Happiness *versus* the Environment—A Case Study of Australian Lifestyles

Appendix A: Methodology—Technical Details

A1. Environmental Impact Calculus

Households' environmental impacts are obtained from raw data according to standardised input-output calculations. Let the satellite accounts be arranged in a $M \times N$ matrix $\mathbf{Q}$, with each element Q_{ij} representing the environmental intervention (emission, resource use, disturbance *etc.*) in terms of indicator i of industrial sector j. In our case, $\mathbf{Q}$ holds $M = 4$ environmental indicators, and $N = 8 \times 344 = 2752$ industrial sectors of the Australian economy, or 344 for each of the eight Australian States and Territories. (NSW = New South Wales, Vic = Victoria, Qld = Queensland, SA = South Australia, WA = Western Australia, Tas = Tasmania, NT = Northern Territory, ACT = Australian Capital Territory.) Emissions are measured in t CO_2-e = tonnes of carbon dioxide equivalent, water use in GL = Gigalitres = 10^9 litres, material flow in t = tonnes, and land disturbance in ha = hectares, so that the units of elements in $\mathbf{Q}$ are {t CO_2-e, GL, t, ha}. (For further information see ISA 2010 [1].) Let $\mathbf{T}$ be a $N \times N$ domestic input-output table of the Australian economy, with $N = 8 \times 344$ industry sectors [2]. Let $\mathbf{y}$ be a $N \times S$ vector constructed from the HES, holding expenditures on 344 commodities, of $S = 1563$ household samples in 8 States. The units of elements in $\mathbf{T}$ and $\mathbf{y}$ are Australian Dollars (AU\$). Then,

$$\mathbf{E} = \mathbf{Q}(\widehat{\mathbf{T1}+\mathbf{y}})\left(\mathbf{I} - \mathbf{T}(\widehat{\mathbf{T1}+\mathbf{y}})^{-1}\right)^{-1}\mathbf{y} = \mathbf{Q}\hat{\mathbf{x}}^{-1}(\mathbf{I} - \mathbf{T}\hat{\mathbf{x}}^{-1})^{-1}\mathbf{y} = \mathbf{q}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} = \mathbf{my} \qquad \text{(A1.1)}$$

is a $M \times S$ vector of total environmental impact, with elements E_{ik} representing the environmental impact of household sample k in terms of environmental indicator i. In Equation A1.1, $\mathbf{I}$ is a $N \times N$ identity matrix with $I_{ij} = 1$ if $i = j$ and $I_{ij} = 0$ if $i \neq j$. $\hat{\mathbf{x}}$ is a diagonal matrix of gross output $\mathbf{x} = \mathbf{T1} + \mathbf{y}$, with $\mathbf{1} = \{1,...,1\}^t$ being the transposed summation operator. $\mathbf{q}$ contains so-called environmental intensities measuring for each industry sector j its environmental impact q_{ij} in terms of indicator i, per unit of its gross output. $\mathbf{A}$ is called the direct requirements matrix holding the domestic industrial production recipe. Each element A_{ij} measures the input of industry i's output into production of industry j, per unit of j's gross output. The units of elements in $\mathbf{E}$ are {t CO_2-e, GL, t, ha}. The $M \times N$ matrix $\mathbf{m} = \mathbf{Q}(\mathbf{I} - \mathbf{A})^{-1}$ contains so-called environmental multipliers. Each element m_{ij} represents the total (that is life-cycle, or supply-chain) environmental impact in terms if indicator i, associated with the final purchase of a dollar unit of commodity j. (We have added direct effects such as emissions from burning natural gas or town gas in the house, or petrol in the private car, to the indirect supply-chain effects in $\mathbf{q}$.) Since $\mathbf{T}$ is a domestic input-output table, $\mathbf{m}$ excludes environmental impacts occurring overseas during the production of imports into Australia. The units of elements in $\mathbf{m}$ are {t CO_2-e/AU\$, GL/AU\$, t/AU\$, ha/AU\$}.

A2. Concordances Used for Matching Explanatory Variables

Table A2.1. AUWS variables used to match HES variables.

HES variable	AUWS variables used to construct match to HES variable										
Inc	income	houseinc									
size	alone	partner	house	house2	housemem						
age	age	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10
emp	work	workpt									
pop	postcode										
qual	edulevl	educat	educode								
Ten	home	rent	mort								
born	cob	ctzshp	ethnic								
Car	car										
NSW	postcode	loc	state								
VIC	postcode	loc	state								
QLD	postcode	loc	state								
WA	postcode	loc	state								
SA	postcode	loc	state								
TAS	postcode	loc	state								
NT	postcode	loc	state								
ACT	postcode	loc	state								

Table A2.2. Definition of qualification indices (A2.2a), and correspondence between AUWS and HES indices (A2.2b).

A2a		**A2b**					
HES variable	**index**	**AUWS** ***educode***	**HES**	**AUWS** ***edulvl***	**HES**	**AUWS** ***educat***	**HES**
Postgraduate Degree	5	1	0	1	0	0	0
Graduate Diploma and Graduate Certificate	4	2	0	2	1	1	0
Bachelor Degree	3	3	0	3	3.5	2	1.5
Advanced Diploma and Diploma	2	4	1	4	5	3	4
Certificate	1	5	2				
		6	4				

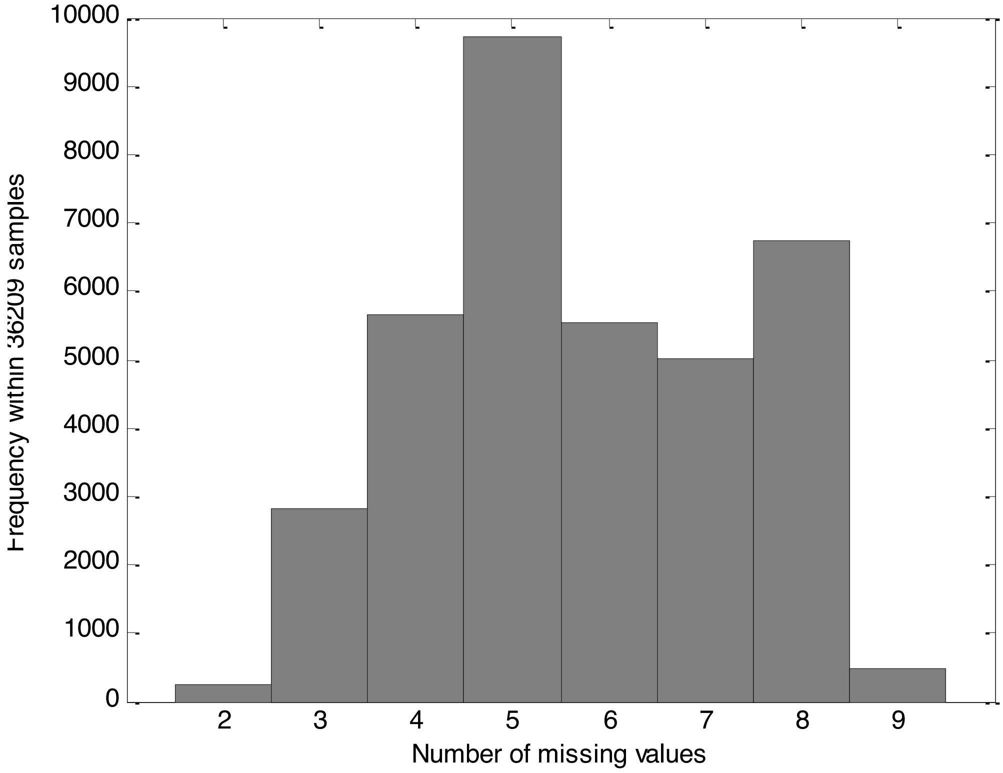
Table A2.3. Definition of tenure type indices (A2.3a), and correspondence between AUWS and HES indices (A2.3b).

A3a		**A3b**					
HES variable	**index**	**AUWS** ***mort***	**HES**	**AUWS** ***rent***	**HES**	**AUWS** ***home***	**HES**
Owners without a mortgage	5	1	4	1	2.5	1	2.5
Owners with a mortgage	4	2	-	2	4.5	2	4
Renters from state or territory housing authority	2					3	5
Renters-other	3						
Other	1						

A3. Dealing with Missing Information

The AUWS is incomplete in a way that there is not a single one amongst the 36,209 samples where all 17 variables are observed (Figure A3.1). This means that a so-called complete-case analysis, where samples afflicted by missing data are simply discarded, was not possible. Similarly, the limited overlap of available cases between variables meant that we were unable to impute missing values for each variable (for example by linear regression) based on the remaining variables. We also did not replace missing values by the mean of existing observations (so-called mean imputation), because of the bias and overstated precision associated with this method [3].

Figure A3.1. Frequency of missing values in the AUWS. In most samples, information is missing on between 4 and 8 variables. None of these variables is a State dummy variable.



Next, we checked the possibility of undertaking a so-called available-case analysis, where both the suite of explanatory variables and the sample population is reduced in order to yield the explanatory variable set with the largest amount of available data [3]. The optimum choice includes 13 variables and 8,611 samples (Table A3.1). Reducing our population to this set would have meant excluding “Qualification”, “Tenure type”, “Migrants” and “Car ownership”, as well as reducing the sample population to a quarter of its original size. We therefore did not follow this approach, however we used available-case analyses in order to test the robustness of our regressions (see Appendix D).

Table A3.1. Analysis of the set of explanatory variables with the largest amount of available data.

	Top-ranked set	2nd–ranked set	3rd–ranked set
Available data (% of total AUWS)	25.5%	15.1%	12.1%
Number of samples	8611	6638	4430
Number of variables	13	10	12
Variables	Median age Household size Income Household members employed Population density 8 State dummies	Median age Population density 8 State dummies	Median age Household size Income Population density 8 State dummies

We therefore substituted missing ABWS and HES data with information from the Australian Census (Table A3.2).

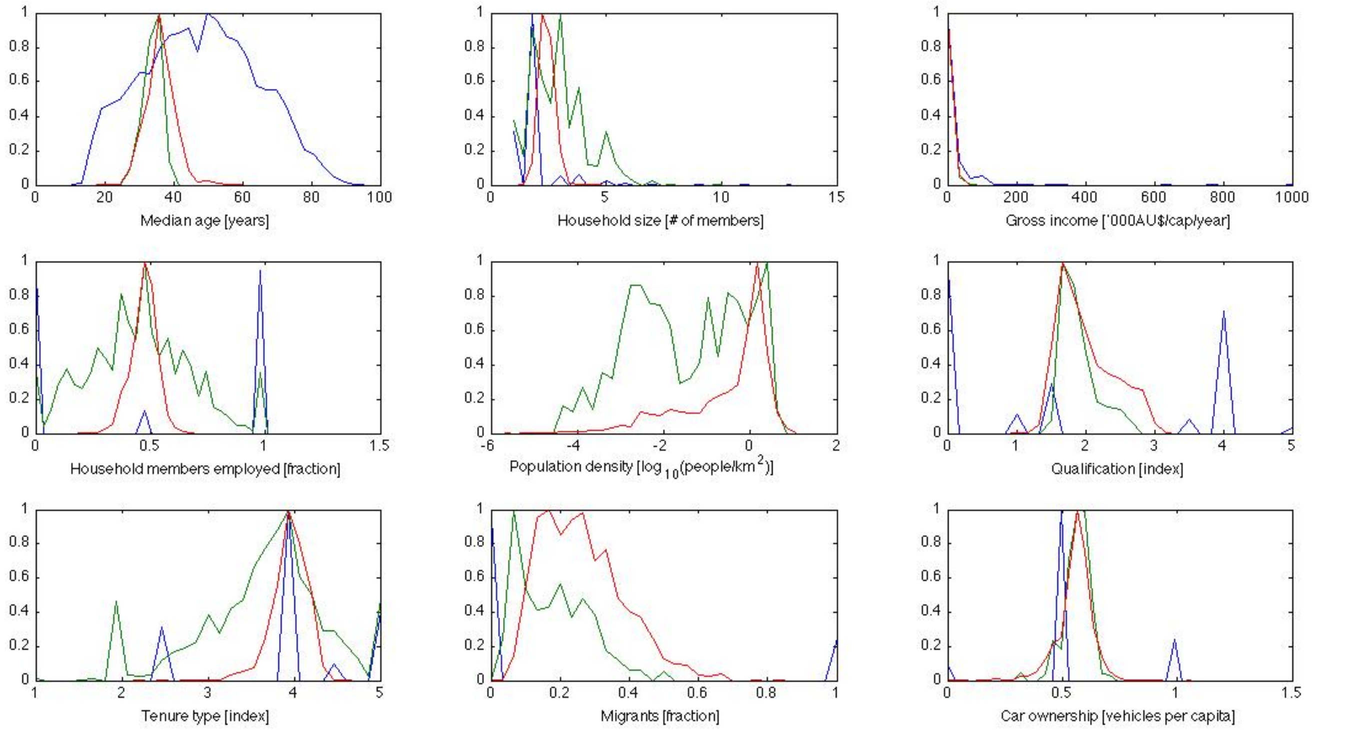
Table A3.2. Census data used for populating missing AUWS and HES data.

Cover sheet: Area	B32: Fully owned	B39: Postgraduate Degree
Postcode	B32: Being purchased	B39: Graduate Diploma and Graduate Certificate
B01: Total persons	B32: Real estate agent	B39: Bachelor Degree
B02: Median age of persons	B32: State or territory housing authority	B39: Advanced Diploma and Diploma
B02: Average household size	B32: Person not in same household	B39: Certificate, Total
B02: Median household income ($/weekly)	B32: Housing co- operative /community/church group	B41: Total labour force male
B09: Australia, Persons	B32: Other landlord type	B41: Total labour force female
B29: None	B32: Landlord type not stated	
B29: 1 motor vehicle	B32: Other tenure type	
B29: 2 motor vehicles	B32: Fully owned	
B29: 3 motor vehicles	B32: Being purchased	
B29: 4 or more motor vehicles		

Appendix B: Raw Sample Characteristics

The raw AUWS data are unpublished, but the single-household samples were available to the authors. Because of confidentiality requirements, the published HES and Census data are aggregates over many households. This leads to the AUWS explanatory variables often spreading over a much wider range than the HES and Census explanatory variables (Figure B.1).

Figure B.1. Normalised frequency distributions of explanatory variables (raw data). Blue: AUWS, before filling in of missing data; green: HES; red: Census. This is different to Figure1, where the data were aggregated into random groups of 50 respondents to plot the frequency distributions.



Appendix C: Multiple Regression Theory and Detailed Results

C.1. Theory

A multiple regression analysis decomposes an explained variable y into contributions of explanatory variables $\{x_i\}$. In order to narrow down the functional specifications linking SWB to the variables listed in Table 1, we first tested whether these can be derived from normal or log-normal distributions. Whilst Jarque-Bera and Lilliefors tests failed on all variables, normal and log-normal fitting yielded useful results in that for most variables the relative standard deviations of the fitted μ and σ parameters (all below 15%), as well as the distribution skewness, pointed unanimously to either normality or log-normality. More specifically, the smaller standard deviations of the fitted μ and σ, and a skewness close to 0 was found for normal age, employment status, qualification, tenure type, and car ownership, and for log-normal emissions, household size, gross income, population density, and migrant status. These findings agree well with visual examination of the distributions in Figure 1. SWB could equally well be represented by normal or log-normal distributions, although log-normal fit parameters were associated with lower standard deviations. As a result of these observations, we proceed with linear functional specifications linking logged or un-logged SWB and emissions, with logged or unlogged explanatory variables. This strategy also agrees with previous approaches documented in the literature.

Perhaps the most simple specification is $y = \sum_i \beta_i x_i$, where the regression coefficients $\beta_i = \frac{\partial y}{\partial x_i}$ describe the absolute change in the explained variable as a result of absolute changes in the explanatory variables. (This specification includes a constant term β_0 if we set x_0 to $\{1,...,1\}$.) Brereton *et al.* [4], for example, use this formulation to explain subjective wellbeing as a function of age, education, employment status, population density, and tenure type, amongst other geographic variables. A general formulation for additive specifications is $y = \sum_i \beta_i f(x_i)$, and in this work we explore the form $y = \sum_i \beta_i \ln(x_i)$, where $\frac{\partial y}{\partial x_i} = \frac{\beta_i}{x_i}$, and the $\beta_i = \frac{\partial y}{\partial x_i / x_i}$describe the absolute change in y as a result of percentage changes $\partial x_i / x_i$ in the x_i. Stutzer and Brereton *et al.* [4,5], for example, use this formulation to explain subjective wellbeing as a function of income.

The literature on environmental impacts of households (for example Wier *et al.* 2001; Lenzen *et al.* 2004; Cohen *et al.* 2005; Lenzen *et al.* 2006) [6–9]) often mention a specification where the explained variable is logged, for example $\ln(y) = \sum_i \beta_i x_i$. Here, $\frac{\partial y}{\partial x_i} = \beta_i \prod_i e^{\beta_i x_i} = \beta_i y$, so that the $\beta_i = \frac{\partial y / y}{\partial x_i}$ describe a percentage change in y as a result of absolute changes in the x_i . Finally, the specification $\ln(y) = \sum_i \beta_i \ln(x_i)$ is used for income variables because $y = \prod_i {x_i}^{\beta_i}$ so that $\frac{\partial y}{\partial x_i} = \beta_i {x_i}^{(\beta_i - 1)} \prod_{j \neq i} {x_j}^{\beta_j} = \frac{\beta_i}{x_i} y$. This leads to $\beta_i = \frac{\partial y / y}{\partial x_i / x_i}$ assuming the well-known elasticity form, where a percentage change in y is the result of percentage changes in the x_i.

Logarithmic specifications are characterised by diminishing sensitivity of changes as variable values increase. Such behaviour has an intuitive explanation. For example, receiving a $1,000 pay rise at a salary of $20,000 leads to larger changes in consumer behaviour than receiving the same pay rise at a salary of $50,000. Similarly, ageing 5 years at the age of 20 may change behaviour more than ageing the same amount at the age of 50. Or, adding one more member to a 2-person household requires more changes in the house than adding one more member to a 5-person household. Therefore, we experiment with logged specifications for the variables *inc*, *age*, *size*, and *born*. We also a trial logarithmic specification for the population density variable because this variable—unlike all others—spans several orders of magnitude, and a logarithmic specification is able to even out differences in magnitude across the explanatory variables.

A well-known issue in multiple regression is (multi-)collinearity: If two or more explanatory variables are highly correlated, they "lose" their explanatory power to each other during the multiple regression, that is their regression coefficients are smaller and less significant than they would be in the absence of correlated variables. It may even be that signs of regression coefficients switch under exclusion of correlated variables from the regression. Most importantly, under collinearity, regression results do not allow the unambiguous interpretation of variables with regard to their power and significance in explaining the regressed variable. Therefore, it is common practice to exclude from the suite of explanatory variables those that are strongly correlated. To this end, we computed a matrix of pairwise Pearson's linear correlation coefficients ρ for all explanatory variables in the AUWS and HES sets (Table C.0).

Table C.0. Matrix of pair-wise Pearson's linear correlation coefficients ρ for all explanatory variables in the HES data set. Bold font: $|\rho|>0.6$, regular: $0.6\geq|\rho|>0.4$, grey italic: $0.4\geq|\rho|$. State dummies are not shown because $|\rho| < 0.1$ for these variables.

	age	***size***	***inc***	***empl***	***pop***	***qual***	***ten***	***born***
size	*−0.05*							
inc	*−0.10*	*−0.17*						
empl	*−0.07*	*0.01*	**0.70**					
pop	*−0.04*	*−0.01*	*0.18*	*0.07*				
qual	*−0.06*	*−0.02*	*0.22*	*0.09*	**0.75**			
ten	*0.13*	*0.10*	*0.01*	*0.03*	*−0.05*	*−0.06*		
born	*−0.28*	*0.05*	*0.14*	*0.03*	**0.68**	0.55	*0.04*	
car	0.48	*−0.08*	*−0.12*	*−0.07*	−0.41	*−0.24*	*0.08*	−0.44

We compared the signs of the correlation coefficients for both sets, and found that for all coefficients with $|\rho| > 0.1$, the signs of the AUWS and HES correlation matrix elements coincide. This indicates that we were reasonably successful in matching the definitions of the explanatory variables we constructed. For all variables in the AUWS data set, as well as for all state dummies we found that $|\rho| < 0.5$, and hence these coefficients are not shown in Table 2. We found three instances of strongly correlated variables. First, 'Income' and 'Employment status' are positively correlated for the obvious reason that workers earn money. Second, 'Population density', 'Qualification' and 'Migrants' are positively correlated amongst each other, indicating that high proportions of highly qualified people born overseas can predominantly be found in urban centres. As a consequence, we chose to exclude 'Employment status', and either 'Population density', 'Qualification' or 'Migrants', from the suite of 17. For the three reduced 15-variable sets, we evaluated the following multiple regression specifications:

$$\left.\begin{array}{ll}(C.1) & SWB \\ (C.2) & \ln(SWB) \\ (C.3) & E \\ (C.4) & \ln(E)\end{array}\right\} = \begin{cases} \beta_0 + \beta_1 age + \beta_2 size + \beta_3 inc + \beta_4 pqb + \beta_5 pqb + \beta_6 ten + \beta_7 car + \boldsymbol{\Sigma}_{i=1}^{7} \beta_{i+7} state_i & \text{(a)} \\ \beta_0 + \beta_1 \ln(age) + \beta_2 size + \beta_3 inc + \beta_4 pqb + \beta_5 pqb + \beta_6 ten + \beta_7 car + \boldsymbol{\Sigma}_{i=1}^{7} \beta_{i+7} state_i & \text{(b)} \\ \beta_0 + \beta_1 age + \beta_2 \ln(size) + \beta_3 inc + \beta_4 pqb + \beta_5 pqb + \beta_6 ten + \beta_7 car + \boldsymbol{\Sigma}_{i=1}^{7} \beta_{i+7} state_i & \text{(c)} \\ \beta_0 + \beta_1 age + \beta_2 size + \beta_3 \ln(inc) + \beta_4 pqb + \beta_5 pqb + \beta_6 ten + \beta_7 car + \boldsymbol{\Sigma}_{i=1}^{7} \beta_{i+7} state_i & \text{(d)} \\ \beta_0 + \beta_1 age + \beta_2 size + \beta_3 inc + \beta_4 \ln(pop) + \beta_5 qb + \beta_6 ten + \beta_7 car + \boldsymbol{\Sigma}_{i=1}^{7} \beta_{i+7} state_i & \text{(e)} \end{cases}$$

where $\beta_4 pqb + \beta_5 pqb$ denotes either $\beta_4 pop + \beta_5 qual$, $\beta_4 pop + \beta_5 born$, or $\beta_4 qual + \beta_5 born$, and where $\beta_5 qb$ denotes either $\beta_5 qual$ or $\beta_5 born$. Note that the specifications in Equations (1–4) only include dummy variables for 7 of the 8 States and Territories (the ACT is excluded). This is once again due to having to avoid multi-collinearity: Since all $state$ dummies add up to β_0, we can either include 7 dummies and the constant β_0, or include all 8 dummies but exclude β_0. The choice between the two options has no effect on the results, except that in the first option, β_0 represents a "baseline" and the dummies measure the deviation from this baseline, whilst in the second option, the dummies represent 8 State-specific baselines. We chose the first option for better comparability.

In total, we carried out 60 multiple regressions: five regression specifications, for three options of excluding two of three correlated variables, for four explained variables. For example, Equation 4d is the well-known regression specification where β_3 is the income-elasticity of environmental impact. We applied Weighted Least Squares (WLS) to both data sets. The AUWS contains only single-household samples with the same variance, so that the AUWS set of variables can be considered homoskedastic, and all WLS weights are equal. However, our HES dataset consists of a 0.1% sample of the Australian population, parsed three times, once into income percentiles, once into family types, and once into SDs, of which the urban SDs are represented once more as SSDs. The income percentile and family type samples are by far the largest, and the rural SDs the smallest samples, yet there are many rural SDs and it is in these that much of the socio-economic-demographic variation occurs, such as population density, car ownership, qualification *etc*. As a consequence, HES sample sizes vary between 10 and 1723 households, and heteroskedasticity is likely. We used the square root of sample sizes as our WLS weights, weighted both explained and explanatory variables, and applied Ordinary Least Squares to the transformed data sets.

It is accepted practice in regression exercises to report on the statistical significance of the regression coefficients. Therefore we carried out a Student's t test on every regression coefficient, and examined the null hypothesis that these coefficients are not different from zero. For each regression coefficient we then report the t statistics and the level of confidence at which the coefficient is different from zero. (Obviously, the significance of explanatory variable measured by the Student's t test is based on survey data alone. There exists the possibility that the some survey data align by coincidence, and that as a result, in reality explanatory variables may not be significant, and corresponding β values not different from 0.) Finally, we report the R^2 coefficient of determination, which is a measure of the overall explanatory power of the specification to explain the variance of the explained variable.

C.2. Interpretation of Results

Multiple regressions yield a wealth of information. The sign of the regression coefficients tell whether the explanatory variables act as retardants or as accelerators for the explained variable. The values of the regression coefficients tell the strength of the influence. The *t* test yields whether the relationships are significant, that is statistically distinct from a lack of connection between explanatory and explained variables. The level of confidence (90%, 95%, and 99%) tells what the chances are (10%, 5%, and 1%, respectively) that, even though the results show a relationship, there is in reality no connection.

The different regression forms provide for different interpretations of the relationships. Take for example greenhouse gas emissions and income (Table C.2a): In Equations C.3a, C.3b, C.3c and C.3e, β_3 describes the change in per-capita tonnes of CO_2-equivalent emissions (0.36 t CO_2-e) that would result from a AU$1000 increase in income. In Equation C.3d, β_3 describes the change in per-capita tonnes of CO_2-equivalent emissions (4.5 t CO_2-e) that would result from a 100% increase (doubling) in income. In Equations C.4a, C.4b, C.4c and C.4e, β_3 describes the percentage change in per-capita tonnes of CO_2-equivalent emissions (2%) that would result from a AU$1000 increase in income. In Equation C.4d, β_3 describes the change in per-capita tonnes of CO_2-equivalent emissions (29%) that would result from a 100% increase (doubling) in income (the "income-elasticity of emissions"). These four results are in good agreement: 0.36 t CO_2-e are indeed about 2% of total emissions (about 18 t CO_2-e/cap), and 4.5 t CO_2-e are about 29% of total emissions.

Table C **1a.** Regression coefficients β_i for the AUWS data set x_i, obtained from regressions $SWB = f(\beta_i, x_i)$ according to Equations 1 and 2. Listed are the mean ± standard deviation over 3 regressions with *empl* and either *pop*, *qual* and *born* excluded. Detailed results are listed in Appendix C. *** significantly different from zero at the 99% level of confidence, ** 95%, * 90%, grey font: significance below 90%. Units of coefficients can be read from column 2 and row 2. For example the unit of the coefficient for Equation 1d and the variable *size* is change in *SWB* points per unit change in the number of household members. Grey background indicates a percentage change in the explanatory variable. For example the unit of the coefficient for Equation 2d and the variable *inc* is the percentage change in *SWB* points per percentage change in per-capita income.

Equation		***Age***	***size***	***inc***	***pop***	***qual***	***ten***	***born***	***Car***
	Units	/year	/member	/AU$1k	/('000/km^2)	/index point	/index point	/%	/vehicle
1a	*SWB* points/	0.08 ± 0.001 ***	1.23 ± 0.012 ***	0.06 ± 0.002 ***	−0.4 ± 0.12 ***	0.4 ± 0.18 ***	2.6 ± 0.12 ***	−1.7 ± 0.47 ***	−0.9 ± 0.73 ***
1b	*SWB* points/	2.9 ± 0.03 ***	1.10 ± 0.012 ***	0.05 ± 0.002 ***	−0.4 ± 0.12 ***	0.4 ± 0.17 ***	2.7 ± 0.12 ***	−1.7 ± 0.47 ***	−0.8 ± 0.72 **
1c	*SWB* points/	0.09 ± 0.001 ***	3.6 ± 0.04 ***	0.06 ± 0.001 ***	−0.3 ± 0.12 ***	0.4 ± 0.15 ***	2.5 ± 0.11 ***	−1.7 ± 0.43 ***	−0.3 ± 0.65
1d	*SWB* points/	0.09 ± 0.000 ***	1.45 ± 0.004 ***	2.4 ± 0.07 ***	−0.4 ± 0.09 ***	0.2 ± 0.18 ***	2.6 ± 0.13 ***	−1.8 ± 0.46 ***	−1.2 ± 0.81 ***
1e	*SWB* points/	0.08 ± 0.000 ***	1.26 ± 0.016 ***	0.06 ± 0.002 ***	−0.3 ± 0.06 ***	0.4 ± 0.18 ***	2.6 ± 0.08 ***	−1.6 ± 0.62 ***	−0.8 ± 0.66 **
2a	% *SWB*/	0.12 ± 0.001 ***	2.06 ± 0.014 ***	0.09 ± 0.002 ***	−0.4 ± 0.18 ***	0.7 ± 0.20 ***	4.2 ± 0.14 ***	−2.4 ± 0.59 ***	−0.6 ± 0.82
2b	% *SWB*/	4.0 ± 0.04 ***	1.84 ± 0.015 ***	0.08 ± 0.002 ***	−0.4 ± 0.18 ***	0.7 ± 0.19 ***	4.4 ± 0.14 ***	−2.3 ± 0.59 ***	−0.5 ± 0.81
2c	% *SWB*/	0.13 ± 0.001 ***	6.0 ± 0.04 ***	0.09 ± 0.002 ***	−0.3 ± 0.17 ***	0.7 ± 0.16 ***	4.0 ± 0.11 ***	−2.4 ± 0.52 ***	0.3 ± 0.68
2d	% *SWB*/	0.13 ± 0.001 ***	2.43 ± 0.004 ***	3.8 ± 0.09 ***	−0.5 ± 0.14 ***	0.4 ± 0.21 ***	4.1 ± 0.16 ***	−2.5 ± 0.57 ***	−1.2 ± 0.95 **
2e	% *SWB*/	0.12 ± 0.000 ***	2.09 ± 0.022 ***	0.09 ± 0.002 ***	−0.3 ± 0.08 ***	0.7 ± 0.22 ***	4.2 ± 0.09 ***	−2.2 ± 0.81 ***	−0.6 ± 0.82

Table C.1b. Table C.1a continued.

Equation	Units	*NSW*	*Vic*	*Qld*	*WA*	*SA*	*Tas*	*NT*	β_0
		/move	/move	/move	/move	/move	/move	/move	
1a	*SWB* points/	−0.1 ± 0.18	0.6 ± 0.17 ***	0.9 ± 0.12 ***	−0.2 ± 0.04	0.6 ± 0.17 ***	−0.1 ± 0.15	2.2 ± 0.14 ***	56 ± 1.1 ***
1b	*SWB* points/	−0.1 ± 0.18	0.6 ± 0.17 ***	0.9 ± 0.12 ***	−0.2 ± 0.04	0.5 ± 0.17 ***	−0.1 ± 0.15	2.1 ± 0.14 ***	49 ± 1.2 ***
1c	*SWB* points/	−0.1 ± 0.16	0.6 ± 0.15 ***	0.9 ± 0.11 ***	−0.2 ± 0.02	0.6 ± 0.15 ***	0.0 ± 0.15	2.2 ± 0.13 ***	56 ± 1.0 ***
1d	*SWB* points/	0.0 ± 0.18	0.7 ± 0.19 ***	1.0 ± 0.09 ***	−0.1 ± 0.05	0.7 ± 0.17 ***	0.1 ± 0.13	2.0 ± 0.13 ***	50 ± 0.8 ***
1e	*SWB* points/	−0.1 ± 0.16	0.7 ± 0.23 ***	1.0 ± 0.17 ***	0.0 ± 0.15	0.7 ± 0.25 ***	0.0 ± 0.22	2.2 ± 0.12 ***	55 ± 1.0 ***
2a	% *SWB*/	−0.4 ± 0.23	0.8 ± 0.20 ***	1.3 ± 0.19 ***	−0.2 ± 0.07	0.8 ± 0.22 **	0.1 ± 0.23	3.7 ± 0.20 ***	4.0 ± 0.02 ***
2b	% *SWB*/	−0.4 ± 0.22	0.8 ± 0.19 **	1.3 ± 0.19 ***	−0.2 ± 0.07	0.8 ± 0.22 **	0.1 ± 0.22	3.6 ± 0.20 ***	3.9 ± 0.02 ***
2c	% *SWB*/	−0.3 ± 0.20	0.8 ± 0.16 ***	1.3 ± 0.18 ***	−0.2 ± 0.07	0.8 ± 0.19 **	0.2 ± 0.21	3.7 ± 0.18 ***	4.0 ± 0.01 ***
2d	% *SWB*/	−0.2 ± 0.22	1.0 ± 0.21 ***	1.4 ± 0.12 ***	−0.1 ± 0.03	1.0 ± 0.20 ***	0.4 ± 0.18	3.3 ± 0.17 ***	3.9 ± 0.01 ***
2e	% *SWB*/	−0.4 ± 0.20	0.9 ± 0.28 ***	1.4 ± 0.24 ***	0.0 ± 0.17	0.9 ± 0.31 ***	0.3 ± 0.30	3.7 ± 0.20 ***	4.0 ± 0.02 ***

Table C.2a. Regression coefficients β_i^* for the HES data set x_i^*, obtained from regressions $GHG^* = f(\beta_i^*, x_i^*)$, according to Equations 3 and 4. Listed are the mean ± standard deviation over 3 regressions with *empl* and either *pop*, *qual* and *born* excluded. Detailed results are listed in Appendix C. *** significantly different from zero at the 99% level of confidence, ** 95%, * 90%, grey font: significance below 90%. Units of coefficients can be read from column 2 and row 2. For example the unit of the coefficient for Equation 3d and the variable *size* is change in emissions per unit change in the number of household members. Grey background indicates a percentage change in the explanatory variable. For example the unit of the coefficient for Equation 4d and the variable *inc* is the percentage change in emissions per percentage change in per-capita income.

Equation		*age*	*Size*	*inc*	*pop*	*qual*	*ten*	*born*	*car*
	Units	/year	/member	/AU$1k	/('000/km^2)	/index point	/index point	/%	/vehicle
3a	t CO_2-e/	0.08 ± 0.054 **	−2.2 ± 0.04 ***	0.36 ± 0.010 ***	0.5 ± 0.56 ***	3.8 ± 0.73 ***	1.0 ± 0.06 ***	−2.0 ± 2.87 **	5.0 ± 5.03 ***
3b	t CO_2-e/	1.3 ± 1.39 ***	−2.3 ± 0.03 ***	0.36 ± 0.008 ***	0.5 ± 0.53 ***	3.7 ± 0.70 ***	0.9 ± 0.07 ***	−3.4 ± 1.34 ***	3.0 ± 2.56
3c	t CO_2-e/	0.06 ± 0.053 *	−6.0 ± 0.08 ***	0.36 ± 0.010 ***	0.5 ± 0.55 ***	3.8 ± 0.79 ***	1.0 ± 0.06 ***	−2.1 ± 2.80 **	5.2 ± 5.07 ***
3d	t CO_2-e/	−0.03 ± 0.055	−2.5 ± 0.04 ***	4.5 ± 0.18 ***	0.7 ± 0.68 ***	4.4 ± 1.18 ***	0.9 ± 0.08 ***	−3.5 ± 2.97 ***	2.8 ± 6.21
3e	t CO_2-e/	0.11 ± 0.114 ***	−2.3 ± 0.02 ***	0.37 ± 0.017 ***	−0.1 ± 0.06 **	4.2 ± 0.25 ***	0.9 ± 0.14 ***	0.7 ± 6.69	2.7 ± 2.57
4a	% *GHG*/	1.85 ± 0.790 ***	−13 ± 0.1 ***	2.16 ± 0.123 ***	0.3 ± 4.56	44 ± 8.4 ***	13 ± 0.8 ***	55 ± 41.4 ***	117 ± 52.6 ***
4b	% *GHG*/	62.0 ± 7.93 ***	−13 ± 0.0 ***	2.14 ± 0.055 ***	0.5 ± 2.71 *	24 ± 2.9 ***	8 ± 0.7 ***	14 ± 13.8 ***	−26 ± 12.9 ***
4c	% *GHG*/	1.76 ± 0.775 ***	−33 ± 0.2 ***	2.14 ± 0.122 ***	0.6 ± 4.57	44 ± 7.7 ***	13 ± 0.7 ***	52 ± 40.6 ***	117 ± 51.9 ***
4d	% *GHG*/	1.17 ± 0.743 ***	−15 ± 0.1 ***	29.3 ± 1.74 ***	1.5 ± 5.09 ***	46 ± 5.7 ***	13 ± 0.6 ***	45 ± 40.0 ***	99 ± 52.7 ***
4e	% *GHG*/	1.86 ± 1.026 ***	−13 ± 0.4 ***	2.18 ± 0.160 ***	−1.7 ± 0.84 ***	44 ± 7.4 ***	13 ± 2.2 ***	86 ± 85.9 ***	114 ± 34.8 ***

Table C.2b. Table C.2a continued.

Equation		*NSW*	*Vic*	*Qld*	*WA*	*SA*	*Tas*	*NT*	β_0
	Units	**/move**	**/move**	**/move**	**/move**	**/move**	**/move**	**/move**	
3a	t CO_2-e/	1.0 ± 1.13 **	1.7 ± 1.30 ***	0.4 ± 1.13	0.1 ± 1.45	−1.3 ± 1.65 **	−3.8 ± 0.97 ***	2.8 ± 0.30 ***	0.3 ± 0.07 *
3b	t CO_2-e/	0.9 ± 1.37 *	1.7 ± 1.29 ***	0.3 ± 1.36	0.1 ± 1.39	−1.2 ± 1.58 **	−3.8 ± 1.12 ***	2.4 ± 0.89 ***	0.2 ± 0.15
3c	t CO_2-e/	1.0 ± 1.12 **	1.7 ± 1.30 ***	0.4 ± 1.12	0.2 ± 1.44	−1.3 ± 1.64 **	−3.8 ± 0.96 ***	2.8 ± 0.29 ***	0.2 ± 0.06
3d	t CO_2-e/	0.8 ± 1.34 *	1.5 ± 1.56 ***	−0.1 ± 1.34	−0.2 ± 1.72	−1.5 ± 1.95 ***	−4.3 ± 1.17 ***	2.4 ± 0.35 ***	0.3 ± 0.10 *
3e	t CO_2-e/	0.9 ± 1.34 **	1.8 ± 1.34 ***	0.2 ± 1.40	−0.1 ± 1.73	−1.3 ± 1.87 **	−3.7 ± 0.97 ***	2.4 ± 0.62 ***	0.3 ± 0.03 *
4a	% *GHG*/	19 ± 14.1 ***	12 ± 15.6 ***	17 ± 13.9 ***	10 ± 18.7 ***	−2 ± 19.9	−19 ± 10.3 ***	44 ± 4.7 ***	0.02 ± 0.001 ***
4b	% *GHG*/	−2 ± 8.3 *	3 ± 8.0 **	−3 ± 8.3 **	1 ± 9.4	−11 ± 9.9 ***	−32 ± 6.2 ***	14 ± 5.3 ***	−0.02 ± 0.005 ***
4c	% *GHG*/	19 ± 13.9 ***	13 ± 15.4 ***	17 ± 13.7 ***	11 ± 18.4 ***	−1 ± 19.6	−19 ± 10.2 ***	44 ± 4.6 ***	0.01 ± 0.001
4d	% *GHG*/	17 ± 14.3 ***	11 ± 15.8 ***	14 ± 14.3 ***	8 ± 18.8 ***	−3 ± 20.3	−22 ± 11.0 ***	41 ± 4.8 ***	0.02 ± 0.001 ***
4e	% *GHG*/	16 ± 16.4 ***	11 ± 16.1 ***	13 ± 17.4 ***	4 ± 23.9 ***	−5 ± 22.5 **	−19 ± 9.8 ***	40 ± 10.4 ***	0.01 ± 0.007 **

Table C.3. Regression coefficients β_i for the AUWS data set x_i, obtained from regressions $SWB = f(\beta_i, x_i)$ according to Equations (1) and (2). ***Empl* and *pop* are excluded from the variable set.** *** significantly different from zero at the 99% level of confidence, ** 95%, * 90%, grey font: significance below 90%. Units of coefficients can be read from column 2 and row 2. For example the unit of the coefficient for equation 1d and the variable *size* is change in *SWB* points per unit change in the number of household members. Grey background indicates a percentage change in the explanatory variable. For example the unit of the coefficient for equation 2d and the variable *inc* is the percentage change in *SWB* points per percentage change in per-capita income.

Equation		*age*	*size*	*inc*	*qual*	*ten*	*born*	*car*	*NSW*	*Vic*	*Qld*	*WA*	*SA*	*Tas*	*NT*	β_0	R^2
	Units	**/year**	**/member**	**/AU$1k**	**/index point**	**/index point**	**/%**	**/vehicle**	**/move**	**/move**	**/move**	**/move**	**/move**	**/move**	**/move**		
1a	*SWB* points/	0.08 ***	1.25 ***	0.054 ***	0.31 ***	2.73 ***	−2.1 ***	−0.06	−0.3	0.5 ***	0.9 ***	−0.2	0.4 **	−0.1	2.3 ***	55.1 ***	0.026
1b	*SWB* points/	2.96 ***	1.11 ***	0.051 ***	0.31 **	2.84 ***	−2.1 ***	−0.02	−0.3	0.4 ***	0.8 ***	−0.2	0.4 **	−0.2	2.3 ***	47.8 ***	0.023
1c	*SWB* points/	0.09 ***	3.65 ***	0.056 ***	0.30 ***	2.58 ***	−2.1 ***	0.41	−0.2	0.5 **	0.9 ***	−0.2	0.4 **	−0.1	2.3 ***	55.0 ***	0.030
1d	*SWB* points/	0.09 ***	1.46 ***	2.32 ***	0.11 ***	2.71 ***	−2.1 ***	−0.31	−0.2	0.5 ***	0.9 ***	−0.2	0.5 **	0.0	2.1 ***	49.2 ***	0.028
1e	*SWB* points/	0.08 ***	1.25 ***	0.054 ***	0.31 ***	2.73 ***	−2.1 ***	−0.06	−0.3	0.5 ***	0.9 ***	−0.2	0.4 **	−0.1	2.3 ***	55.1 ***	0.027
2a	% *SWB*/	0.12 ***	2.07 ***	0.09 ***	0.58 ***	4.34 ***	−2.8 ***	0.31	−0.5 *	0.6 **	1.3 ***	−0.1	0.7 **	0.1	3.9 ***	4.0 ***	0.023
2b	% *SWB*/	4.00 ***	1.86 ***	0.08 ***	0.58 ***	4.51 ***	−2.8 ***	0.38	−0.5	0.6 **	1.3 ***	−0.1	0.7 **	0.0	3.8 ***	3.9 ***	0.020
2c	% *SWB*/	0.13 ***	6.05 ***	0.09 ***	0.57 ***	4.09 ***	−2.8 ***	1.09	−0.4 *	0.7 **	1.3 ***	−0.1	0.7 **	0.2	3.9 ***	4.0 ***	0.026
2d	% *SWB*/	0.13 ***	2.43 ***	3.76 ***	0.25 ***	4.31 ***	−2.9 ***	−0.10 **	−0.4	0.7 **	1.4 ***	−0.1	0.8 **	0.3	3.5 ***	3.9 ***	0.025
2e	% *SWB*/	0.12 ***	2.07 ***	0.09 ***	0.58 ***	4.34 ***	−2.8 ***	0.31	−0.5 *	0.6 **	1.3 ***	−0.1	0.7 **	0.1	3.9 ***	4.0 ***	0.023

Table C.4. Regression coefficients β_i^* for the HES data set x_i^*, obtained from regressions $GHG^* = f(\beta_i^*, x_i^*)$, according to Equations (3) and (4). ***Empl* and *pop* are excluded from the variable set.** *** significantly different from zero at the 99% level of confidence, ** 95%, * 90%, grey font: significance below 90%. Units of coefficients can be read from column 2 and row 2. For example the unit of the coefficient for equation 3d and the variable *size* is change in emissions per unit change in the number of household members. Grey background indicates a percentage change in the explanatory variable. For example the unit of the coefficient for equation 4d and the variable *inc* is the percentage change in emissions per percentage change in per-capita income.

Equation		*age*	*size*	*inc*	*qual*	*ten*	*born*	*car*	*NSW*	*Vic*	*Qld*	*WA*	*SA*	*Tas*	*NT*	β_0	R^2
	Units	/year	/member	/AU$1k	/index point	/index point	/%	/vehicle	/move	/move	/move	/move	/move	/move	/move		
3a	t CO_2-e/	0.04	−2.2 ***	0.36 ***	4.33 ***	1.0 ***	−4.1 ***	0.8	1.9 ***	2.8 ***	1.3 ***	1.3 **	0.0	−3.1 ***	3.0 ***	0.3 *	0.74
3b	t CO_2-e/	0.67 *	−2.3 ***	0.36 ***	4.24 ***	1.0 ***	−4.4 ***	0.0	1.8 ***	2.8 ***	1.2 **	1.3 **	0.1	−3.1 ***	2.8 ***	0.3 *	0.74
3c	t CO_2-e/	0.02	−6.0 ***	0.35 ***	4.32 ***	1.1 ***	−4.1 ***	0.8	1.9 ***	2.8 ***	1.3 **	1.4 **	0.1	−3.1 ***	3.1 ***	0.2	0.75
3d	t CO_2-e/	−0.07	−2.5 ***	4.39 ***	5.26 ***	0.9 ***	−5.6 ***	−3.0	2.0 ***	2.9 ***	1.0 ***	1.4 ***	0.2	−3.4 ***	2.7 ***	0.3	0.72
3e	t CO_2-e/	0.04	−2.2 ***	0.36 ***	4.33 ***	1.0 ***	−4.1 ***	0.8	1.9 ***	2.8 ***	1.3 ***	1.3 **	0.0	−3.1 ***	3.0 ***	0.3 *	0.74
4a	% *GHG*/	1.41 ***	−13.0 ***	2.1 ***	38.4 ***	13.6 ***	25.7 ***	109.7 ***	23.5 ***	17.0 ***	22.0 ***	15.8 ***	5.1 **	−14.8 ***	46.7 ***	0.02 ***	0.98
4b	% *GHG*/	57.45 ***	−13.3 ***	2.1 ***	22.0 ***	8.5 ***	4.7 ***	−25.2 ***	1.7 ***	6.4 ***	1.1 ***	4.6 ***	−7.0 ***	−28.8 ***	17.2 ***	−0.01 ***	0.98
4c	% *GHG*/	1.32 ***	−32.9 ***	2.1 ***	38.5 ***	13.7 ***	23.6	107.6 ***	23.6	17.4 ***	22.3	16.8 **	5.8 ***	−15.1 ***	46.3 ***	0.01 **	0.98
4d	% *GHG*/	0.75 ***	−14.6 ***	28.3 ***	41.9 ***	12.9 ***	16.3 ***	83.8 ***	23.4 ***	17.4 ***	20.0 ***	15.4 ***	5.9 ***	−16.9 ***	43.1 ***	0.02	0.98
4e	% *GHG*/	1.41 ***	−13.0 ***	2.1 ***	38.40 ***	13.6 ***	25.7 ***	109.7 ***	23.5 ***	17.0 ***	22.0 ***	15.8 ***	5.1 **	−14.8 ***	46.7 ***	0.02 ***	0.98

Table C.5. Regression coefficients β_i for the AUWS data set x_i, obtained from regressions $SWB = f(\beta_i, x_i)$ according to Equations (1) and (2). ***Empl* and *qual* are excluded from the variable set.** *** significantly different from zero at the 99% level of confidence, ** 95%, * 90%, grey font: significance below 90%. Units of coefficients can be read from column 2 and row 2. For example the unit of the coefficient for equation 1d and the variable *size* is change in *SWB* points per unit change in the number of household members. Grey background indicates a percentage change in the explanatory variable. For example the unit of the coefficient for equation 2d and the variable *inc* is the percentage change in *SWB* points per percentage change in per-capita income.

Equation		***age***	***size***	***inc***	***pop***	***ten***	***born***	***car***	***NSW***	***Vic***	***Qld***	***WA***	***SA***	***Tas***	***NT***	β_0	R^2
	Units	**/year**	**/member**	**/AU$1k**	**/('000/km^2)**	**/index point**	**/%**	**/vehicle**	**/move**	**/move**	**/move**	**/move**	**/move**	**/move**	**/move**		
1a	*SWB* points/	0.08 ***	1.22 ***	0.057 ***	−0.27 ***	2.55 ***	−1.4 ***	−1.41 ***	−0.2	0.6 ***	0.8 ***	−0.2	0.5 **	−0.2	2.0 ***	57.3 ***	0.026
1b	*SWB* points/	2.91 ***	1.08 ***	0.054 ***	−0.27 ***	2.66 ***	−1.4 ***	−1.36 ***	−0.2	0.6 ***	0.7 ***	−0.2	0.5 ***	−0.2	2.0 ***	50.1 ***	0.023
1c	*SWB* points/	0.09 ***	3.59 ***	0.059 ***	−0.24 ***	2.43 ***	−1.4 ***	−0.80 ***	−0.2	0.6 ***	0.8 ***	−0.2	0.5 **	−0.1	2.1 ***	57.1 ***	0.030
1d	*SWB* points/	0.09 ***	1.45 ***	2.46 ***	−0.33 ***	2.50 ***	−1.5 ***	−1.82 **	0.0	0.8 ***	0.9 ***	−0.1	0.7 **	0.0	1.9 ***	50.8 ***	0.028
1e	*SWB* points/	0.08 ***	1.25 ***	0.058 ***	−0.22 ***	2.60 ***	−1.2 ***	−1.36 ***	−0.2	0.8 ***	0.9 ***	0.0	0.6 ***	−0.1	2.1 ***	56.3 ***	0.027
2a	% *SWB*/	0.12 ***	2.05 ***	0.09 ***	−0.28 ***	4.15 ***	−1.9 ***	−1.22 **	−0.5 *	0.7 **	1.1 ***	−0.2	0.6 **	−0.1	3.5 ***	4.0 ***	0.023
2b	% *SWB*/	3.94 ***	1.83 ***	0.09 ***	−0.28 ***	4.33 ***	−1.9 ***	−1.13 ***	−0.5	0.7 ***	1.1 ***	−0.3	0.6 ***	−0.1	3.4 ***	3.9 ***	0.020
2c	% *SWB*/	0.13 ***	5.98 ***	0.09 ***	−0.22 ***	3.94 ***	−2.0 ***	−0.20 **	−0.5 *	0.7 **	1.1 ***	−0.3	0.6 **	0.0	3.5 ***	4.0 ***	0.026
2d	% *SWB*/	0.13 ***	2.42 ***	3.94 ***	−0.38 ***	4.06 ***	−2.1 ***	−1.88	−0.2	1.0 **	1.3 ***	0.0	0.9 **	0.3	3.2 ***	3.9 ***	0.025
2e	% *SWB*/	0.12 ***	2.08 ***	0.09 ***	−0.25 ***	4.18 ***	−1.6 ***	−1.31 **	−0.5 *	0.9 ***	1.2 ***	0.0	0.8 ***	0.1	3.5 ***	4.0 ***	0.023

Table C.6. Regression coefficients β_i^* for the HES data set x_i^*, obtained from regressions $GHG^* = f(\beta_i^*, x_i^*)$, according to Equations (3) and (4). ***Empl* and *qual* are excluded from the variable set.** *** significantly different from zero at the 99% level of confidence, ** 95%, * 90%, grey font: significance below 90%. Units of coefficients can be read from column 2 and row 2. For example the unit of the coefficient for equation 3d and the variable *size* is change in emissions per unit change in the number of household members. Grey background indicates a percentage change in the explanatory variable. For example the unit of the coefficient for equation 4d and the variable *inc* is the percentage change in emissions per percentage change in per-capita income.

Equation		*age*	*size*	*inc*	*Pop*	*ten*	*born*	*car*	*NSW*	*Vic*	*Qld*	*WA*	*SA*	*Tas*	*NT*	β_0	R^2
	Units	**/year**	**/member**	**/AU$1k**	**/('000/km^2)**	**/index point**	**/%**	**/vehicle**	**/move**	**/move**	**/move**	**/move**	**/move**	**/move**	**/move**		
3a	t CO_2-e/	0.14 ***	−2.2 ***	0.38 ***	0.86 ***	1.0 ***	0.0	10.6 ***	−0.3	0.2	−0.9 **	−1.5 ***	−3.1 ***	−4.9 ***	2.5 ***	0.2	0.74
3b	t CO_2-e/	2.94	−2.2 ***	0.37 ***	0.84 ***	0.8 ***	−2.5	4.2 ***	−0.7	0.3	−1.3 ***	−1.4 ***	−2.9 ***	−5.1 ***	1.3 ***	0.0	0.74
3c	t CO_2-e/	0.12 ***	−5.9 ***	0.37 ***	0.88 ***	1.1 ***	−0.2 **	10.7 *	−0.3 *	0.3	−0.9 ***	−1.4 ***	−3.1 ***	−4.9 ***	2.5 ***	0.1	0.74
3d	t CO_2-e/	0.03 ***	−2.5 ***	4.70 ***	1.17 ***	1.0 ***	−1.4	9.3 ***	−0.6	−0.2	−1.6 **	−2.1 ***	−3.6 ***	−5.6 ***	2.0 ***	0.2	0.72
3e	t CO_2-e/	0.24 ***	−2.3 ***	0.39 ***	−0.03	0.7 ***	5.4 ***	5.6 ***	−0.6	0.3	−1.4 ***	−2.0 ***	−3.4 ***	−4.8 ***	1.8 ***	0.3 **	0.73
4a	% *GHG*/	2.77 ***	−13.1 ***	2.3 ***	3.5 ***	12.4 ***	84.3 ***	173.3 ***	2.8 *	−5.1 ***	1.0	−11.1 ***	−24.2 ***	−30.4 ***	39.0 ***	0.02 ***	0.98
4b	% *GHG*/	71.11 ***	−13.3 ***	2.2 ***	2.5 ***	7.2 ***	24.1 ***	−13.2 ***	−11.5	−5.8 ***	−12.3 *	−10.1 ***	−22.5 ***	−38.6 ***	8.1 ***	−0.02 ***	0.98
4c	% *GHG*/	2.65 ***	−33.0 ***	2.3 ***	3.8 ***	12.6 ***	81.0 ***	172.8 *	3.0 ***	−4.7 ***	1.3 ***	−10.1 ***	−23.5 ***	−30.8 ***	38.8 ***	0.01 ***	0.98
4d	% *GHG*/	2.03 ***	−14.7 ***	31.3 ***	5.1 ***	11.8 ***	72.9 ***	158.0 ***	1.1 *	−6.9 ***	−2.8	−13.7 ***	−25.9 ***	−34.4 ***	35.0 ***	0.02	0.97
4e	% *GHG*/	3.04 ***	−13.4 ***	2.4 ***	−2.28 ***	10.1 ***	147.3 ***	151.0 ***	−2.6 *	−7.2 ***	−6.9 ***	−23.1 ***	−30.7 ***	−30.4 ***	27.7 ***	0.01 **	0.98

Table C.7. Regression coefficients β_i for the AUWS data set x_i, obtained from regressions $SWB = f(\beta_i, x_i)$ according to Equations (1) and (2). ***Empl* and *born* are excluded from the variable set.** *** significantly different from zero at the 99% level of confidence, ** 95%, * 90%, grey font: significance below 90%. Units of coefficients can be read from column 2 and row 2. For example the unit of the coefficient for equation 1d and the variable *size* is change in *SWB* points per unit change in the number of household members. Grey background indicates a percentage change in the explanatory variable. For example the unit of the coefficient for equation 2d and the variable *inc* is the percentage change in *SWB* points per percentage change in per-capita income.

Equation		*age*	*size*	*inc*	*pop*	*qual*	*ten*	*car*	*NSW*	*Vic*	*Qld*	*WA*	*SA*	*Tas*	*NT*	β_0	R^2
	Units	**/year**	**/member**	**/AU$1k**	**/('000/km^2)**	**/index point**	**/%**	**/vehicle**	**/move**	**/move**	**/move**	**/move**	**/move**	**/move**	**/move**		
1a	*SWB* points/	0.08 ***	1.23 ***	0.056 ***	−0.44 ***	0.56 ***	2.5 ***	−1.23 ***	0.1	0.8 ***	1.0 ***	−0.1	0.7 ***	0.1	2.2 ***	56.0 ***	0.026
1b	*SWB* points/	2.89 ***	1.09 ***	0.052 ***	−0.44 ***	0.55 ***	2.6 ***	−1.17 ***	0.1	0.8 ***	1.0 ***	−0.1	0.7 ***	0.1	2.1 ***	48.8 ***	0.023
1c	*SWB* points/	0.09 ***	3.59 ***	0.057 ***	−0.40 ***	0.52 ***	2.4 ***	−0.60 ***	0.1	0.8 ***	1.0 ***	−0.2	0.7 ***	0.1	2.2 ***	55.8 ***	0.030
1d	*SWB* points/	0.09 ***	1.45 ***	2.39 ***	−0.47 ***	0.37 ***	2.5 ***	−1.57 *	0.1	0.9 ***	1.1 ***	−0.1	0.8 ***	0.2	1.9 ***	49.9 ***	0.028
1e	*SWB* points/	0.08 ***	1.28 ***	0.056 ***	−0.30 ***	0.56 ***	2.6 ***	−0.92 ***	0.0	0.9 ***	1.2 ***	0.1	0.9 ***	0.3	2.3 ***	54.3 ***	0.027
2a	% *SWB*/	0.12 ***	2.06 ***	0.09 ***	−0.53 ***	0.86 ***	4.1 ***	−0.98 *	−0.1	1.0 ***	1.5 ***	−0.1	1.0 ***	0.4	3.7 ***	4.0 ***	0.023
2b	% *SWB*/	3.93 ***	1.84 ***	0.08 ***	−0.53 ***	0.85 ***	4.2 ***	−0.89 ***	−0.1	1.0 ***	1.4 ***	−0.1	1.0 ***	0.3	3.6 ***	3.9 ***	0.020
2c	% *SWB*/	0.13 ***	5.98 ***	0.09 ***	−0.47 ***	0.79 ***	3.9 ***	0.07	−0.1	1.0 ***	1.5 ***	−0.2	1.0 ***	0.4	3.7 ***	4.0 ***	0.026
2d	% *SWB*/	0.13 ***	2.42 ***	3.84 ***	−0.57 ***	0.55 ***	4.0 ***	−1.54	0.0	1.2 ***	1.6 ***	0.0	1.2 ***	0.6	3.3 ***	3.9 ***	0.025
2e	% *SWB*/	0.12 ***	2.11 ***	0.09 ***	−0.37 ***	0.88 ***	4.2 ***	−0.69	−0.1	1.2 ***	1.7 ***	0.2	1.3 ***	0.6	3.8 ***	4.0 ***	0.023

Table C.8. Regression coefficients β_i^* for the HES data set x_i^*, obtained from regressions $GHG^* = f(\beta_i^*, x_i^*)$, according to Equations (4) and (5). ***Empl* and *born* are excluded from the variable set.** *** significantly different from zero at the 99% level of confidence, ** 95%, * 90%, grey font: significance below 90%. Units of coefficients can be read from column 2 and row 2. For example the unit of the coefficient for equation 3d and the variable *size* is change in emissions per unit change in the number of household members. Grey background indicates a percentage change in the explanatory variable. For example the unit of the coefficient for equation 4d and the variable *inc* is the percentage change in emissions per percentage change in per-capita income.

Equation		*age*	*size*	*inc*	*pop*	*qual*	*ten*	*car*	*NSW*	*Vic*	*Qld*	*WA*	*SA*	*Tas*	*NT*	β_0	R^2
	Units	**/year**	**/member**	**/AU$1k**	**/('000/km²)**	**/index point**	**/%**	**/vehicle**	**/move**	**/move**	**/move**	**/move**	**/move**	**/move**	**/move**		
3a	t CO_2-e/	0.06	−2.3 ***	0.36 ***	0.07	3.3 ***	0.9 ***	3.7 *	1.3 ***	2.0 ***	0.8	0.4	−0.8	−3.3 ***	2.9 ***	0.4 **	0.74
3b	t CO_2-e/	0.40	−2.3 ***	0.36 ***	0.09	3.2 ***	0.9 ***	4.7	1.4 **	2.1 ***	0.9	0.5	−0.6 *	−3.2 ***	2.9 ***	0.3 **	0.74
3c	t CO_2-e/	0.04	−6.1 ***	0.35 ***	0.10	3.2 ***	1.0 ***	4.0 **	1.3 ***	2.0 ***	0.8 *	0.5	−0.8	−3.4 ***	2.9 ***	0.2 **	0.75
3d	t CO_2-e/	−0.06	−2.6 ***	4.39 ***	0.21	3.6 ***	0.8 ***	2.1 **	1.0 ***	1.7 ***	0.2 *	−0.1	−1.0	−3.9 ***	2.4 ***	0.4	0.72
3e	t CO_2-e/	0.04	−2.3 ***	0.36 ***	−0.12 ***	4.0 ***	0.9 ***	1.7	1.4 ***	2.4 ***	0.8 *	0.4	−0.5	−3.2 ***	2.5 ***	0.3	0.74
4a	% *GHG*/	1.39 ***	−12.9 ***	2.1 ***	−2.9 ***	50.3 ***	13.8 ***	69.0 ***	29.7 ***	25.0 ***	27.2 ***	24.8 ***	13.8 ***	−10.9 ***	47.5 ***	0.02 ***	0.98
4b	% *GHG*/	57.31 ***	−13.3 ***	2.1 ***	−1.4 ***	26.1 ***	8.5 ***	−39.1 ***	3.9 ***	9.2 ***	2.9 ***	7.4 ***	−4.0 ***	−27.2 ***	17.4 ***	−0.01 ***	0.98
4c	% *GHG*/	1.30 ***	−32.5 ***	2.1 ***	−2.7 ***	49.4 ***	13.9 ***	70.3 ***	29.3 **	24.8 ***	27.1 *	25.0 ***	13.8 **	−11.5 ***	47.1 ***	0.01 **	0.98
4d	% *GHG*/	0.74 ***	−14.5 ***	28.3 ***	−2.1 ***	49.9 ***	13.0 ***	56.0 ***	27.6 ***	22.8 ***	23.5 ***	21.4 ***	11.7 ***	−14.2 ***	43.6 ***	0.02	0.98
4e	% *GHG*/	1.14 ***	−12.6 ***	2.1 ***	−1.09 ***	48.8 ***	14.3 ***	81.9 ***	27.8 ***	23.2 ***	24.4 ***	20.4 ***	10.9 ***	−12.4 ***	44.3 ***	0.01	0.98

Most importantly, with the exception of the 'Migrants' coefficient in the GHG regressions, there is not a single instance where the signs of highly significant coefficients change as a results of applying a different regression specification. Similarly, restricting the range of the AUWS and HES explanatory variable sets by excluding observations with values at the extreme ends of the distributions did not alter the identity of significant coefficients. This indicates the robustness of the regression specifications with regard to extracting trends and relationships. We found however two reasons that single out the elasticity formulations 2d and 4d as preferred regression specifications. First, only 2d and 4d produce neither negative nor exploding values for *SWB* and emissions (see Appendix D). Second, only these correctly reproduce the diminishing effects of income growth that are inherent in the data sets, which we elaborate on below.

Appendix D: Robustness and Quality Tests

Excluding Census data from the AUWS data set, and running a regression on 2,681 AUWS samples only, made no difference to the sign and significance of regression coefficients, except for the car ownership variable, where it caused a profound change. Whilst the regression coefficient for emissions does not change significantly, the regression coefficient for well-being changes sign, and stays significant at the 99%-confidence level. This result is interesting in the sense that car ownership decreases well-being when measured as "general car ownership in the area of residence", but increases well-being when measured as "car ownership in the household". In principle, we cannot rule out cross-variable influence with age since in the reduced AUWS sample per-capita car ownership is weakly and positively correlated ($\rho = 0.12$) with age. However, household size is now much more strongly and negatively correlated with per-capita car ownership ($\rho = -0.53$, in larger households people appear to share cars), and this correlation should push the car ownership regression coefficient into negative ranges. Hence, we may have detected some kind of double-standard attitude, even if only a subconscious one, that rules cars as beneficial when owned within the household, but as detrimental when owned outside the household.

The main difference between the regression specifications in Equations C.1-C.4 and their interpretations lies in their behaviour for samples with characteristics at or beyond the boundary of the sample population. This is evident especially for the emissions regressions, where specifications C.3 and C.4 often do not agree with each other. For example in Equations C.3a, C.3b, C.3c and C.3e, we postulate that emissions grow linearly with income, no matter how high this income. In Equations C.4a, C.4b, C.4c and C.4e, this relationship is even exponential, thus making emissions even more sensitive to income. The log-taking of income in Equations 3d (logarithmic growth of emissions with income) and C.4d (power relationship) has the effect of saturating emissions at higher incomes.

Table D.1. Quality assessment of regressions: Determination coefficients R^2, minimum, median, maximum, and standard deviation σ of emissions $GHG = f(\beta_i^*, x_i\ )$ estimated for the AUWS sample.

Equation	R^2	R^2	**minimum**	**median**	**maximum**	σ
	SWB	*GHG*	t CO_2-e	t CO_2-e	t CO_2-e	t CO_2-e
1/3a	0.03	0.74	−20.5	19.5	388.8	9.9
1/3b	0.02	0.74	−20.5	18.5	382.6	9.8
1/3c	0.03	0.75	−7.4	19.0	383.9	9.9
1/3d	0.03	0.72	−31.5	18.2	42.3	5.1
1/3e	0.03	0.74	−21.5	19.8	401.4	10.2
2/4a	0.02	0.98	1.1	24.2	2.1E+11	4.3E+8
2/4b	0.02	0.98	1.9	21.5	5.4E+10	1.7E+8
2/4c	0.03	0.98	1.8	23.5	1.6E+11	3.4E+8
2/4d	0.02	0.97	0.6	21.7	289.9	11.3
2/4e	0.02	0.98	1.1	24.0	4.2E+11	8.1E+8

This is evident from the minima and maxima, and the standard deviation σ of emissions estimated for the AUWS sample, as recorded in Table D.1. In cases where we did not take the logarithm of income, emissions can grow out of bounds for some outlier samples with very high income. For the linear specifications, some emissions can even become negative, which does not make sense. Nevertheless, the medians of all specifications agree reasonably well, hovering between 18 and 24 t CO_2-e. (This value is lower than results reported elsewhere [7,10], because in this work we have excluded emissions embodied in imports, and emissions in government consumption and capital infrastructure. This was done because first, the HES does not distinguish imported and domestically produced products, and second, because emissions caused by government consumption and production of capital goods are usually allocated to households on a per-capita basis, thus adding no insights to the role of socio-economic-demographic characteristics.) In summary, our quality and robustness tests yielded that the elasticity specifications 2d and 4d perform best. This is supported by results from the literature (Wier *et al.* 2001; Lenzen *et al.* 2004; Cohen *et al.* 2005; Lenzen *et al.* 2006 [6–9] on environmental impacts of households, and Frey and Stutzer 2002 [11] on wellbeing).

Whilst greenhouse gases can be explained well by the suite of 15 explanatory variables (R^2 around 0.7), the AUWS appears to be also dependent on factors outside our multiple regression, which is why the R^2 is low between 0.02 and 0.03 (see the large scatter in Figure 2, left).

Appendix E: Potential Cross-application of Regressions

In order to further integrate wellbeing and environmental impact we attempted to combine the regressions of these two key variables as follows: Let $SWB = f(\beta_i, x_i)$ and $E^* = f(\beta_i^*, x_i^*)$, where SWB denotes the personal wellbeing index of the AUWS sample and E^* the environmental impact of the HES sample. The function symbol f stands for a regression specification, x_i and β_i for the AUWS explanatory variable data set and its regression coefficients, and x_i^* and β_i^* for the HES explanatory variable data set and its regression coefficients (see Equations (1) and (2) in main text). Assuming that the definitions of the AUWS variables x_i and the HES variables x_i^* are identical, we apply the regression coefficients β_i obtained from the AUWS data set to the HES set x_i^*, and vice versa, to estimate the environmental impact

$$E = f(\beta_i^*, x_i\ ) \qquad \text{(E.1)}$$

of the AUWS sample, and the wellbeing

$$SWB^* = f(\beta_i\ , x_i^*) \qquad \text{(E.2)}$$

of the HES sample.

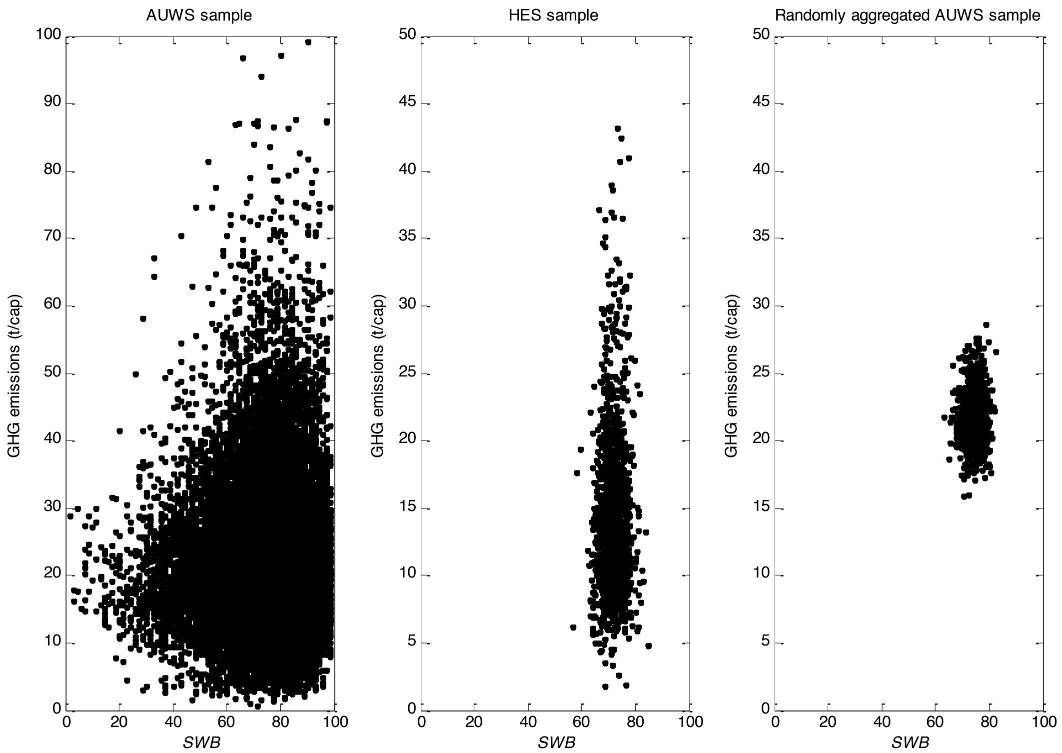
The AUWS reports on the wellbeing of each survey participant only, not on the wellbeing of their household. The HES reports expenditures and, in combination with the other data sources, the environmental impact of the entire household, not just of the survey participant. Hence, Equation (1) estimates the environmental impact of the AUWS respondent's household, assuming that the explanatory variables x_i given by the respondent apply equally to the entire household. Similarly, Equation 2 estimates the wellbeing of the HES respondent, assuming that the explanatory variables x_i^* of the household apply equally to the entire respondent.

In order to check whether the strategy outlined in Equations (E.1) and (E.2) is permissible, we carried out a Chow test in order to quantitatively test whether the AUWS and HES samples can be regarded as stemming from the same population. As could be expected from the distributions shown in Figure 1 in the main text, this test failed, and in fact the AUWS and HES samples are different. Even a tailored reduction of both the HES and AUWS samples towards Chow-type similarity proved unsuccessful.

Any cross-applications of regression coefficients to the respective other data set would need to be interpreted with severe qualifications in mind. Especially emissions estimates for AUWS samples would be projected on the basis of socio-economic-demographic characteristics that fall outside the range for which the emissions regression was specified on the basis of the HES samples. This shortcoming can only be ameliorated through undertaking a new survey combining SWB and expenditure questions for one and the same sample population. However, such a survey takes years to prepare, carry out and evaluate, and in the meantime we report results of our failed integration attempt for archival purposes.

As explained above, we attempted to estimate the environmental impact of AUWS respondents, and the SWB of HES respondents, by inserting the values of explanatory variables of one dataset into the regression formula obtained from the other dataset. Applying the HES-based environmental impact regression to the AUWS data set (Figure E.1) shows that the range of AUWS emissions (regressed, left panel) is larger than the range of HES emissions (data, middle panel). This is because the AUWS is a single-household sample database, with a wider range in explanatory variables than the HES (see Figure 1 in main text). On the other hand, the HES contains only observations for aggregates of households, but despite the low R^2 value measured for the *SWB* relationship in Equation E.2, both AUWS and HES samples closely cluster around the same average wellbeing index of about 70 (Figure E.1, middle panel). We confirmed this by randomly aggregating samples from the AUWS set (left), and re-plotting (right graph). Indeed, when the AUWS set is aggregated, it assumes a shape similar to the HES set. Finally, the median emissions estimated for the AUWS are slightly higher than the emissions calculated for the HES set, mainly because the median income in the AUWS set is higher than the median income in the HES set, and the median household size in the AUWS is lower than the median household size in the HES set (see Figure 1 in main text).

Figure E.1. Results of applying an environmental impact regression formula to the AUWS dataset (left panel), and an *SWB* regression formula to the HES data sets (middle panel). The right panel shows that once aggregated, the AUWS dataset assumes a shape similar to that of the HES dataset.



Further, emissions are only low for samples with reported low wellbeing, but not vice versa: Even respondents with reported high wellbeing can achieve low emissions. SWB homeostasis as well as the low R^2 of the AUWS regressions could account for part of this ambiguity. However, there could also exist several possible pathways for transitions to wealth: a "hedonistic" one (increasing wealth through increasing material metabolism, causing increasing emissions and SWB), and a "Buddhist" one (increasing wealth through improving life balance, accompanied by decreasing emissions and increasing SWB).

Appendix F: Remaining Environmental Indicators

We re-ran all multiple regressions for the per-capita indicators of water use, material flow, and land disturbance. The clouds in the *SWB-E* diagram look similar to those in Figure E.1, but obviously cluster around different means (Table F.1).

We found that per-capita income, tenure type, qualification and household size remain significant in their roles for all environmental indicators. Their Student's *t* values for income and household size are even considerably larger than in the greenhouse gas emissions regression. These variables therefore deserve special attention when designing policies aimed at reducing environmental impact of households.

Table F.1. Means and commodity breakdowns of material flow, greenhouse gas emissions, water use, and land disturbance for the average Australian household.

	Material flow (t)	GHG emissions (t CO_2-e)	Water use (ML)	Land disturbance (ha)
Household operations				
Construction & renovations	2.67	2.39	0.02	0.06
Water	0.10	0.12	0.11	0.01
Electricity	1.61	2.44	0.02	0.00
Gas, coal, oil, firewood	0.65	0.38	0.00	0.00
Gardening – lawn care	0.49	0.22	0.02	0.05
Transport				
Petrol for car	1.45	1.74	0.00	0.01
Public Transport	0.11	0.82	0.00	0.00
Air travel	0.16	0.17	0.00	0.00
Food				
Beef	0.05	0.42	0.01	0.44
Dairy	0.40	0.39	0.06	0.04
All other	1.72	1.78	0.17	0.66
Restaurants – take-out	0.90	1.41	0.07	0.50
Consumer goods and services				
Clothing and fabrics	0.34	0.73	0.04	0.40
Furniture and appliances	0.53	0.94	0.01	0.10
Books/ magazines	0.18	0.37	0.01	0.03
Tobacco and alcohol	0.48	0.50	0.06	0.09
Personal care	0.50	0.57	0.02	0.06
Other [a]	3.64	4.34	0.13	0.69
Total	**16.0**	**19.7**	**0.8**	**3.2**

[a] Vehicles and parts, electronic equipment, repairs, accommodation, postage and phone, insurance, entertainment, community services.

Median age appears to be a weak but significant retardant for water use and land disturbance. We have not investigated the underlying reasons for the different effects of age on emissions, water use and land disturbance. This is an area for future research.

We found population density to be a weak accelerator for water use, which could be a side-effect of a weak correlation with income and qualification. As mentioned previously, in the HES sample population density is negatively correlated with expenditures on energy commodities (petrol, natural gas, electricity). Since these commodities are emissions-intensive, their reductions cancel out the increased income effect. Once other indicators are examined, the income effect causes population density to be positively significant.

Car ownership causes impacts in terms of material flow, but not so much in terms of land disturbance, and not at all in terms of water use. This can be understood given that cars need steel and petrol, which requires the extraction of iron and other metal ores and crude oil. Neither of these extractive or manufacturing industries is water- or land-intensive.

Compared to greenhouse gas emissions, many of the State dummies become more significant for land disturbance, but not for water use or land disturbance. Moving to Qld, NT, WA and SA would drive land disturbance up, whilst moving to Vic and Tas would reduce it. NSW remains on average. This significance is caused almost solely by land use characteristics and stocking rates for beef cattle. This is because beef meat is mainly consumed in the State where it is produced (with the exception of NT beef which is also consumed in SA). As a consequence, Qld, NT, WA and SA residents consume beef meat produced on large tracts of land, of which considerable portions were, and in some areas still are cleared, with severe impacts on biodiversity. In contrast, Victorian and Tasmanian livestock requires much less land due to the higher rainfall in these States.

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