meaningful. As such cross sectional research is likely to be biased. The following model of self reported happiness for individual *i*, in area *j* at time *t* is estimated.

$$HP_{ijt} = \beta_0 + \beta_1 rec\_rate_{jt} + \beta_2 \log(y_{it}) + \beta' z_{ijt} + \gamma W_{jt} + \mu_i + l_j + \theta_t + l_j T + \varepsilon_{ijt} \qquad (12)$$

The dependent variable *HP* is the happiness response, subscript *i* denotes the individual, $rec_{j,t}$, is the recycling rate in linear respectively in location *j* and in time *t*, $log(y_{i,t})$ denotes the logarithm of household income and *z* is a vector of household and demographic factors, discussed in the next section. *W* is a vector of meteorological variables, as average, maximum and minimum temperature, wind speed and precipitation, in location *j* and in time *t*. Wind direction could be useful; however, because of the data unavailability it is not used in the study. Set μ_i denotes the individual-fixed effects, l_j is a location (local authority) fixed effects, θ_t is a time-specific vector of indicators for the day and month the interview took place and the survey wave, while l_jT is a set of area-specific time trends. Finally, $\varepsilon_{i,j,t}$ expresses the error term which we assume to be *iid*. Standard errors are clustered at the local authority level. To limit endogeneity issue the population of interest is limited to non-movers. Focussing on non-movers also allow us to capture unobservable characteristics of the neighbourhood that may be correlated with pollution and happiness that are fixed over time. Non-mover status is to be preferred, since this indicates whether the individual has moved in comparison with its location at the last wave (Taylor et al., 2010). In addition, by examining separately the non-movers the endogeneity issue is limited, since the decision to move may well be correlated to environmental quality including recycling. Furthermore, it is important to distinguish the analysis into movers and non-movers because both groups may experience very different dynamics regarding unemployment, wage earnings and quality of life including school among other factors.

In its current form the model cannot be estimated by ordered probit or logit using fixed effects. Therefore there are two options, either by estimating the model considering the dependent variable as continuous or converting the dependent ordinal variable in continous variable assigning z-scores. This procedure was introduced by van Praag and Ferrer-i-Carbonell (2004). To compute probit OLS, the categorical dependent variable is rescaled by deriving *Z*-values of the standard normal distribution that correspond to cumulative frequencies of the original categories. More specifically the probit OLS uses a transformation such that the new dependent variable takes the conditional mean-given the original ordinal rating- of a standardised normally-distributed continuous variable, calculated based on the frequencies of the ordinal ratings in the sample (see Cornelissen, 2006, for an example). The advantages of this are that it is quicker to compute, as well as, there is the possibility of applying panel data methods, such as individual fixed effects. Although satisfaction and happiness scores are collected on an ordinal scale, assuming cardinality of satisfaction scores makes little difference to the results of regression analyses. Nevertheless, this study uses the Probit –OLS to compare the results derived from OLS; however the results are not presented as are the same. The reason why this framewok is employed is because it allows for fixed effects, while the ordered Probit model does not. In addition, these estimates are used as robustness check to the traditional ordered Probit estimates. Van Praag and Ferrer-i-Carbonell (2004; 2006) show both heuristically and in several applications that Probit OLS is virtually identical to the traditional ordered probit analysis. Generally, both OLS and Probit-OLS have been compared with the ordered models and no differences have been found among them (Van Praag and Ferrer-i-Carbonell. 2006; Luechinger, 2009, 2010; Stevenson and Wolfers, 2008; Wunder and Schwarze, 2010). The calculation of the dependent ordinal variable can be stated as:

$$HP_{i,j,t} = E(Z \mid \mu_1 < Z < \mu_2) = [\phi(\mu_1) - \phi(\mu_2)]/[\Phi(\mu_2) - \Phi(\mu_1)] \quad (13)$$

, where Z is a standard normal random variable, φ is the standard normal probability density function, and Φ is the standard normal cumulative density function (see Van Praag and Ferrer-i-Carbonell , 2004 for more details).

4.2 Latent class generalized ordered probit

Using the conventional fixed or random effects models described in the previous sections, correct for intercept heterogeneity. One step further, is to model for slope heterogeneity. Therefore this approach is asking not only how much “money buys happiness”, but also “for whom it buys the most happiness”. The model endogenously divides the observations-in a probabilistic sense- into separate classes, which differ by the parameters-slope and intercept- of the relation between income and happiness (Clark et al., 2005). This model assumes that an agent i evaluates her health status at time t. Let β_{it} denotes her answer, which belonging to ordered set of labels $J = \{j_1, j_2 ... j_J\}$, where J denotes the labels for $j=1,2...J$. The ordered probit (OP) model is usually justified on the basis of an underlying latent variable, HP, in our case, which is a linear in unknown parameters, function of a vector of observed characteristics z, and its relationship to certain boundary parameters, μ. We can therefore write for simplicity the model:

$$HP^{*} = z'\gamma + u \qquad (14)$$

So model (1) is related to the observed outcome *HP* as:

$$HP = \begin{Bmatrix} 0 \quad if\ HP^{*} \leq 1 \\ j \quad if\ \ \mu_{j-1} < HP^{*} \leq \mu_{j},\ \ for 1 < j < J \\ J\ if\ \ \mu_{J-1} \leq HP^{*} \end{Bmatrix} \qquad (15)$$

with, under the assumption of normality, associated probabilities (Maddala 1983) of:

$$\Pr(HP) = \begin{Bmatrix} \Pr(HP = 0 \mid z) = \Phi(\mu_{j=0} - z'\gamma) \\ \Pr(HP = j \mid z) = \Phi(\mu_{j} - z'\gamma) - \Phi(\mu_{j-1} - z'\gamma);\ for - < j < J \\ \Pr(HP = J \mid z) = 1 - \Phi(\mu_{J-1} - z'\gamma) \end{Bmatrix} \qquad (16)$$

Formally, a latent variable c^{*} is defined, which determines latent class membership. This is assumed to be a function of a vector of observed characteristics *x*; with unknown weights $\beta$and a random disturbance term ε as:

$$c^{*} = x'\beta + \varepsilon \qquad (17)$$

The overall probability of an outcome *j=1,2…J* is simply the sum of those respective classes and have the form:

$$\Pr(HP = j \mid x, z) = \Pr(c = 1 \mid x)\Pr(HP = j \mid z, c = 1) + ... + \Pr(c = J \mid x)\Pr(HP = j \mid z, c = J) \quad (18)$$

So, for example for those belonging to class 1we have:

$$P_{i|c} = \left\{ \begin{array}{l} \Pr(HP = 0 \mid z, c = 1) = \Phi(x'\beta)[\Phi(-z'\gamma_1)] \\ \Pr(HP = j \mid z, c = 1) = \Phi(x'\beta)[\Phi(\mu_{1,j} - z'\gamma_1) - \Phi(\mu_{1,j-1} - z'\gamma_1)];\ for - < j < J \\ \Pr(HP = J \mid z, c = 11) = \Phi(x'\beta)[1 - \Phi(\mu_{1,J-1} - z'\gamma_1)] \end{array} \right\} \quad (19)$$

The log likelihood function, for a random sample of *i=1,……,N* individual, can be written as:

$$l(\Theta) = \sum_{i=1}^{N}\sum_{j=0}^{J} h_{ij} \ln[\Pr(y_i = j \mid x_i, z_i)] = \sum_{i=1}^{N}\sum_{j=0}^{J} h_{ij} \ln[\sum_{c=0}^{C=1} P_{ij|c}] \quad (20)$$

, where the indicator function h_{ij} is

$$h_{ij} = \left\{ \begin{array}{l} 1\ \ if\ \ individual\ i\ chooses\ outcome\ j \\ 0\ otherwise \end{array} \right\} (i=1,.....,N;\ j=0,1,.....,J). \quad (21)$$

In this context the estimated parameters of relation (4) are individual and potentially time-varying parameters. Therefore, in this general model heterogeneity is twofold; firstly because the "marginal utility" of income and the baseline-intercept- level of self reported happiness are individual-specific, and secondly because individuals may use different labels to express the same level of happiness. The second heterogeneity may reflect variations in attitudes towards pleasure, happiness, health and pain. Additionally, this model restricts the marginal probability effects by design, whether the income and recycling effects differ based on the person's well-being class.

3 Data

We use the British Household Panel Survey (BHPS) an annual survey of each adult member of a nationally representative sample which started in 1991. Based on the data availability for the recycling rates, the period examined in the current study covers the years 1999-2009. The BHPS takes place during the whole year, except June and July. The variables included in vector X are demographic and household variables as household income, age, family size or household size, labour force status, house tenure, health status, marital status, education level, whether the respondent lives in rural or urban area and local authority districts. The income of the last month is used as is found to be significant. Also the latter is measured in thousands of pounds and has been converted to 2009 British pounds using the CPI.

The survey contains a question about their general happiness. General happiness is an ordinal variable measured on a 4-point scale and the specific phrasing of the question is the following "Have you recently been feeling reasonably happy, all things considered".

The meteorological variables are the average, minimum and maximum temperature, wind speed and precipitation. The recycling rates have been derived from the UK National Statistics, while the weather data have been derived from Met Office and the National Climatic Data Center (NCDC). The aggregation level of recycling rates is household and are calculated based on the household waste which includes household collection rounds, other household collections such as bulky waste collections, waste deposited by householders at household waste recycling Centres and recycling points/ bring banks. In table 2 the summary statistics for recycling rate and income are reported

4 Empirical results

In table 3 the Probit-OLS with fixed effects are reported[2]. It should be noticed that the sum of non-movers and movers within Britain is not equal to total sample. The reason is that additional classes of moving status are included, as moving from abroad or unknown status, which classes are not useful for the analysis, because the main interest is the respondents who move across Britain.

More specifically, the association between self-reported well-being and recycling rates is positive and significant. This can be explained by the fact that it takes less energy to process recycled materials than to process virgin materials. For example, it takes a lot less energy to recycle paper than to create new paper from trees. The energy from transporting virgin materials from the source is also saved. Saving energy also has its own benefits like decreasing pollution. This creates less stress on own health and consequently increases happiness. In addition, by saving energy in industrial production through recycling, the greenhouse gas emissions from factories and industrial plants are lessened and the use of fuels that emit harmful gasses during production is also minimised. Furthermore, by recycling, the waste materials that are placed into landfills are reduced, emitting less air pollutants.

Regarding the other coefficients, we observe that the coefficients of age and age squared are negative and positive respectively. Age is commonly found to have a U-shaped relation to

[2] Based on Hausman and Breusch-Pagan Lagrange multiplier tests fixed effects are preferred.

happiness, with those in middle age having lower happiness than the young and old (Blanchflower and Oswald, 2004). Furthermore, a significant negative association between poor health, unemployed and household size with well-being is reported[3]. Additionally, the respondents who own the house and who are married present a positive and significant coefficient. All these findings are consistent with other studies (Clark and Oswald, 1996; MacKerron and Mourato, 2009). On the other hand, respondents who have the highest academic degree present a positive with happiness; however, the coefficients are insignificant. Finally, the respondents who live in rural area present a strong and positive association with happiness.

Regarding the meteorological data maximum temperature and wind speed presents the expected negative and positive signs respectively; however wind speed is insignificant. The precipitation, average and minimum temperature present positive signs respectively; nevertheless minimum temperature is insignificant. Levinson (2012) finds no effect of precipitation and a positive-though declining- effect of temperature on life satisfaction, while Barrington-Leigh (2008) reports that life satisfaction varies significantly with the amount of recent cloud cover. Finally, Lucas and Lawless (2012) find little evidence of a relationship between any of a large number of weather variables and life satisfaction.

Finally, in table 4 the latent class generalized ordered probit estimates are reported. Using conventional fixed or random effects corrects for intercept heterogeneity. However, latent class models allow the parameters of the unobserved (latent) individual utility function to differ across individuals i.e. slope heterogeneity (Tinbergen, 1991; Clark et al., 2005). From table 4 it becomes clear that recycling rates have significant stronger effects in class 3 (same

[3] The results remain the same even when the health status is excluded from the regressions accounting for the possibility of reverse causality Therefore, based also on literature we keep this variable as it is useful to examine the effects of health status on happiness.

as usual), than in other classes, while the effects become less improtant concerning classes 1 (much less happy) and 2 (less happy). Additionally, the income effects become stronger in class 1, while are declined consecutively in classes 2 and 3.   The membership of class 1 is 2.852. per cent while the memberships for classes 2 and 3 are 14.85. and 67.38 per cent. The results can be explained by the fact that the individuals who have self reported as being less happy (class 1), might be more interested on basic needs, job status and income, which the latter has the strongest effects among all classes. In addition, the effects of the rest variables are similar to those in table 4; however, the highest degree significant and positive effects on subjective well-being for the individuals belonging in classes 1-2.

Recycling can be the platform from which many people can be educated about their environment and good citizenship. Councils should also promote and support waste minimisation schemes. These include the use of home composting, local bring banks and household amenity sites as well as opportunities to reduce waste and reuse items where possible. For example, this could include preventing food waste and promoting furniture reuse schemes, nappy washing services, local refillable schemes and low packaging shops and markets.

Conclusions

This study has used a set of panel micro-data on self-reported well-being from the British Household Survey. Life satisfaction approach has been used to estimate the relationship between happiness and air recycling rates..

Life satisfaction approach contains very useful information on individuals' preferences. In addition, one very strong point of the life satisfaction is that it does not suffer from the contingent valuation problem of large gaps between stated willingness to pay and willingness to accept. Moreover, the life satisfaction approach can be very helpful in environmental and economic policy planning and decisions. Future research suggests the study of alternative techniques, as dynamic panel data regressions, as well as, examination of recycling rates for specific materials, as paper, aluminium and steel among others.

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Table 1. Granger causality test between well-being and recycling rates using GMM

	DV: Happiness	DV: Recycling rates
Constant	0.8947 (0.0297)***	0.9241 (0.1833)**
Happiness with one lag	0.3768 (0.0058)***	0.0744 (0.4333)
Recycling rates with one lag	0.0019 (0.0007)**	0.6359 (0.0081)***
Sargan test	2.145 (0.888)	2.841 (0.519)
Wald chi square	11,570.92 [0.000]	18,347.26 [0.000]
No. obs	61,872	61,860

Standard errors between brackets, p-values between square brackets , ***, ** and * denote significance at 1%, 5% and 10% level

Table 2. Summary statistics

	Mean	Standard deviation	Minimum	Maximum
Income	2,694.672	2,159.329	0	86,703.29
Recycling rates	23.293	11.659	1	62

Table 3. Probit-OLS Happiness Regressions

	Total Sample	Non-movers	Movers within Great Britain
Recycling rate	0.0018 (0.0008)**	0.0021 (0.0010)**	0.0006 (0.089)
Household Income	0.0293 (0.0123)**	0.0278 (0.0122)**	0.0248 (0.0375)
Age	-0.0123 (0.0045)***	-0.0138 (0.0048)***	-0.0176 (0.0172)
Age Square	0.00014 (0.00007)**	0.00015 (0.00007)**	0.00021 (0.0008)
Average Temperature	0.0025 (0.0013)*	0.0028 (0.0014)**	-0.0055 (0.0063)
Minimum Temperature	0.0005 (0.0011)	0.0006 (0.0011)	-0.0119 (0.0095)
Maximum Temperature	-0.0024 (0.0011)**	-0.0028 (0.0013)**	-0.0095 (0.0109)
Wind Speed	0.0013 (0.0016)	0.0010 (0.0016)	0.0022 (0.0016)
Precipitation	0.0052 (0.0026)**	0.0050 (0.0024)**	0.0299 (0.0168)*
Household size	-0.0232 (0.0111)**	-0.0215 (0.0101)**	0.0762 (0.0428)*
Job status (unemployed)	-0.202 (0.0421)***	-0.2373 (0.0437)***	0.2794 (0.3231)
Marital Status (married)	0.2411 (0.0934)**	0.2440 (0.0966)**	0.9220 (0.7252)
Tenure (house owned)	0.0612 (0.0310)*	0.0740 (0.0322)**	0.0252 (0.0277)
Highest degree (university or higher)	0.0270 (0.128)	0.0716 (0.0150)	-0.334 (0.617)
Health status (Poor)	-0.0192 (0.0079)**	-0.0181 (0.0075)**	0.0492 (0.193)
Rural area	0.532 (0.243)**	0.523 (0.121)***	0.505 (0.576)
No obs.	135,710	112,638	8,856
R square	0.4173	0.4327	0.8370
Omitted Variables test	3.056 [0.0875]	2.677 [0.1023]	1.887 [0.1311]
Heteroskedasticity test	3.66 [0.0596]	3.27 [0.0612]	2.14 [0.0745]
Autocorrelation test	6.798 [0.0388]	5.255 [0.0514]	2.593 [0.1095]

Standard errors between brackets, p-values between square brackets , ***, ** and * denote significance at 1%, 5% and 10% level, clustered standard errors on local authority districts

Table 4. Latent Class Generalized Ordered Probit Regressions

Model	Class 1 (Much less happy)	Class 2 (Less happy)	Class 3 (Same as usual)
Recycling rate	0.0011 (0.0020)	0.0015 (0.0007)**	0.0023 (0.0009)***
Household Income	0.0473 (0.0235)**	0.0409 (0.0157)**	0.0171 (0.0078)**
Age	-0.0165 (0067)**	-0.0127 (0.0045)***	-0.0132 (0.0044)***
Age Square	2.2e-0.4 (6.7e-0.5)***	1.7e-0.4 (4.6e-0.5)***	1.3e-0.4 (6.4e-0.5)**
Average Temperature	0.0048 (0.0017)***	0.0037 (0.0018)**	0.0021 (0.0009)**
Minimum Temperature	0.0034 (0.0044)	0.00085 (0.0025)	0.0016 (0.0024)
Maximum Temperature	-0.0051 (0.0022)**	-0.0012 (0.0006)**	-0.0025 (0.0011)**
Wind Speed	0.0046 (0.0022)	0.0011 (0.0034)	0.0041 (0.0031)
Precipitation	0.0143 (0.0063)**	0.0035 (0.0014)**	0.0039 (0.0016)**
Household size	-0.0264 (0.0115)**	-0.0194 (0.0087)**	-0.0187 (0.0091)**
Unemployed	-0.3925 (0.1021)***	-0.1034 (0.0477)**	-0.1930 (0.0659)***
Marital Status married	0.2524 (0.1197)**	0.0962 (0.0419)**	0.2065 (0.1037)**
Tenure house owned	0.1098 (0.0506)**	0.0663 (0.0312)**	0.0593 (0.0246)**
Highest degree	0.3581 (0.1425)**	0.2035 (0.1128)*	0.1097 (0.1104)
Health status (Poor)	-0.0211 (0.0098)**	-0.0263 (0.0239)	-0.0294 (0.0118)**
Rural Area	0.0448 (0.0675)	0.492 (0.234)**	0.610 (0.257)**
No obs.	135,710		
LR chi-square	1,640.82 [0.000]		

Standard errors between brackets, p-value between square brackets ***, ** and * denote significance at 1%, 5% and 10% level