QUANTIFYING THE HEALTH AND WELL-BEING EFFECTS OF GREEN LIFESTYLE CHOICES IN A BUILT ENVIRONMENT CONTEXT

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ABSTRACT

This paper examines the effect of voluntary commitments to sustainable living on self-reported household wellbeing as well as its potential contributions to higher-level environmental and climate change initiatives and policies. To this aim, we combine household panel data from the UK and Germany to estimate these effects based on green lifestyle measures and a set of exogenous and control variables. We find empirical preliminary evidence of higher well-being and health in individuals and households that have pro-environmental attitudes and lifestyles.

Keywords: Green Lifestyles, Health, Well-Being, Built Environment

INTRODUCTION

Support at the individual citizen level is crucial for environmental policies to be successful (Ferrer-i-Carbonell and Gowdy, 2007, p. 510). Individual support is likely to be greater where individuals perceive that their compliance with environmental policies, particularly those involving non-mandatory measures, also yield tangible individual benefits. Increased well-being as a direct or indirect result of pro-environmental behaviour is potentially a key individual benefit. However, the call for voluntary action of individuals and households to reduce carbon footprints has recently come under severe criticism. For example, Perino (2015) argues that sustainable lifestyles may paradoxically lead to more, not less, aggregate greenhouse gas emissions if some of the affected sectors are covered by cap-and-trade schemes such as the EU Emission Trading System (EU ETS). The general reasoning behind this claim is that aggregate demand shifts away from capped sectors create leakage effects, particularly if the capped sectors are carbon-intensive. By contrast, Ostrom (2012), Andreoni (1990) and Brekke *et al.* (2003) show that these adverse effects may be smaller than predicted if consumers have an intrinsic motivation not just to lower aggregate carbon emissions but primarily to lower their overall individual carbon footprints. In a similar vein, Kotchen (2013) reports a generally positive net effect for information-based and voluntary approaches acting as complements to regulatory measures. An important aspect that is generally neglected in the empirical debate about the effectiveness of voluntary green action as exemplified by voluntary green building labelling schemes such as Green Star in Australia or BREEAM in the UK are indirect benefits such as positive health, well-being and life satisfaction effects.

Over the last two decades academic research on sustainability influenced decision making at all levels, although expectations and recommendations regarding actions of individuals are mixed. International organizations have adopted policies based on the studies on its economic (Willard, 2002; Warren-Myers, 2012; Fuerst and McAllister, 2011; Fuerst *et al.*, 2015), social (United Nations, 2016) and environmental benefits (Adams and Yellen, 1976; Fuerst *et al.*, 2014). Interestingly, while some researchers argue that only collective action of committed individuals can make a tangible impact (Seyfang and Smith, 2007; Barr and Gilg, 2006) others advocate policies that are not influenced by voluntary actions (Paterson and Stripple, 2010). Nevertheless, many households have been shown to choose to live more sustainably (Sutcliffe *et al.*, 2008; Mapes and Wolch, 2011), despite the required change in behaviour and a significant economic cost (Hobson, 2002; Gilg *et al.*, 2005). While some studies have suggested individual benefits of environmental commitments and investments (Adan and Fuerst, 2016), little empirical evidence has been published and studies that have examined this issue tend to focus on selected short-term effects. Additionally, existing practices may simply be relabelled as 'sustainable' without any tangible change in substance (Warren-Myers, 2012). However, the cost of voluntary contribution to sustainability and the effect of such choice on well-being and large-scale sustainability programs have not received much attention from academics.

This paper intends to close this research gap by providing a review of recent findings as well as empirical evidence for the importance of voluntary commitments to sustainability through the analysis of survey data from the United Kingdom and Germany. Further, potential contributions to environmental and climate change initiatives and policies are deducted from our findings.

DATA AND METHODOLOGY

This paper aims at investigating the relationship between sustainable lifestyles, housing characteristics and measures of household health and well-being. We first describe the socio-economic survey data for Germany (GE) and the United Kingdom (UK) and subsequently elaborate on the methodology applied. Accordingly, we use the German Socio-Economic Panel (SOEP) and the United Kingdom Household Longitudinal Study (UKHLS) which perpetuates the British Household Panel Survey (BHPS). Each of those panel data include variables for both green action and well-being and thus allow for comparative empirical investigations. Panel data have the advantage of observing adaptation within the same entities over time.

The German Socio-Economic Panel (SOEP) is an official and representative household panel dataset which is being conducted annually by the German Institute for Economic Research (DIW Berlin) since 1984 (West Germany) and 1990 (East Germany) respectively. The SOEP study entitled as "Living in Germany" is government-funded and collected through personal interviews performed by TNS Infratest, a private market research company. The German panel dataset is compiled through personal interviews of adult household members with a minimum age of 16 years currently amounting to roughly 27,000 sample individuals of 11,000 randomly selected households. The SOEP is based on the first panel study of income dynamics (PSID) which is being conducted in the United States since 1968. The SOEP dataset adopts multi-stage random sampling and includes diverse measures for household composition, employment, housing as well as subjective indicators for health and satisfaction.

The main aim of the panel datasets is to collect representative microdata for households, individuals and families to facilitate analyses on inter- and intra-individual changes over time. They have facilitated empirical studies on a diverse range of topics affecting living conditions and significantly contributed to academic discourse in the social sciences. Figure 1 describes the development of the sample size through the waves 1 (1984) to 31 (2014). Since its first implementation, various new samples have been added to account for social and economic developments such as the German unification and migration.

Figure 1: Development of SOEP Sample Size through the Waves
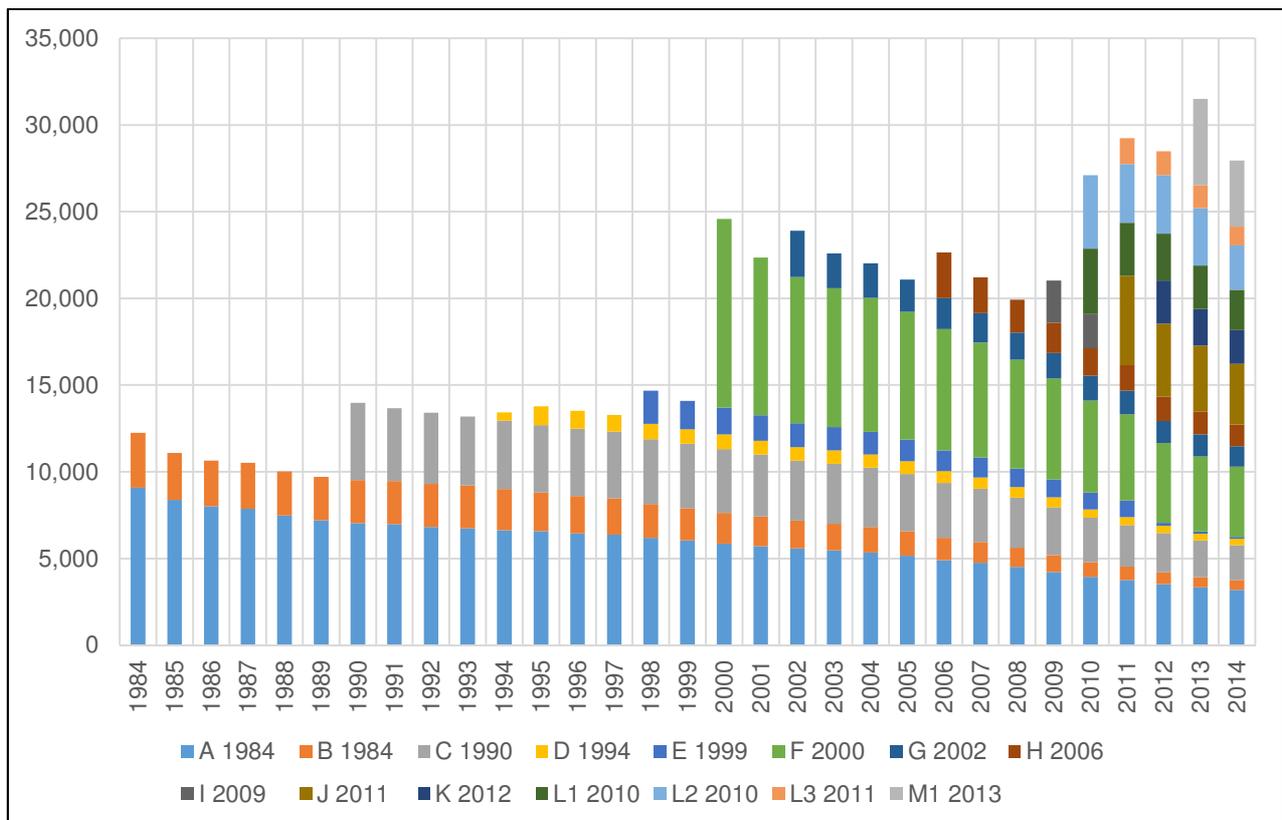
Apart from the additional households and individuals interviewed over time, the scope of the survey includes regularly asked core questions and changing supplementary topic modules. The core survey includes questions regarding (i) population and demography, (ii) education, training and qualification, (iii) labour market and occupational dynamics, (iv) earnings, income and social security, (v) housing, (vi) health, (vii) basic orientation and (viii) satisfaction with life and various aspects.

The survey is specifically designed to gather contemporaneous as well as retrospective data. Each wave introduces changing supplemental and changing topic modules which are replicated every 3-10 years. While the latter include diverse topics such as social security, assets, education and time use, green lifestyles and the built environment are particularly addressed in the modules neighbourhood (1994) and ecology and environmental behaviour (1998, 2003).

The United Kingdom Household Longitudinal Study (UKHLS) has been compiled by the Institute for Social and Economic Research at the University of Essex since 2009 and incorporates the British Household Panel Survey (BHPS) which started in 1991. The UKHLS is entitled Understanding Society and financed through the Economic and Social Research Council and the UK government.

Analogous to its German SOEP counterpart, the UKHLS is generated through personal interviews of adult household members with a minimum age of 10 and currently includes data for roughly 100,000 individuals from about 40,000 households. Currently, the UKHLS is the largest panel dataset based on household surveys in the world.

We draw upon subjective well-being and self-assessed health as outcome variables and incorporate green lifestyle variables in addition to common potential predictors of well-being as control variables. The SOEP and UKHLS both include several measures for well-being, health and variables related to green lifestyles. Although the question regarding current subjective well-being (SWB) is comparable,[1] the responses scales differ with ranges from 1 to 10 (SOEP) and 1 to 7 (UKHLS). Data on subjective satisfaction with health is measured accordingly.
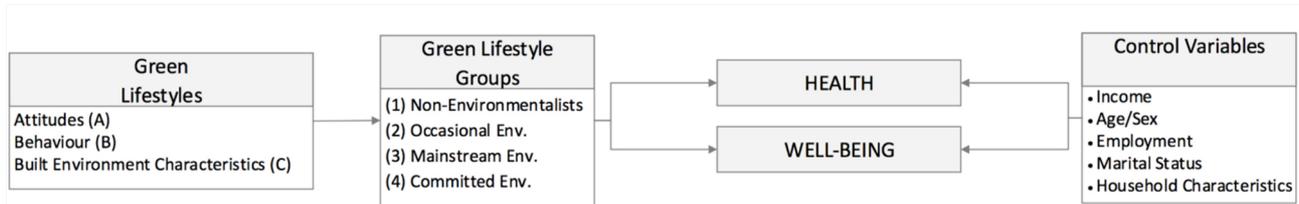
Green lifestyles are approximated through environmental attitudes (A) and behaviour (B) as well as the characteristics (C) of the surrounding environment which are available for Germany as well as the UK. Although the SOEP provides data on environmental **attitudes** such as consciousness, the data is only available for specific waves (1998, 2003) and therefore not suitable for the subsequent analysis. Prior work such as (Hirsh, 2010) has investigated environmental concern using diverse metrics which are not constantly present in the SOEP such as environmental consciousness (1998, 2003), importance of environmental protection (1994, 1998, 1999) and worries about the environment (since 2005). Analogous issues arise for several other environmental-related measures such as development in local environment. Therefore, we use worries about the environment as a proxy for environmental attitude since it is the only measure which is annually reported. The UKHLS provides diverse measures related to environmental attitudes in waves 1 and 4. We use the question asked referring to individual perceptions of the current lifestyle and the environment. In analogy to the SOEP data, environmental attitude is measured on a scale from 1 to 3. Hence environmental attitude is estimated based on the stated concern about the environment (SOEP) and self-reported perception of current lifestyle in regard to the environment (UKHLS). All variables have been transformed such that larger values indicate higher dimensions of green lifestyles unless otherwise stated.

We calculate environmental **behaviour** based on environmental retrofits to homes as no common behavioural patterns such as consumption or recycling behaviour can be drawn from either dataset. The SOEP reports implementation of heating installations and insulations since 2009. We summarize environmental behaviour into one variable which indicates whether green retrofits have been undertaken. Similarly, the UKHLS reports installations of solar panels for electricity, solar water heating and wind turbines to generate electricity in waves 19 and 22. Although the UKHLS includes recycling behaviour and further variables related to the environment, we concentrate on the former retrofit variables to ensure comparability between German and UK data. Therefore, environmental behaviour is approximated by green retrofits in the built environment in both countries. We estimate binary variables indicating whether households have initiated retrofits. In addition, the environmental **characteristics** of the built environment are approximated through the self-rated condition of the dwelling and reported access to a garden.

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[1] More precisely: "How satisfied are you at present with your life as a whole?" (SOEP) and "How satisfied are your with your life overall?" (UKHLS).

Following previous work, we control potential predictors for well-being (Ferrer-i-Carbonell, 2005). In particular, income, age, partnership and employment status have been found to be amongst the most prominent measures to impact subjective well-being. Figure 2 describes the methodology applied in this study.

Figure 2: Research Methodology

The descriptive statistics for well-being, health, respective measures used to approximate green lifestyles and control variables are provided in Table 1. The metrics summarized in Table 1 indicate common patterns for Germany and the UK. We observe similar descriptive statistics for well-being, green lifestyle characteristics and covariates. Variable selection was guided by ensuring symmetric information in both data sources that could be matched and compared. Where reference categories and ordinal scales differ, we additionally transform the data to match in both countries.

Table 1: Descriptive Statistics of SOEP and UKHLS Sample Data

Variable	Mean	Std. Dev.	Min.	Median	Max.
SOEP					
Outcome Variables					
Current Life Satisfaction (Well-Being)	7.12	1.72	1.00	7.00	10.00
Current Health Satisfaction (Health)	6.74	2.11	1.00	7.00	10.00
Green Lifestyles					
Environmental Attitude (A)	2.14	0.62	1.00	2.00	3.00
Environmental Behaviour (B)	0.04	0.20	0.00	0.00	1.00
Condition of house (C)	2.68	0.52	0.00	3.00	3.00
Yard (C)	0.68	0.47	0.00	1.00	1.00
Control Variables					
Net Income	2898.16	1992.69	0.00	2500.00	90000.00
Age	52.24	17.51	20.00	51.00	105.00
Sex (reference: female)	0.53	0.50	0.00	1.00	1.00
Employment Status	0.59	0.49	0.00	1.00	1.00
Partnership Status	0.59	0.49	0.00	1.00	1.00
Children in HH	0.34	0.48	0.00	0.00	1.00
No of adults in HH	3.14	1.54	1.00	3.00	17.00
UKHLS					
Outcome Variables					
Current Life Satisfaction (Well-Being)	5.15	1.50	1.00	6.00	7.00
Current Health Satisfaction (Health)	4.78	1.74	1.00	5.00	7.00
Green Lifestyles					
Environmental Attitude (A)	1.40	0.58	1.00	1.00	3.00
Environmental Behaviour (B)	0.08	0.28	0.00	0.00	1.00
Condition of house (C)	2.45	1.04	0.00	3.00	3.00
Yard (C)	0.91	0.29	0.00	1.00	1.00
Control Variables					
Net Income	1300.97	1230.75	0.00	1092.39	15000.00
Age	46.46	18.40	14.00	45.00	104.00
Sex (reference: female)	0.54	0.50	0.00	1.00	1.00
Employment Status	0.55	0.50	0.00	1.00	1.00
Partnership Status	0.51	0.50	0.00	1.00	1.00
Children in HH	0.35	0.48	0.00	0.00	1.00
No of adults in HH	2.32	1.08	1.00	2.00	12.00

A: Attitude, B: Behaviour, C: Characteristics of the Built Environment, CV: Control Variable, GLS: Green Lifestyle

FINDINGS

Prior work on well-being incorporating socio-economic data has primarily focused on personal characteristics and social environments. In line with prior work, for example by Blanchflower and Oswald, 2004; Ferrer-i-Carbonell, 2005; Ferrer-i-Carbonell and Gowdy, 2007, we estimate the determinants of satisfaction S with life (*SWL*) and health (*SWH*) as

$$S = h\big(u(y,z,g,t)\big) + e,$$

where h relates actual to reported well-being subject to the true utility of an individual as a function of income y, a set of personal and demographic measures z during time period t as well as an error term e. We extend the function by the additional incorporation green lifestyle characteristics g.

In order to analyse the individual green lifestyle measures, we first calculate pairwise correlations between the different green lifestyle measures. As described in Table 2, all measures are significantly correlated in the UK, whereas this finding is only partially found for Germany. While behaviour and attitude are positively correlated with each other, attitude and built environment characteristics seem negatively correlated. Hence, individuals living in built environments with degrading conditions and those with restricted access to green space may have a higher awareness of environmental issues. However, the magnitude of the correlations are just marginal. Overall, we conclude that the measures we constructed to define green lifestyles carry distinct information.

Table 2: Correlation Matrix for Green Lifestyle Measures

	GSOEP			UKHLS		
	Attitude	Behaviour	Cond. House	Attitude	Behaviour	Cond. House
Attitude	1.0000			1.0000		
Behaviour	-0.0001	1.0000		**0.0480**	1.0000	
Cond. House	0.0071	-0.0007	1.0000	**-0.0633**	**0.0728**	1.0000
Garden	-0.0025	**0.0630**	**0.1056**	**-0.0449**	**0.0571**	**0.1671**

Bold characteristics indicate significance at the 0.001 level.

Next, we investigate the green lifestyle characteristics included in survey data for Germany and the United Kingdom. Table 3 provides preliminary evidence that higher environmental attitude is generally accompanied by increasing environmental behaviour and decreasing characteristics of the built environment. The descriptive statistics for the green lifestyle measures particularly highlight that dwelling condition and proximity of green space are typically lower for individuals with high environmental attitudes. Individuals living in below average built environment characteristics are generally more concerned with changes in their immediate and surrounding environments.

Table 3: Environmental Attitude and Other Green Lifestyle Measures

	GSOEP			UKHLS		
Attitude	Behaviour	Condition House	Yard	Behaviour	Condition House	Yard
(1)	0.036	2.669	0.656	0.077	2.498	0.925
(2)	0.043	2.698	0.687	0.101	2.427	0.911
(3)	0.039	2.689	0.664	0.122	2.183	0.870
All	0.041	2.678	0.681	0.084	2.445	0.907

Regression Results

We expect significant and positive relationships between environmental attitude, behaviour and characteristics of the built environment and corresponding satisfaction levels. As time-invariant factors have been found to significantly affect well-being measures, we estimate a random effects model which takes unobserved time-varying individual specific effects into account (Clark *et al.*, 2008b; Ferrer-i-Carbonell and Gowdy, 2007). The results of random effects models with life (SWL) and health (SWH) satisfaction as dependent variables for Germany and UK are summarized in Table 4.

All in all, we find a negative relationship between stated environmental attitude and well-being. We find that a more pronounced pro-environmental attitude significantly reduces health and well-being levels in both countries. However, no significant effect of environmental behaviour such as energetic renovations can be found in either Germany or the UK. As expected, characteristics of the built environment have a positive impact on well-being. More specifically, the condition of the built environment and access to green space both increase well-being measures significantly. In line with prior work, the control variables exhibit significant and mostly reasonable coefficients. While income has a more pronounced positive effect on life satisfaction

than on health in Germany, the results highlight a marginal negative effect for the UK. Confirming the results of related research (Ferrer-i-Carbonell, 2005), being female, employed and living in a partnership does increase well-being. By contrast, the coefficient for our gender dummy with female reference exhibits a negative sign for health satisfaction. Although employment has a generally positive effect, we observe an exception for life satisfaction in Germany. The coefficients for kids and the number of adults in households are in line with prior work and statistically significant. That is, kids increase and additional adults decrease well-being measures.

All in all, we conclude quite similar well-being effects of green lifestyles across both countries. Furthermore, the results underline a stronger effect of green lifestyle measures on life satisfaction with the exception of conditions of built environment, children in the household and individual age. Interestingly, the relationship between environmental attitude and the well-being measures is much more pronounced in the UK with almost double the impact for health and a roughly tenfold impact for life satisfaction. The adjusted R^2 is around 3 to 12 percent and thus in line with the finding of prior work that only a minor portion of subjective well-being can be explained through objective factors (Ferrer-i-Carbonell, 2005).

Table 4: Green Lifestyles and Satisfaction

	GSOEP		UKHLS	
	SWL	SWH	SWL	SWH
Attitude (A)	-0.0278**	-0.0995***	-0.2744***	-0.1741***
Behaviour (B)	0.0611	0.0420	0.0443	0.0168
BE Cond. (C1)	0.2816***	0.3182***	0.1799***	0.1141***
BE Gard. (C2)	0.1693***	0.0989***	0.1670***	-0.0130
ln(Income)	0.6244***	0.4425***	-0.0395***	-0.0449***
ln(Age)	-0.4882***	-1.6931***	-0.5848***	-0.6276***
Female	0.0685***	-0.0517**	0.0274	-0.0232
Employment	-0.0378***	0.01986***	0.3185***	0.4041***
Partnership	0.2146***	0.0440*	0.2618***	0.1917***
Kids in HH	0.0923***	0.1297***	2.3780*	-0.7489
ln(Adults in HH)	-0.4771***	-0.3179***	0.0237	-01172***
Const.	3.6479	9.3486	4.4536	7.8052
Obs.	24,460	24,460	18,367	18,367
R^2	0.062	0.127	0.068	0.031

* significance at the 0.1 level, ** significance at the 0.05 level, *** significance at the 0.001 level.

As the main aim of the study is to identify the relationship between green lifestyles and well-being, we summarize the intensity of green lifestyle based on the individual green lifestyle characteristics as described. Consequently and following the procedure applied by Barr and Gilg (2006) and Gilg *et al.* (2005), we cluster individuals into four green lifestyle groups (GLG).

Table 5: Green Lifestyles and Individual Characteristics

GLG	Income	Age	Gender	Employment	Partnership	Kids	Adults
				GSOEP			
(1)	2261.44	55.12	0.54	0.52	0.46	0.17	2.63
(2)	2086.76	49.53	0.53	0.56	0.39	0.22	2.84
(3)	3135.66	55.60	0.56	0.55	0.67	0.26	3.28
(4)	3226.16	54.54	0.49	0.60	0.66	0.27	3.37
All	2879.10	54.30	0.52	0.57	0.59	0.24	3.14
				UKHLS			
(1)	1261.84	34.79	0.64	0.55	0.44	0.99	2.26
(2)	1180.27	32.78	0.64	0.48	0.44	1.00	2.24
(3)	1552.52	37.22	0.59	0.75	0.65	0.99	2.37
(4)	1441.17	37.33	0.56	0.59	0.60	1.00	2.39
All	1457.90	36.38	0.60	0.68	0.59	0.99	2.34

More precisely, we categorise individuals into non-environmentalists (1), occasional environmentalists (2), mainstream environmentalists (3) and committed environmentalists (4). As the green lifestyle measures include binary variables as well as frequency data, we estimate the respective clusters using Gower's distance. Comparing the descriptive statistics for those environmental groups, we can confirm the findings of literature in regard to characteristics of environmentally conscious individuals.

Accordingly, sustainable lifestyles correspond with increasing income, increasing age, female sex, employment, living in partnerships and having kids and number of adults in the household. The results are in line with prior work on the role individual characteristics and pro-environmental lifestyles (Welsch and Kühling, 2010).

Table 6: Green Lifestyles and Satisfaction

	GSOEP		UKHLS	
	SWL	SWH	SWL	SWH
Green Lifestyle	0.0513***	0.0318***	0.1541**	0.0933***
ln(Income)	0.6742***	0.4932***	-0.0461***	-0.0485***
ln(Age)	-0.4503***	-1.6618***	-0.5848***	-0.6364***
Female	0.0702***	-0.05778**	0.0391*	-0.0166
Employment	-0.0479**	0.1879***	0.3807***	0.4374***
Partnership	0.2293***	0.0564**	0.2794***	0.2019***
Kids in HH	0.0918***	0.1283***	2.1577	-0.8722
ln(Adults in HH)	-0.4878***	-0.3306***	0.0486*	-0.1049***
Const.	3.7820	9.4646	4.4373	7.7143
Obs.	26,649	24,460	18,367	18,369
R^2	0.070	0.127	0.043	0.024

* significance at the 0.1 level, ** significance at the 0.05 level, *** significance at the 0.001 level.

The results of the random effects model incorporating green lifestyle groups is summarised in Table 6. The results indicate a positive and statistically significant impact of the incorporation of green lifestyle on well-being measures. In fact, we detect a much stronger impact on life satisfaction than on self-reported health. We further observe that the covariates exhibit similar coefficients and significance levels as in the initial regression setup and conclude that green lifestyles confer additional well-being effects through voluntary green action purely hedonic lifestyles (Lindert *et al.*, 2015).

Research Limitations

While this study has analysed individual pro-environmental attitude, behaviour and characteristics of the built environment in regard to well-being, research still lacks thorough measures for voluntary environmental action. The insights from this study might help uncover further individual benefits which could prove instrumental for environmental policies and initiatives. However, our definition of green lifestyles is not comprehensive and could be enriched by additional attitudes and behaviours. In addition, comparisons of countries in terms of satisfaction need to take cultural differences into account (Ferrer-i-Carbonell, 2005). However, we assume that cultural differences between Germany and United Kingdom are smaller than those of previous studies that investigated a larger range of countries.

Potential contributions to environmental policies

While the results indicate that individual well-being may be positively affected by green lifestyles, their aggregate and individual cost implications are uncertain. Hence, future work might seek to calculate carbon footprints to enable the estimation of cost-effective measures and initiate voluntary green action of households.

CONCLUSION

This study complements existing studies on green lifestyles and well-being by investigating voluntary pro-environmental lifestyles and their effect on well-being in a cross-country setting. To this aim, a model of subjective well-being measures is presented and applied to the UK and German household panel dataset. While the incorporation of emotional (impure) altruism significantly enhances the power of economic models of donations, we find comparable empirical evidence on the interaction between environmental, health and well-being factors. In particular, the consistent empirical evidence from two countries highlights that the adoption of pro-environmental lifestyles appears to increase individual well-being. The insights provided in this study reveal key determinants of well-being including healthy living and green environment.

However, research has not yet fully incorporated the distinction and potential trade-offs between purely competitive and non-competitive goods in regard to well-being (Ferrer-i-Carbonell and Gowdy, 2007). More specifically, environmental policy could account for the value of non-competitive goods such as environmental quality. It might be useful to draw the attention of public policy goals to key aspects of health and environment.

However, these preliminary findings pose further research questions for follow-up research addressing the relationship between environmental aspects and well-being such as cost implications of green lifestyles. As it seems viable to enhance well-being on the individual level, implementation is dependent on the level of information and awareness on environmental issues. The green lifestyle of an individual might confer indirect positive effects on other household members. In addition, research implications are limited through uncertainty on the direction of causality. To that effect, environmental policy should further take individual adaption and feedback effects to other household members into account.

Furthermore, the presented database on green lifestyles could be enriched by real estate price and valuation data to investigate potential links between green lifestyles, health and property markets. While some studies have attempted to relate health outcomes to housing markets (Davis, 2004), negative effects of health risks might be prevailing even if health risks improve (Currie et al., 2015). The effect of green lifestyles on housing markets however, is yet to be investigated.

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