



Report on uses of productivity growth (product and nonproduct growth uses) and well-being and sustainability

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Executive summary

This report, produced under the Horizon Europe project *WISER – Well-being in a Sustainable Economy Revisited*, explores whether economic growth can simultaneously support sustainability and human well-being.

Context and objectives

This study addresses the so-called “double dividend” hypothesis—the idea that pro-environmental behaviors (PEBs) not only benefit the planet but also enhance human well-being. Deliverable 3.2 pursues two main objectives. The first is to examine how income relates to the likelihood of engaging in PEBs. The second is to assess whether PEBs, in turn, contribute to higher levels of subjective well-being (SWB). In doing so, the report provides new evidence on the interconnections between economic growth, sustainability, and well-being, exploring whether these objectives can be achieved simultaneously.

Methodology and approach

Longitudinal household data from the UK Understanding Society study were used, spanning more than a decade and including detailed measures of income and 11 distinct PEBs. Panel fixed-effects models and causal diagrams (directed acyclic graphs) were employed to **discuss and** account for unobserved factors such as personality traits and regional differences. This approach provides stronger evidence than most previous studies, which have typically relied on cross-sectional or purely correlational data.

Main results

The findings challenge systematic assumptions about the double dividend:

- Increases in income are associated with a decline in PEBs.
- No robust evidence was found that PEBs are related to greater SWB.

Although symbolic actions (such as recycling or using reusable bags) are less sensitive to income, the overall association remains negative. Moreover, the expected boost in SWB from “living greener” is not supported by the evidence.

Expected impact

These findings have direct implications for European policy. On the one hand, economic growth in its current form is unlikely to yield simultaneous gains in sustainability and well-being. Achieving Europe’s transformation goals will therefore require policy measures that extend beyond income growth alone. On the other hand, reshaping consumption patterns and household behaviors will be essential to align environmental and social objectives.

Introduction

Can economic growth simultaneously enhance subjective well-being (SWB) and sustainability? As incomes rise, societies increasingly question not only whether additional income translates into higher well-being, but also whether these income gains come at the expense of the natural environment and, consequently, the well-being of future generations. In this way, debates about material progress are directly linked to concerns about non-material well-being and long-term sustainability.

The literature on income, sustainability, and well-being is broad and multifaceted. Our article situates itself within the economics of wellbeing research, a field that has examined both the links between income, wealth and SWB (Stevenson & Wolfers, 2008; De Neve et al., 2017; Easterlin & O'Connor, 2022), as well as the relationship between sustainable behaviors and SWB (Welsch & Kühling, 2010; Binder et al., 2020a; Bartolini, 2025). We ask whether income growth can be harnessed to advance both sustainability and well-being, whether the two goals can be achieved jointly rather than traded off.

Specifically, we examine whether increases in income foster pro-environmental behaviors (PEBs), and whether these PEBs, in turn, enhance SWB, creating what has been called a “double dividend” of PEBs (Jackson, 2005; Herziger et al., 2020; Prinzing, 2020). Prior research shows that PEBs are positively related to various aspects of well-being (Zawadzki et al., 2020), and this double-dividend narrative is increasingly promoted to policymakers as a way to legitimize reductions in material consumption (Binder et al., 2025). In effect, societal increases in income and productivity could be used more sustainably and hence create a double dividend for planet and individuals, when measured in the currency of SWB.

Yet skepticism about the double dividend remains. While higher-income countries have succeeded in reducing domestic material consumption per unit of GDP, their overall material footprints continue to rise at rates equal to or faster than GDP growth (Bruckner et al., 2022). At the individual level, evidence on the double dividend is mixed: although some studies have shown that higher incomes can go hand-in-hand with more PEBs (e.g., Milfont & Markovitz, 2016; Grimmer et al., 2016; Pleeging et al., 2020), others report that people with a higher income tend a larger ecological footprint and are less inclined to engage in PEBs (e.g., Wiedmann et al., 2020; Chancel, 2022; Berthold et al., 2023).

Studies examining the relationship between PEBs and SWB have generally reported a positive association between the two, suggesting that environmentally friendly actions may provide an additional motivation for individuals to adopt them (Zawadzki et al., 2020). However, the evidence is far from uniform: some studies find no or negative effects (Binder et al., 2020a). Moreover, much of the existing literature suffers from limited causal credibility, as results typically rely on observational data analyzed with standard regression techniques. A recent contribution by Binder et al. (2025), using directed acyclic graphs (DAGs) and equivalence testing, strengthens the methodological rigor of this debate and finds no evidence that engaging in PEBs enhances SWB.

The study by Binder et al. (2025) explicitly rejects the notion that individuals who act in environmentally friendly ways experience greater SWB, challenging the widely cited “double

dividend" hypothesis. At the same time, the study does not address the relationship between income and PEBs. In case income growth yields more PEBs, than we could at least promote economic growth for future well-being. Building on the work of Binder et al. (2025), we bring together these debates by examining the interconnections between income, PEBs, and SWB.

Using rich household panel data from the UK (the Understanding Society survey), we analyze eleven PEBs measured across three waves (2009/2010, 2012/2013, 2018/2019). Applying panel fixed effects methods, we assess how changes in income shape PEBs and SWB (measured via life satisfaction). The dataset further allows us to examine heterogeneity across gender, age, and education, and to distinguish between different types of PEBs.

Our contribution to the literature is threefold. First, we are the first study that examines the relationship between income, PEBs and SWB over a long period of time using panel data. Together with the use of DAGs, we provide a more robust testing of the relationship between the two variables. Second, we integrate work on income and PEBs with the literature on PEBs and SWB, thereby further exploring the validity of the "double dividend" hypothesis. Utilizing fixed effects models, we show that it is very unlikely that there is a double dividend, let alone a single dividend. Third, we examine heterogeneities in PEBs. Given mixed findings in the literature on income and PEBs, it might be the case that people with higher income might engage in specific PEBs. In this study, we compare PEBs related to energy, mobility and shopping as well as symbolic versus impactful PEB.

Research questions

1. Relationship between income, PEBs and SWB
 - How is income related to PEBs and SWB over time?
2. The "double dividend" hypothesis
 - Is there empirical evidence to support the "double dividend" hypothesis, which states that PEBs simultaneously generate environmental benefits and an increase in SWB?
3. Heterogeneity of PEBs
 - Does the relationship between income and PEBs vary across individual characteristics and type of PEB?

Structure of the report

The remainder of this study is structured as follows. Part 1 reviews the background literature and outlines the theoretical framework on the determinants of economic growth, happiness, and sustainability. Part 2 describes the methodology and model, presents the empirical results and main conclusions, and offers an overview of key findings and directions for future research and policy practice. The Annexes include summary statistics, zero-order correlations, and sensitivity tests.

Part 1 Theoretical framework

1. Theoretical and conceptual framework: key concepts and definitions

This section introduces the theoretical background that offers the key concepts, the conceptual clarifications, and empirical evidence that guide our thought processes concerning the relationship between income, pro-environmental behavior (PEB), and subjective well-being (SWB). First, we operationalise the PEB and SWB constructs, followed by a discussion of their estimation procedures. Finally, we summarize existing empirical evidence.

1.1. Defining pro-environmental behavior

PEB can be defined as any action that reduces environmental stress or has a positive environmental impact (Steg and Vlek, 2009; Schmitt et al., 2018; Kollmuss and Agyeman, 2002).¹ PEB can encompass a wide range of behaviors, including reducing energy and water usage, recycling, using public transport, avoiding flying, purchasing green products, consuming organic or locally grown food, and participating in climate activism (Kollmuss and Agyeman, 2002; Furchheim et al., 2019; De Matos et al., 2025). Different taxonomies of PEB exist such as the distinction between public-sphere actions (e.g., joining environmental protests) and private-sphere actions (e.g., using reduced water usage), as well as between regular and occasional actions (Capstick et al., 2022). Factors influencing PEB include environmental knowledge, emotional involvement, values, and situational constraints. The adoption of such behaviors can also be influenced by environmental values, self-image, and identity (Whitmarsh & O'Neill, 2010).

The measurement of PEB can be achieved through self-reported surveys, behavioral observations, and composite indices (Preisendörfer & Diekmann, 2021). In practice, most studies rely on self-reported surveys that capture a broad spectrum of behaviors—from recycling and energy conservation to environmentally conscious consumption (Binder, 2025; Franzen & Vogel, 2013).

In this study, we make a distinction between PEBs related to mobility, energy, and shopping as well as between symbolic and impactful PEBs. Symbolic behaviors involve highly observable acts that signal greenness but have small ecological impact (e.g., carrying reusable bags), while impactful behaviors are typically less visible but high-impact actions (e.g., reducing meat consumption, avoiding flights). This framing is used in psychology to study green signaling (e.g., Griskevicius et al., 2010) and also closely follows the work of Diekmann and Preisendörfer (2003) who distinguished between low-cost behaviors that are often symbolic, easy to adopt and socially visible and high-cost behaviors that involve a more substantial sacrifice or change. Moreover, it aligns with the classification by Hansmann and Binder (2020), who distinguish between salient private “lighthouse” PEBs (private actions meant to convey a

¹ PEB is delineated more narrowly by Berthold et al. (2023) as actions that benefit the natural environment (e.g., recycling) and the avoidance of actions that harm the natural environment (e.g., forgoing air travel).

pro-environmental message) and less socially salient private PEBs (more intimate or routine behaviors with lower visibility). In the context of the relationship between income and PEBs, this distinction may be important, as higher incomes are more likely to be associated with symbolic behaviors motivated by social status rather than with high-cost behaviors.

1.2. Defining subjective well-being

Subjective well-being (SWB) refers to people's cognitive and affective evaluation of their lives (Diener, 1984) and is by Veenhoven (1984) defined as "degree to which an individual judges the overall quality of his/her own life-as-a whole favourably" (Veenhoven, 1984, Chapter 2). People draw on two key sources when evaluating their SWB: their emotional states and their cognitive judgments. This means individuals may assess their SWB on how they generally feel and at the same time compare their current life to both the ideal and worst imaginable. Though distinct constructs, both have been shown to correlate with each other (Schimmack, 2008; Graham, 2016), especially in Western contexts (Blanchflower & Bryson, 2024a). For our analysis, we focus on life satisfaction (LS) as an evaluative measure of SWB.

1.3. Existing evidence on the relationship between income and PEB

The relationship between income and PEB is contested. Higher income can expand the capacity to adopt costly but sustainable practices, such as purchasing organic food or investing in green technologies, by reducing financial barriers to these choices (Neubert et al., 2022). Yet greater affluence also tends to fuel overall consumption, particularly in high-impact domains such as mobility and energy use, thereby offsetting potential environmental gains (Whitmarsh et al., 2017; Preisendörfer & Diekmann, 2021). In addition, higher income is often linked to values such as materialism, which are generally less supportive of PEBs (Alzubaidi et al., 2021). Another reason why higher incomes would be less receptive to PEBs is that they perceive less environmental risks (Lo, 2014; Berthold et al., 2023).

Empirical work underscores this tension: while some studies document that economic resources facilitate environmentally friendly behaviors, others reveal that rising income is strongly associated with higher carbon emissions (Wiedmann et al., 2020). Longitudinal and cross-national analyses suggest a dynamic pattern: environmental concern often increases during early stages of economic development but declines once affluence reaches a level where consumption-driven lifestyles and shifting values take precedence (Franzen & Vogel, 2013). Moreover, income effects are not linear. Berthold et al. (2023) find that both higher income and subjective financial scarcity reduce willingness to engage in PEB, with these relationships shaped by expectations about future resource availability and the perceived effort involved in environmental action.

1.4. The relationship between PEB and SWB

The relationship between PEB and SWB has seen increased research attention lately. A recent meta-analysis finds an overall correlation between PEBs and evaluative well-being of $r = 0.213$ across 34 (Zawadzki et al., 2020). But these associations are unconditional (zero-order) correlations and the meta-analysis also includes studies that analyze the reverse causal

relationship from SWB to PEB.² In effect, only 16 studies in the meta-analysis claim they deal expressly with the causal direction from PEB to life satisfaction (PEB→LS). Of those, the majority finds positive associations between PEB and SWB (e.g., Welsch and Kühling, 2010; Schmitt et al., 2018; Laffan, 2020). For instance, Schmitt et al. (2018) find a positive and significant relationship between their overall measure of PEB and life satisfaction (standardized coefficient $\beta = 0.19^{**}$, $n = 2220$ US & Canada, p. 135), but not all associations between their 39 individual PEBs are as large as the overall coefficient and not all are statistically significant (Table 4, p. 136). With other large-scale data, similarly positive relationships have been reported by Welsch and Kühling (2010, for World Values Survey data) or Laffan (2020, for UK data). Capstick et al. (2022) surveyed seven countries and discovered a strong positive association between PEB and SWB, especially when people participated in public-sphere environment actions in collectivist societies. Similarly, De Matos et al. (2025) found that organic food consumption has a positive impact on SWB, primarily through cognitive routes (such as belief in health/environmental benefits) and self-enhancement (presenting oneself as environmentally responsible).

Other research finds no evidence for a relationship at all (Suárez-Varela et al., 2014), and some studies find negative effects (Verhofstadt et al., 2016; Furchheim et al., 2019; Binder et al., 2020a): in case of the latter, and controlling amongst other factors also for green self-image, the standardized effect size for an index of 20 PEBs on life satisfaction in a large sample of Spanish students is $\beta = -0.08^*$ ($n = 640$, p. 9).

In sum, even though there may be a “robust association” between PEB and SWB, the overall evidence for a causal impact of PEB on SWB in general and life satisfaction in particular, is rather weak (see more extensively Binder et al., 2025).

² The authors also find modest associations with hedonic and eudaimonic well-being.

Part 2 Examining the relationship between income and PEB, and between PEB and SWB

This section provides the empirical analysis of the research, describing the econometric techniques, data sources, and findings that identify the relationships between income and PEB, and the causal relationships between PEB and SWB.

2. The relationship between income and PEBs

In this section, we examine the relationship between income and PEBs. To this end, we use fixed-effect regressions on panel data but lack experimental variation. Hence, the identification of a causal effect of our main variables of interest depends on a convincing and systematic selection of relevant control variables (Bartram et al., 2024). This requires a departure from the usual reference to control variables that are typically used in the literature, and from empirically driven procedures to establish which control variables to use.

Instead, we utilize a principled approach of selecting control variables based on an explicit causal model developed with "directed acyclic graphs" (DAG). Directed Acyclic Graphs (DAGs) are visual tools used in causal inference to map causal relationships and assumptions between variables, helping to identify potential sources of bias like confounding and selection bias, and to determine the appropriate adjustments (e.g., what variables to control for) needed to estimate causal effects from observational data. They use nodes for variables and directed arrows for causal effects, forming a graph that is "acyclic" because it contains no feedback loops. (Pearl & Mackenzie, 2018; Rohrer, 2018; Cinnelli et al., 2022, Bartram et al., 2024).

Careful reflection about which control variables *W* help in multivariate regression, and which are harmful can help in making causal claims from observational data more credible.

Many different patterns for the relationship between *W* and *X* and *Y* have been identified, with differing needs to control for them or not (Cinelli et al., 2022). After providing arguments for the causal structure of potential confounds in our relationships of interest and drawing a directed acyclic graph, identification of these confounding patterns can be automatized, and programs exist that quite conveniently then identify which of the variables in the graph need to be controlled for.³

2.1. Relevant Control Variables

In our analysis, we start by developing a causal model for our analyses with PEB as dependent variable, i.e. income → PEB, which is presented in Figure 1. PEB, which is presented in Figure 1. The literature has established that personality can impact income, and PEB. In recent meta-analyses, Alderotti et al. (2023) and Vella (2024) report that evidence from primary studies strongly indicates that higher personal earnings are linked to higher levels of openness,

³ See, for instance, <https://dagitty.net/dags.html>.

conscientiousness, and extraversion, whereas earnings tend to be significantly lower among individuals scoring higher on agreeableness and neuroticism. These findings hold even when adding education and cognitive ability as control variables. Research has also connected personality to PEB and attitudes (Gifford & Nilsson, 2014; Milfont, 2021; Soutter & Möttus, 2021), with neuroticism and extraversion emerging as the main traits lacking a consistent association with environmentalism.

There is a considerable wage gap between men and women worldwide, although this has been declining over time (Weichselbaumer & Winter-Ebmer, 2005; Matysiak & Cukrowska-Torzewska, 2018; Gebrewolde et al., 2025). Yet, a relationship has been established from gender to PEB, as women were found to engage in PEB more than men, and display more pro-environmental attitudes (see Franzen and Vogel, 2013; Gifford and Nilsson, 2014; Preisendörfer and Diekmann, 2021). Studies have attributed this relationship between gender and PEBs to differences in degree of socialization (Zelezny et al., 2000), value priorities (Dietz et al., 2002) as well as differences in risk perception (McCright, 2010).

The relationship between age and income is well-established in the literature and tends to be U-shaped (Mincer, 1974). Income tends to increase with age, reaching a peak in people's late 40s or early 50s (OECD, 2023) and then declines due to retirement transitions or reduced work capacity. Following work on Mincer wage equations (Heckman et al., 2006), this pattern reflects human capital accumulation in the early stages of life, followed by depreciation of skills and lower productivity growth later in life. Otto and Kaiser (2014) attribute the relationship between age and PEBs to learning: the more exposed people are to environmental information, the more pronounced their PEBs. At the same time, younger people may sometimes show more concern but face practical obstacles that limit behavior (Cantillo et al., 2025).

It is clear that education is (causally) related to income (see, e.g., Card, 1999; Harmon et al., 2003; Psacharopoulos & Patrinos, 2018). Higher education levels also lead to individuals acting increasingly environmentally friendly (Gifford and Nilsson, 2014; Hansmann et al., 2020) but also may increase people's environmental impact (if only through increased income; cf. Preisendörfer and Diekmann, 2021, p. 141).

The corresponding DAG is shown in Figure 1. Based on this discussion, our analyses need to control for age, education, gender, and personality traits. Note that we control for personality traits and gender only indirectly via the fixed-effects estimator which differences out time-invariant confounds (this means we need to assume that personality traits do not change (much) over time, something which can be contested, see, e.g., Boyce et al., 2013). In addition, the UKHLS data set allows us to control for time and regional fixed effects, hence allowing us to take into account otherwise unmeasured confounds

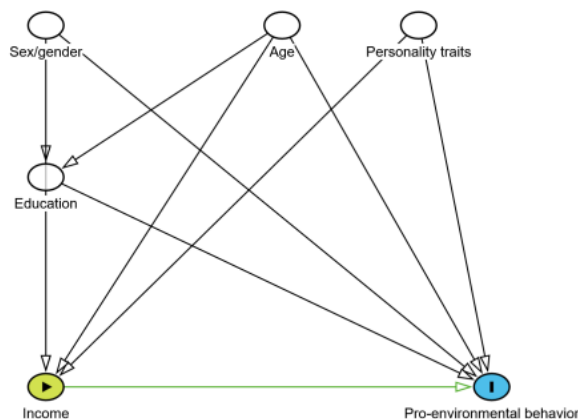


Figure 1. DAG for the relationship between income and PEB

2.2. PEB and SWB

For our model that estimates the impact of $PEB \rightarrow LS$, we draw on the causal model developed in Binder et al. (2025), who examined the relationship between PEB and LS in the German town of Goettingen. The DAG is depicted in Figure 2. The set of control variables identified via this exercise includes green self-image, income, personality traits, gender, age and education (this has been defended in Binder et al., 2025), with the same caveat about gender and personality traits.

Green self-image, or the degree to which individuals view themselves as environmentally conscious (Gatersleben et al., 2002) has been both linked to PEBs and SWB. The dominant interpretation in this literature is that green self-image drives PEB, but causal conclusions can not yet be drawn because many studies often lack adequate controls (Udall et al., 2021). A smaller body of research has explored connections between green self-image and SWB. Binder and Blankenberg (2017) showed for the UK that green lifestyle is positively related to SWB, while similar findings were found using European survey data (Welsch & Kuehling, 2018) and data on Spanish students (Binder et al., 2020a). Although also clear causal evidence for a green self-image–SWB link remains limited, most of the literature assumes the direction of causality flows from green self-image to both PEBs and SWB. Hence, we consider green self-image an important control variable.

As the other control variables that are relevant for the regressions on PEBs and SWB were also relevant for the regressions on income and PEBs, we discuss here the relation with these variables to SWB below. Income shapes people’s SWB both directly and indirectly, through its impact on health, living conditions, and access to opportunities. While debates remain about the precise nature of this relationship (Easterlin & O’Connor, 2022), the evidence strongly points to a logarithmic association between income and SWB.⁴ Recent research, including

⁴ Kahneman & Deaton, 2010; Jebb et al., 2018; Killingsworth et al., 2023.

natural experiments, reinforces the view that this link is causal rather than purely correlational (e.g., Lindqvist et al., 2020).

In addition, personality traits are consistently found to be robust predictors of SWB (e.g., DeNeve & Cooper, 1998; Schimmack et al., 2008). A recent meta-analytic regression by Busseri and Erb (2024) showed that higher life satisfaction was uniquely predicted by higher extraversion, agreeableness, emotional stability (i.e. lower neuroticism) and conscientiousness, while openness had no effect.

Whereas income and personality can be considered direct determinants of SWB, variables such as gender, age, and education affect PEBs but show only indirect links to well-being. For instance, although some studies highlight gender differences in SWB (e.g., Stevenson & Wolfers, 2009; Blanchflower & Bryson, 2024b), a comprehensive meta-analysis finds no systematic direct association (Batz-Barbarich et al., 2018). Gender-based disparities in well-being that appear in certain countries may instead stem from broader structural inequalities, including income gaps (Bartram, 2022). Age presents a similarly complex case: evidence is mixed regarding whether its association with well-being follows a U-shape, is linear, or is negligible (López Ulloa et al., 2013). More fundamentally, any apparent effect of age is likely mediated by factors such as health, education, and income rather than reflecting a direct causal role (Bartram, 2024). Education, too, appears to affect well-being primarily through indirect pathways. While research on direct education–well-being effects yields mixed results (Clark, 2018), strong evidence indicates that education enhances well-being indirectly via its influence on income (Card, 1999) and health (Conti & Heckman, 2010).

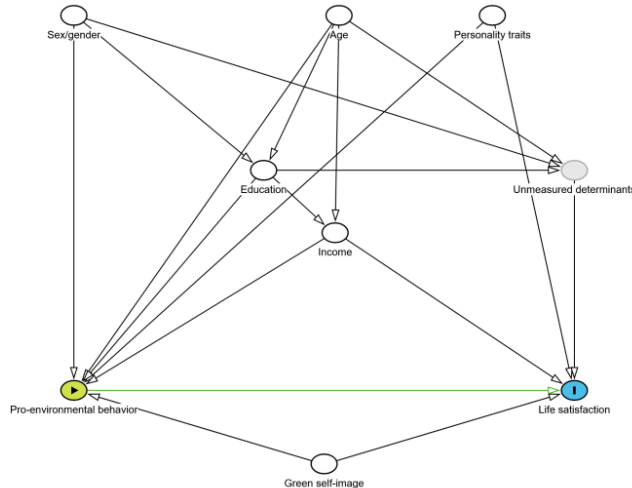


Figure 2. DAG for the relationship between PEB and SWB

The following subsections present the methodological framework in detail. In “The Methodology”, we include the data and the econometric specification. “Empirical Results” presents the findings of each model, followed by “Discussion and Conclusion”, where we interpret the results in light of existing literature and policy relevance.

3. Methodology

In this section, we present the data and the econometric specification. A detailed description of all variables, including definitions, summary statistics for the full sample, and zero-order correlations, is provided in Annex A.

3.1. Data

Our analysis is based on the UK Household Longitudinal Study (UKHLS), the revamped continuation of the British Household Panel Study (Knies, 2015).⁵ The new UKHLS study was launched in 2009, and the first wave of interviews was conducted in 2009/2010. The first wave included about 40.000 UK households, covering about 100.000 individuals (aged 16 years and older). These households were selected in the beginning via a multistage random sampling (random sample of post codes of the UK, and a random sample of addresses within these post codes). Given the format, a longitudinal study, the same people were used again over time for interviews. The data set covers data on all aspects of the life of an individual (well-being, employment status, health etc.). For our purposes, the UKHLS contains subjective assessments of one's perceived lifestyle, attitudes toward climate change and environmentally friendly behavior, as well as 11 self-reported variables on the frequency of PEB (e.g., saving water, using public transport, or recycling).

To capture overall engagement, we created an index of PEB by summing the recoded scores for all 11 items (see Variables and Summary Statistics in Appendix 1). This "sum index of PEB" ranges from 0 to 44, with the maximum value attained when a respondent reports "always" engaging in every behavior. For additional analysis, we made distinguished between symbolic PEB (items 1, 3, 4, 5, 10 and 11) and impactful PEB (items 2, 6, 7, 8, and 9) and PEB related to energy (items 1, 2, 10, and 11), mobility (items 6, 7, 8, and 9), and shopping (items 3, 4, and 5).

3.2. Econometric estimations

Regarding our econometric estimations, we used a two-way fixed-effects ordinary least squares regression model (TWFE OLS), which controls for both individual-specific unobserved heterogeneity and time fixed effects.

Our dependent variables are:

1. Pro-environmental behavior, which is measured as a sum index adding up behavioral frequencies on a 44-point scale.
2. Life satisfaction as measure of SWB, which is measured on a 7-point, endpoint-labeled numerical response scale, where values have a natural ordering but do not necessarily presuppose a cardinal interpretation.

For latter, applying an OLS approach has been a dominant model choice in the literature despite ordered choice models being technically more correct. Ease of interpretation of the regression coefficients, but also the ability to apply fixed effects estimators (which do not have

⁵ www.understandingsociety.org.uk

comparable fixed effects ordered choice estimators with similar properties) inform this choice.⁶

Our regression equations thus take the following form:

$$PEB_{it} = \beta INCOME_{it} + \gamma \mathbf{W}_{it} + \alpha_i + \lambda_t + \varepsilon_{it} \quad (1),$$

and

$$LS_{it} = \beta PEB_{it} + \gamma \mathbf{W}_{it} + \alpha_i + \lambda_t + \varepsilon_{it} \quad (2),$$

where PEB_{it} is our index of pro-environmental behavior, LS_{it} denotes life satisfaction, and $\mathbf{W}_{it}$ and $\mathbf{Z}_{it}$ are the vectors of control variables discussed and defended in the Appendix. α_i represents individual-specific time-invariant fixed effects, λ_t period dummies, and ε_{it} is the idiosyncratic error term, purged of the afore-listed time and person fixed effects. We use heteroscedasticity-robust standard-errors clustered at the individual level to further account for intra-person correlation of otherwise not directly modeled disturbances.

With the fixed effects (“within”) estimator, we do not compare levels of SWB between individuals but how the dependent variable changes as a result of a change in the independent variable. In ordinary (one-way) FE OLS, the treated individuals themselves act as their own control (Allison, 2009, p. 1). so that only individuals with such changes are used in the estimation of the coefficients, and other panel members do not contribute. Importantly, where an individual is observed multiple periods before and after the change, the fixed effects regression coefficient then captures the difference in average levels of the respective variables.

The TWFE estimator, in addition, allows us to account for potential age and period effects via time dummies (within estimation with a control group), which means that other individuals who do not experience a change in the independent variable are used as a control group to estimate time trends. Under the assumptions that there are parallel trends between the treatment and control groups, and that all relevant time-varying confounders are controlled for, that past outcomes may not influence treatment selection, and that lagged treatments may not influence current outcomes, the TWFE estimator yields a causal average effect on the treated.⁷

⁶ In the case of life satisfaction, it has been shown in countless applications that ordered probit models return ain the literature, both because the anchoring of the questions induces some linearity in response styles as well as their technical robustness regarding deviations from the related linearity assumption (for this, see, e.g., van Praag, 1991; Ferrer-i-Carbonell and Frijters, 2004).

⁷ ATT; cf. more extensively Allison, 2009; Bruederl, 2010; Hill et al., 2020.

4. Empirical results

4.1. Key Results: Main findings on relationships between income and PEB

Do income increases affect PEB? Table 1 presents the results of this analysis, which suggests a negative relationship between changes in income and PEBs. In general, an increase in (log) household net income (equivalized) is associated with a slight reduction in sustainability behaviors. This pattern is observed in both symbolic behaviors, such as expressing favorable attitudes towards sustainability, and in behaviors with a greater impact, including practical decisions related to energy (only marginally significant), mobility, or consumption.

Table 1. TWFE on the relationship between income and PEBs

	(1)	(2)	(3)	(4)	(5)	(6)
	PEB	Symbolic	Impactful	FA: Energy	FA: Mobility	FA: Shopping
HH net income equiv. (log)	-0.31*** (-4.31)	-0.11* (-2.40)	-0.18*** (-4.83)	-0.08+ (-1.95)	-0.14*** (-3.58)	-0.09** (-3.04)
No income reported (y/n)	-2.41* (-2.37)	-1.20# (-1.74)	-1.40** (-2.69)	-1.15* (-2.02)	-0.63 (-1.13)	-0.63 (-1.39)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Region and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	57355	57355	57355	57355	57355	57355
F-statistic	35.37	26.94	20.34	12.03	39.68	102.08
Degress of freedom	40438	40438	40438	40438	40438	40438
Adjusted R-squared	0.04	0.04	0.03	0.02	0.05	0.13
t statistics in parentheses						
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$						

While the magnitude of the effects is moderate, the trend is clear. Among the different dimensions, mobility is the area where the influence of income is most pronounced, suggesting that income improvements have a greater impact on daily transportation decisions than on attitudes or small gestures of environmental support. Conversely, the link with symbolic behaviors is weaker, indicating that income affects statements of environmental support less than it does practical decisions.

In terms of public policy, these results highlight that increasing incomes does not guarantee greater sustainability in individual behavior patterns. On the contrary, a moderate trend, towards a reduction in sustainable behaviors, is observed as disposable income increases. This implies that European policies aimed at sustainability must accompany economic growth with specific instruments, both economic incentives and regulatory and informational measures, that clearly guide consumption and mobility decisions towards more environmentally friendly options.

4.2. Key Results: Main findings on the relationship between PEB and SWB

In Table 2, we regress LS on our different PEB indices. Results here indicate a lack of relationship between PEB and LS for our sample. These results differ from some previous findings reported in previous literature, but it is important to emphasize that the present study employs a more robust methodology than most prior research: almost all studies establishing a connection come from cross-sectional observational data, with often much smaller sample sizes and often uncontrolled. Although Table A2 in Annex A shows a significant zero-order correlation between the two variables, this relationship disappears when a multivariate framework with appropriate controls is used. This suggests that the results in the previous literature may have been influenced by unobserved or time-invariant factors, thus weakening the validity of those conclusions.

Table 1: TWFE on the relationship between PEBs and SWB

	PEB DV: Life satisfaction		
	(1) PEB	(2) Symbolic/Impact	(3) Factor analysis
Sum index PEB	-0.00 (-0.39)		
Sum index PEB (simbolic)		- 0.00 (-0.77)	
Sum index PEB (impact)		- 0.00 (-0.31)	
Sum index PEB (shiopping)			-0.00 (-0.31)
Sum index PEB (mobility)			0.01 (1.32)
Sum index PEB (energy)			0.01+ (1.71)
Control variables (green self-image, Income, education, age)	Yes	Yes	Yes
Region and Year fixed effects	Yes	Yes	Yes
Observations	57355	57355	57355
F-static	11.99	11.51	11.17
Degrees of freedom	40438.00	40438.00	40438.00
Adjusted R-squared	0.02	0.02	0.02

t statics in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.001$, *** $p < 0.001$

4.3. Key Results: Sensitivity analyses

Working time

In addition to the income-PEB regressions, we also explored working time-PEB regressions. Working time can play a critical role in the relationship between income and PEBs. High-income societies tend to be characterized by long working hours alongside high consumption levels. In this regard, time pressure can foster unsustainable convenience consumption, while reductions in paid working time have been shown to reduce environmental pressures (Antal et al., 2020; Fitzgerald & Schor, 2023; Bartolini, 2025). However, the relationship is complex as working hours can influence PEBs both in a direct and indirect way, by shaping income levels and the amount of available free time. Comparative research suggests that societies with shorter average working weeks often report lower per-capita emissions (Knight et al., 2013), although leisure time can have a dual impact. On one hand, having more free time can help overcome barriers to time-demanding sustainable actions such as repairing, gardening, or

choosing slower but environmentally friendly transport options (Wynes et al., 2018). It can also encourage community participation, political engagement (Larson et al., 2015), and, when spent in nature, strengthen environmental values and promote spillover into broader PEBs (Whitburn et al., 2019). On the other hand, leisure may be resource-intensive. One can think here of long-distance travel or motorized sports, tendencies that are especially common when paired with higher incomes (Lenzen et al., 2018). Hence, the environmental implications of less working time may depend less on how much time is available than on the ways individuals choose to spend it.

Regressions in which we replace the income variable by a working hours variable are presented in Annex Table B1. Similarly to our income variable, we include dummy variables that account for reporting zero working hours. Our main findings support our findings regarding income and PEBs: more working time also translates into fewer PEBs. These findings suggest that channeling productivity gains into shorter working hours could be a strategy to promote PEBs.

Heterogeneity analysis

In our main findings, we observed that increases in income are associated with reductions in the execution of common PEBs. Although these declines are not particularly large, the results raise doubts about whether societal gains in productivity can translate into more pro-environmental action. Furthermore, our analysis provided no evidence that engaging more frequently in PEB would, in turn, enhance SWB.

These regression results provide averages and may hide heterogeneity in the relationships of interest. To that end, in this section, we provide further sensitivity tests for our results by checking whether there exist inequalities in the effects we have found with regard to gender, age, education, as well as with regard to the broader region of the UK the individuals live in. To do so, we consider the variables mentioned above to be moderators in the relationship between income and PEB (Annex Table B2), as well as PEB and SWB (Annex Table B3). This means that we interact our main independent variable in separate models with each of the moderators to see, for example, whether gender changes the relationship between income worked and PEB.

In the regressions analyzing the relationship between income and SWB, the joint F-tests for the interaction terms with the main variable were statistically significant. Nevertheless, almost none of the individual interaction terms reached conventional levels of statistical significance. Joint F-tests for the relationship between SWB and other variables did not show statistical significance, except for the regional moderator. For this model, a few regions exhibit significant moderation effects compared to the base category of the London region. However, the remaining moderation analyses do not yield statistically significant results. This means that our analysis does not provide any evidence that gender, age, or education moderate the main relationships of interest, whereas the evidence regarding the regional variable is inconsistent. While detecting interaction effects requires a considerably higher degree of statistical power to detect such interaction effects compared to main effects, the size of our sample provides some assurance that these non-significant results are not due to a lack of statistical power.

5. Discussion and Conclusion

In this report, we examined whether economic growth can simultaneously enhance well-being and sustainability. Increasingly, societies are questioning not only whether additional income translates into greater SWB, but also whether such income gains come at the expense of the natural environment and, by extension, the well-being of future generations. Our analysis specifically asked whether higher income fosters PEBs and whether these PEBs, in turn, enhance SWB, thereby creating what has been termed a “double dividend”. The existing literature provides mixed evidence for both income’s influence on PEBs and PEBs’ influence on SWB. To help clarify these relationships, we drew on rich household panel data from the UK and adopted a longitudinal perspective.

The empirical analysis identifies several improvements from current literature that lead to identification and results. First, we examined the relationship between income, PEBs, and SWB over an extended period using panel data. Combined with the use of DAGs, this approach provides a more robust test of these relationships, placing any causal interpretation on a firmer footing than simple cross-sectional studies allow.

Second, we integrated research on income and PEBs with the literature on PEBs and SWB, thereby testing the validity of the double dividend hypothesis, and we show that the existence of a double dividend in the UK is highly unlikely: income increases are associated with less PEB, particularly in resource-intensive domains such as energy and mobility. In addition, sensitivity analyses showed that reductions in working hours are associated with more PEB. However, even if societies were to reduce working hours while holding incomes constant, our analysis provides no evidence that increased PEB translates into gains in SWB, as measured by life satisfaction.

Third, we examined heterogeneity in PEBs. Given the mixed findings in the literature on income and PEBs, it might be the case that individuals with higher incomes engage in specific types of PEB. In this study, we compared PEBs related to energy, mobility, and shopping, as well as symbolic versus impactful PEBs. While the overall patterns are consistent across all types of PEBs, the effect sizes differ: symbolic PEBs are less affected than impactful PEBs, and mobility- and energy-related PEBs are generally more strongly influenced by income. Although all of our results reflect regression averages, our sensitivity analyses provided no evidence that moderators such as gender, age, or education moderate these relationships. The same holds for unobserved factors that could generate regional disparities across the UK.

Nevertheless, our study has several limitations. All analyses are based on self-reported behavior, as is much of the literature, and there is ample evidence that such reports have limited value in predicting actual behavior. Because all of our variables are self-reported, common-method variance is a concern. However, the differencing out of personality traits through the fixed-effects estimator helps address at least one source of such variance in self-reported attitude items. Respondents may also suffer from imperfect recall or exaggerate their past behaviors due to social desirability bias. Given the prominence of climate change in public discourse, some respondents may have felt pressured to portray themselves as ‘greener’ than they actually are, even though the survey was large-scale and anonymous.

We also cannot rule out measurement imprecision in some of the variables. For example, we rely on an ad hoc measure of green self-image that has not been validated, as the UKHLS does

not offer a better alternative. Similarly, multi-item measures of life satisfaction, which would be more reliable, were not included in the survey. Moreover, the eleven PEBs were selected somewhat ad hoc (cf. Poortinga, 2022). Due to the content of these items, our index of PEB is weighted heavily toward mobility-related actions, which are known to decrease with rising income. Other potentially PEBs might show different associations with our variables of interest.

Even though our analysis employed a rigorous approach to selecting control variables, it is possible that some relevant factors were not fully accounted for, which could introduce bias into our causal estimates. However, stable effects such as values, political preferences, or personality traits are likely to have been captured by the fixed effects models. This finding underscores the need to strengthen the evidence regarding causal relationships in the existing literature, which remains largely correlational, to better support evidence-based policymaking.

Even if we use a more robust selection of control variables, longitudinal analyses with fixed effects based on observational data may not fully address the issue of reverse causality. This limitation is further compounded by the fact that, although we have panel data spanning a long period, the main PEB variables were only measured at three distinct time points. As a result, short-term changes in our variables of interest may be overlooked. More generally, directed acyclic graphs (DAGs) assume the absence of cycles in causal relationships, which makes it difficult to incorporate reverse causality into this framework. Future research could explore the implementation of multi-period directed acyclic graphs to address this limitation and improve our understanding of causal relationships in panel data.

In sum, our results overall are somewhat sobering and challenges policy narratives that economic growth can jointly advance sustainability and well-being: we found that, in the UK, more income translates into less PEB, as does working more hours (while holding income constant) in our sensitivity analysis. This would suggest that one should use productivity gains to encourage working less if one would like to increase PEBs. But even when arguing that less time worked would mean more PEB, we have no evidence in our study that more PEB translates into higher SWB, i.e. the commonly argued “double dividend” will likely not materialize in the UK. This complements earlier research on the UK (Binder and Blankenberg, 2017, Binder et al., 2020b), as well as similar research findings for Germany (Binder et al., 2025), and it suggests, sadly, that when it comes to cutting down on harmful PEBs, there seems to be no free lunch.

From a public policy perspective, these findings have important implications for European policymakers. First, economic growth, as currently structured, could inadvertently hinder the adoption of behaviors critical to achieving environmental goals. Strategies aimed at reducing working hours could promote more sustainable behaviors without compromising incomes, but additional interventions are needed to ensure that these policies lead to a contribution to overall well-being. Second, policies should prioritize high-impact actions and combine regulatory, infrastructural, and behavioral measures to foster meaningful environmental change. Since the effects remain consistent across different demographic groups, systemic approaches are likely more effective than policies targeting specific groups.

In conclusion, achieving the dual goals of sustainability and well-being in Europe requires deliberate and integrated policies. Economic growth alone is insufficient; promoting sustainable behaviors and improving well-being requires coordinated interventions in labor markets, environmental infrastructure, behavioral incentives, and social policies. This

evidence underscores the need for comprehensive strategies that align economic, environmental, and social objectives, ensuring that the transition to a greener and more prosperous Europe benefits both current and future generations.

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ANNEX A. Variables and Summary Statistics

Measuring PEB

The UKHLS contains 11 questions on environmental behaviors, which were asked in only three survey waves: 2009/2010, 2012/2013, and 2018/2019. Respondents were instructed as follows:

"Now a few questions about the environment. Please look at this card and tell me how often you personally do each of the following things." The behaviors are:

1. Switch off lights in rooms that are not being used
2. Put on more clothes when feeling cold rather than turning on or up the heating
3. Decide not to buy something because it has too much packaging
4. Buy recycled paper products such as toilet paper or tissues
5. Take your own shopping bag when shopping
6. Use public transport (e.g., bus, train) instead of traveling by car
7. Walk or cycle for short journeys of less than 2 or 3 miles
8. Car share with others who need to make a similar journey
9. Take fewer flights when possible
10. Leave the TV on standby overnight
11. Keep the tap running while brushing your teeth

Responses were recorded on a 5-point Likert scale: 1 = "always," 2 = "very often," 3 = "quite often," 4 = "not very often," and 5 = "never," plus an additional category for "not applicable, cannot do this." For some items, the scale was reverse-coded in the questionnaire. For consistency, we recoded all items to range from 0 to 4, where higher values represent more frequent pro-environmental behavior and 0 indicates the respondent never performs the behavior. "Not applicable" responses were recoded as missing, ensuring that the mean values in Table 1 reflect the average behavior among respondents for whom the activity is applicable. Participation rates vary substantially across behaviors, with "taking fewer flights" being relatively uncommon and showing a high proportion of missing values.

Table A1: Summary statistics for the full sample

	Estimation Sample		
	Mean	Std. Deviation	Observations
Life satisfaction (SWB)	5.24	1.41	57355
Sum index PEB	20.03	6.28	57355
No. PEBs reported	11.00	0.00	57355
Sum index PEB (impact)	6.19	3.09	57355
Sum index PEB (symbolic)	13.04	4.19	57355
Sum index PEB (shopping)	5.08	2.62	57355
Sum index PEB (mobility)	4.62	3.22	57355
Sum index PEB (energy)	10.33	3.25	57355
EB: TV	2.26	1.78	57355
EB: lights	3.36	0.97	57355
EB: water	2.34	1.64	57355
EB: heating	2.37	1.26	57355
EB: packaging	0.79	1.00	57355
EB: recycled paper	1.48	1.29	57355
EB: shopping bags	2.81	1.44	57355
EB: public transport	1.19	1.27	57355
EB: short journeys	1.75	1.36	57355
EB: car share	0.88	1.16	57355
EB: fewer flights	0.79	1.26	57355
Green self-image (GSI)	1.68	0.85	57355
Log equivalent household net income: deflated	7.40	0.94	57355
No/negative hh equiv net income	0.00	0.06	57355
Education: Degree	0.28	0.45	57355
Education: Other higher degree	0.13	0.34	57355
A-level etc.	0.21	0.41	57355
GCSE etc.	0.20	0.40	57355
Other qualification	0.08	0.28	57355
Age	47.18	17.15	57355
Age ² /100	25.20	16.77	57355
Year: 2012/2023	0.36	0.48	57355
Year: 2018/2019	0.32	0.47	57355
Region: North East	0.04	0.18	57355
Region: North West	0.11	0.31	57355
Region: Yorkshire and the Humber	0.08	0.27	57355
Region: East Midlands	0.07	0.26	57355
Region: West Midlands	0.08	0.27	57355
Region: East of England	0.09	0.28	57355
Region: London	0.12	0.32	57355
Region: South East	0.13	0.34	57355
Region: South West	0.09	0.28	57355
Region: Wales	0.06	0.24	57355
Region: Scotland	0.09	0.28	57355
Region: Northern Ireland	0.06	0.24	57355
Female	0.54	0.50	57355

Measuring SWB

SWB is assessed using the question: “Please tick the number that best reflects how dissatisfied or satisfied you are with the following aspects of your current situation. Your life overall.” Responses are given on a 7-point Likert scale, ranging from 1 (“completely dissatisfied”) to 7 (“completely satisfied”). Despite their brevity, such single-item measures have been shown to be valid and reliable.⁸

Measuring income

For income, the analysis uses data on equivalized household net income and weekly working hours. To account for discontinuities at zero, a dummy variable indicating zero income is included. These variables capture the substantial differences between individuals with no income or employment—such as the unemployed, retirees, or students—and those with positive income.

Control variables

In addition to the main analysis variables, several personal and socio-demographic controls were included: age and age² (divided by 100), dummy variables for educational attainment (“1st degree,” “other higher degree,” “A-level etc.,” “GCSE etc.,” “other qualification,” with “none” as the reference category), as well as region and year dummies. Gender and personality traits are implicitly accounted for through the two-way fixed effects (TWFE) estimator, which differences out all time-invariant confounders.

For the life satisfaction analysis, we additionally controlled for green self-image (Binder et al., 2025), measured by the UKHLS item: “Which of these would you say best describes your current lifestyle?” Responses range from 1 (“I don’t really do anything environmentally friendly”) to 5 (“I’m environmentally friendly in everything I do”), with 1 serving as the reference category. Given its broad conceptual scope and relatively low correlation with specific pro-environmental behaviors, we interpret this variable as a proxy for self-image rather than a precise behavioral measure. Zero-order correlations for all control variables (Table 2) remain well below conventional thresholds for multicollinearity concerns.

⁸ Krueger & Schkade, 2008; Lucas, 2018

Table A2: Zero-order correlations for the full sample

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Life satisfaction	1.00					
(2) Sum index PEB	0.04*** (0.00)	1.00				
(3) Green self-image (GSI)	0.09*** (0.00)	0.30*** (0.00)	1.00			
(4) Log hh income	0.08*** (0.00)	-0.02*** (0.00)	0.00 (0.51)	1.00		
(5) Age	0.07*** (0.00)	0.04*** (0.00)	0.20*** (0.00)	0.02*** (0.00)	1.00	
(6) Highest education level	0.04*** (0.00)	-0.10*** (0.00)	-0.02*** (0.00)	-0.19*** (0.00)	0.24*** (0.00)	1.00
Standard errors in parentheses. ***p<0.001						

ANNEX B. Sensitivity Analyses

Table B1. Two-way fixed-effects model on the relationship between working hours and PEBs

	(1) PEB	(2) Symbolic	(3) Impactful	(4) FA: Energy	(5) FA: Mobility	(6) FA: Shopping
Hours worked (log)	-0.34*** (-3.75)	-0.11+ (-1.84)	-0.21*** (-4.12)	-0.12* (-2.56)	-0.22*** (-4.25)	-0.09** (-2.18)
No hours worked (y/n)	-1.16* (-2.31)	-0.38 (-1.11)	-0.75** (-2.64)	-0.55* (-2.03)	-0.75** (-2.62)	-0.34 (-1.58)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Region and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	57355	57355	57355	57355	57355	57355
F-statistic	34.34	25.30	21.26	12.67	43.53	100.05
Degrees of freedom	40438	40438	40438	40438	40438	40438
Adjusted R-squared	0.04	0.04	0.03	0.02	0.05	0.12

t statistics in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In the following tables, Table 5, Table 6, and Table 7 present a moderation analysis for the relationship between worker hours, income, or life satisfaction, respectively, and PEBs. Each column introduces a separate moderator (gender, age, education, UK regions). A horizontal line separates the indicators for interaction for better readability. Source: UKHLS data set. Source: UKHLS data set.

Table B2: Heterogeneity Analysis on the Relationship between Income and PEBs

	(1) Gender		(2) Age		(3) Education		(4) Region	
HH net income equiv. (log)	- 0.27**	(-3.20)	-0.56***	(-3.57)	-0.013	(-0.93)	-0.22*	(-1.69)
No income reported (y/n)	- 2.37*	(-2.34)	-2.64***	(-2.59)	-2.30*	(-2.30)	-2.29*	(-2.19)
Female (y/n)=1	- 4.67*	(-2.16)						
Female (y/n)=1 X Hours worked (log)	-0.08	(-0.91)						
Age	-0.05	(-1.14)	-0.21	(-1.51)	-0.09	(-0.66)	-0.10	(-0.67)
Age ² /100	0.03***	(4.86)			-0.08**	(-2.94)	-0.08**	(-2.94)
HH net income equiv. (log) X Age			0.001*	(1.92)				
Degree					0.38	(1.18)		
Other higher degree					2.11	(1.56)		
A-level etc					2.92*	(2.28)		
GCSE etc					1.50	(1.18)		
Other qualification					1.97	(1.44)		
Degree X HH net income equiv. (log)					-0.15	(-1.14)		
Other higher degree X HH net income equiv. (log)					-0.17	(-1.08)		
A-level etc X HH net income equiv. (log)					-0.28*	(-1.78)		
GCSE etc X HH net income equiv. (log)					-0.19	(-1.23)		
Other qualification X HH net income equiv. (log)					-0.21	(-1.21)		
North East							-2.68	(-1.24)
North West							1.89	(1.27)
Yorkshire and the Humber							-0.60	(-0.38)
East Midlands							-1.13	(-0.55)
West Midlands							0.41	(0.20)
East of England							-1.40	(-0.95)
South East							-0.55	(-0.43)
South West							0.24	(0.17)
Wales							0.82	(0.38)
Scotland							-1.42	(-0.92)
Northern Ireland							0.49	(0.26)
North East X HH net income equiv. (log)							0.07	(0.31)
North West X HH net income equiv. (log)							-0.24	(-1.41)
Yorkshire and the Humber HH net income equiv. (log)							-0.06	(-0.35)
East Midlands X HH net income equiv. (log)							-0.05	(-0.19)
West Midlands X HH net income equiv. (log)							-0.19	(-0.72)
East of England X HH net income equiv. (log)							-0.05	(0.29)
South East X HH net income equiv. (log)							0.02	(-0.13)
South West X HH net income equiv. (log)							0.017	(-0.99)
Wales X HH net income equiv. (log)							0.23	(-0.89)
Scotland X HH net income equiv. (log)							-0.11	(-0.65)
Northern Ireland X HH net income equiv. (log)							-0.15	(-0.97)
Control variables (education, age)	Yes		Yes		Yes		Yes	
Region and Year fixed effects	Yes		Yes		Yes		Yes	
Observations	57355		57355		57355		57355	
F-statistic	32.68		35.15		28.97		23.93	
Degrees of freedom	40438.00		40438.00		40438.00		40438.00	
Adjusted R-squared	0.04		0.04		0.04		0.04	

t statistic in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.001$, *** $p < 0.001$

Table B3: Heterogeneity Analysis on the Relationship between PEBs and Life Satisfaction

	(1) Gender		(2) Age		(3) Education		(4) Region	
Sum index PEB	0.00	(-0.18)	-0.01	(1.56)	0.01	(0.59)	0.01*	(1.70)
Female (y/n)=1	1.20	(1.34)						
Female (y/n)=1 X Hours worked (log)	0.00	(-0.08)						
Age	-0.05	(-1.14)	-0.02	(-0.41)	-0.05	(-1.14)	-0.05	(-1.21)
Age ² /100	0.03***	(4.86)			0.03*	**	-0.03***	(4.90)
Sum index PEB X Age			0.00	(1.50)				
Degree					-0.05	(-0.18)		
Other higher degree					0.22	(0.79)		
A-level etc					0.05	(0.18)		
GCSE etc					0.01	(0.05)		
Other qualification					-0.29	(-1.11)		
Degree X Sum index PEB					-0.00	(-0.44)		
Other higher degree X Sum index PEB					-0.02	(-1.43)		
A-level etc X Sum index PEB					-0.01	(-0.83)		
GCSE etc X Sum index PEB					-0.01	(-0.67)		
Other qualification X Sum index PEB					-0.00	(0.17)		
North East							0.37	(0.94)
North West							0.40	(1.39)
Yorkshire and the Humber							0.36	(1.18)
East Midlands							0.44	(1.56)
West Midlands							-0.63*	(2.23)
East of England							0.45*	(1.73)
South East							0.19	(0.79)
South West							0.32	(1.19)
Wales							0.68*	(2.08)
Scotland							0.09	(0.25)
Northern Ireland							1.55***	(3.90)
North East X Sum index PEB							0.00	(0.25)
North West X Sum index PEB							-0.01	(-0.80)
Yorkshire and the Humber X Sum index PEB							-0.01	(-1.36)
East Midlands X Sum index PEB							-0.02	(-1.40)
West Midlands X Sum index PEB							-0.02*	(-2.16)
East of England X Sum index PEB							-0.02*	(-2.04)
South East X Sum index PEB							0.01	(-1.04)
South West X Sum index PEB							0.01	(-1.08)
Wales X Sum index PEB							-0.03*	(2.43)
Scotland X Sum index PEB							-0.01	(-0.67)
Northern Ireland X Sum index PEB							0.00	(0.17)
Control variables (green self-image, education, income, age)	Yes		Yes		Yes		Yes	
Region and Year fixed effects	Yes		Yes		Yes		Yes	
Observations	57355		57355		57355		57355	
F-statistic	11.13		11.13		11.13		11.13	
Degrees of freedom	40438.00		40438.00		40438.00		40438.00	
Adjusted R-squared	0.04		0.05		0.06		0.07	

t statistic in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.001$, *** $p < 0.001$