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LETTER

Popular Support for Environmental Protection: A Life-Cycle Perspective

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'Global warming is a total, and very expensive, hoax!'

(Donald J. Trump at age 67, 6 December 2013)

Political preferences are often believed to be molded early in life, typically shaped by prevailing economic or other circumstances in this period (for example, Inglehart 1971; Inglehart 1981; Inglehart 1990; Inglehart and Abramson 1994). For instance, birth cohorts socialized in times of relative abundance – such as the 'baby boomers' – are expected to have a stronger appreciation for non-material values including environmental protection. Earlier cohorts that 'experienced war and economic hardship in their childhood years' are instead believed to be more materialistically oriented (Pampel and Hunter 2012, 422). A direct implication of such a generational focus is that political attitudes linked to non-material values – including support for environmental protection – will thrive in the immediate future as older materialist generations are replaced by younger cohorts with different values.

A vast literature has tried to pin down this proposition using (repeated) cross-sectional datasets on popular support for environmental protection (for example, Franzen and Meyer 2010; Gelissen 2007; Johnson and Schwadel 2019; Nawrotzki and Pampel 2013; Pampel and Hunter 2012). However, such analyses must invoke heroic assumptions to separate between cohort, life-cycle and period effects due to the linear dependency of age and birth cohort at any point in time (Bell and Jones, 2014; Cheng, Powdthavee and Oswald 2017; Neundorf and Niemi 2014). This is important since *life-cycle* effects may lead individuals to put different levels of emphasis on protecting the environment depending on their age and stage in life (Franzen and Meyer 2010; Jagodzinski 1983; Torgler and Garcia-Valiñas 2007).

Theoretically, we argue that investments in environmental protection yield long-term benefits, but are costly in the short term since they constrain the use of natural resources and divert investments away from more immediately profitable ventures. Since long-term benefits are discounted more when one's remaining lifespan is shorter (Read and Read 2004; Trostel and Taylor 2001), the elderly will be less interested in investments in environmental protection – as indicated by Donald J. Trump's tweet cited above. However, young people may also discount the future more (de Water, Cillessen, and Scheres 2014; Rogers 1994; Steinberg et al. 2009). They have not yet produced offspring (which reduces discounting of future environmental benefits; Read and Read 2004) and may not yet know or understand how risky/safe their world really is (which from an evolutionary perspective implies they are better off acting 'as if there is no tomorrow'; Sozou and Seymour 2003). Either way, moving from young- to middle-adulthood may decrease intertemporal discounting. As such, the life-cycle effect might well be inverted-U shaped and reach its peak during middle age. This line of argument is consistent with research into time discounting over the lifespan, which finds that 'older people discount more than younger ones, and that middle aged people discount less than either group' (Read and Read 2004, 22). We return to the various potential shapes of the life-cycle effect – and which of these we can identify empirically – below.

Our analysis revisits this important and persistent scholarly debate (Abramson 2011) and pushes the boundaries of the existing literature in two ways. First, from a theoretical and conceptual perspective, we shift focus from cohort to life-cycle effects in order to draw attention to differences in environmental concerns between age groups. The potential implications of finding inverted-U-shaped life-cycle effects may be considerable. Whereas Inglehart's generational hypothesis for most advanced economies implies that public opinion gradually shifts towards a greater emphasis on protecting the environment, any inverted-U-shaped life-cycle effect suggests that aging populations in these economies may profoundly counteract this tendency.

Secondly, from a methodological perspective, we uniquely rely on overlapping panels in the Norwegian Election Studies (1989–2013) to analyze repeated observations of the *same* individuals rather than cross-sectional data (as in earlier work). These panel data facilitate a novel analysis able to identify life-cycle effects by exploiting the first-difference properties of the environmental concern function. While this approach does not resolve the Age-Period-Cohort problem, it *does* allow us to identify specific shapes of life-cycle effects while controlling for period effects (by detrending the data) and cohort effects (by analyzing the change in, rather than the level of, individuals' environmental attitudes) (Cheng, Powdthavee and Oswald. 2017).[1] This approach is very different from those employed in the existing literature, and offers a novel tool in settings where a panel dataset is available.

Dataset and Dependent Variable

The Norwegian Election Studies are conducted by Statistics Norway every four years in line with the national electoral cycle. They are based on a random sample taken from the nationwide population register. The surveys consistently achieve response rates above 50 per cent and the resulting samples are representative of the Norwegian population aged 18–79 years. Each survey includes detailed background information about respondents (including year of birth and age at the time of the survey) and covers questions about the elections as well as individuals' political attitudes and policy preferences. Since 1989, a question on respondents' preferences for protecting the environment has been included, which we employ as the basis of our dependent variable. The formulation used in the 1989 and 1993 surveys was as follows:

> [Imagine] the issue of nature conservation and environmental protection. The value 1 expresses the desire to see more done for environmental protection, even if people's standard of living is reduced to a considerable extent, yourself included. The value 10 expresses the desire that environmental protection measures should not be taken so far as to affect our standard of living. Where would you place yourself on this scale, or have you not given this issue much thought?

In the 1997 survey, the answer scale was extended such that it now started at 0 rather than 1. In the 2001, 2005, 2009 and 2013 surveys, the order of the preference options was reversed. For consistency, we recoded the answers provided during the first three surveys (1989, 1993 and 1997) to match the response order of the survey format used from 2001 onwards.

Important for our purposes, half of the sample in each survey wave was interviewed again four years later. This creates high-quality rotating panels of approximately 500 to 700 respondents (see

[1]This directly controls for any existing cohort effects – even though we cannot exactly identify them – since the same individual naturally remains part of the same birth cohort over time.

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Table 1), which we exploit to study repeated observations of the *same* individuals. Note, however, that the small changes in the survey design documented above create concerns about the rotating panels around the 1997 survey. With the scale reversal in 2001, respondents included in both 1997 and 2001 faced 10 as both a negative and positive statement. Moreover, the scale's extension in 1997 implies that respondents in both 1993 and 1997 faced (slightly) different scales. Both issues might affect their answers over time, which is our key interest in the analysis. Hence, both the 1993–1997 and 1997–2001 rotating panels are excluded from our final sample, leaving us with four rotating panels spanning a 24-year period (see Table 1). Appendix Figure A1 shows that most respondents shifted preferences at least somewhat over these four-year periods (that is, less than 30 per cent show no change at all). Some even document very substantial changes (we return to this below). These changes over time within the same individual are the main dependent variable in our analysis.

Empirical Analysis

Method: Identification of the Life-Cycle Effect

Our aim is to identify a life-cycle effect in environmental concerns *independent of any cohort and time effects*. As mentioned, the key problem is the linearly dependent relationship Age = Time – Cohort, which makes independent identification of these three elements extremely challenging (Bell and Jones 2014). Our approach is to focus on the first difference of the environmental concerns function. Clearly, cohort effects are eliminated by first-differencing the data because the same individual remains in the same birth cohort over time. Taking out cohort effects is a price we are willing to pay for being able to identify life-cycle effects.

Although the slope of the first difference (that is, the second difference) can be empirically identified, the first difference itself can only be estimated up to a constant, because potential time-specific effects (see Appendix Figure A2) could still contaminate the estimate of the life-cycle effect. The basic issue is that when four years have passed everyone is exactly four years older. This implies an unclear assignment of age and time effects when including both in an empirical model, such that the age at which environmental concerns reach a peak (or trough) cannot generally be identified. We follow Cheng, Powdthavee and Oswald (2017) and address this problem by running a first-stage regression with the within-person change in environmental concerns as the dependent variable, and a full set of time dummies as independent variables (whereby survey years represent the time effects). The residuals from this regression reflect individuals' detrended change in environmental concerns. Any time-specific effects are eliminated from these residuals as the individual-level changes are scaled down by the average change in the data within a period.[2]

We then run a second-stage regression with the detrended change in environmental concerns as the dependent variable, and age as the independent variable. This regression reveals the effect of a change in age – over and above the average time and age effects within a period – on the change in environmental concerns independent of any cohort effects. With subscripts i and t referring to individuals and time, respectively, this estimation approach can be written as:

$$\Delta \text{Pref}_{it} = \beta_0 + \beta_t \text{time dummies} + \varepsilon_{\text{it}} \tag{1}$$

$$\hat{\varepsilon}_{it} = \alpha_0 + \alpha_1 \text{Age}_{it} (+\alpha_2 \text{Controls}_{it}) + \mu_{it} \tag{2}$$

where ΔPref_{it} equals within-person changes in environmental preferences, and time dummies is a full set of survey-year indicator variables. $\hat{\varepsilon}_{it}$ is the residual from estimating Equation 1, and

[2]This average change can be attributed to *either* an average age effect in a period *or* a time effect, as these two effects are inseparable in the data.

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Table 1. Structure of the rotating panel

Panel indicator	1989	1993	1997	2001	2005	2009	2013	Total
1989–1993	686	686	–	–	–	–	–	1,372
2001–2005	–	–	–	666	666	–	–	1,332
2005–2009	–	–	–	–	635	635	–	1,270
2009–2013	–	–	–	–	–	489	489	978
N	686	686	–	666	1,301	1,124	489	4,952

Note: the response order and coding on our main variable of interest changed slightly in 1997, which undermines the comparability of the responses within the 1993–1997 and 1997–2001 rotating panels. As each individual appears in two subsequent surveys, the number of individual respondents equals 2,476. Note also that 2013 is the latest available survey at the time of writing.

indicates detrended changes in environmental concerns.[3] Age_{it} is respondents' age at the time of the second survey. Importantly, $\alpha_1 \neq 0$ reflects non-linear life-cycle effects on environmental concerns. In particular, a combination of $\alpha_0 > 0$ and $\alpha_1 < 1$ is consistent with a positive first difference at young ages and a negative first difference at old ages (that is, an inverted-U shape over the life cycle). Note that $\alpha_1 = 0$ need not imply the absence of life-cycle effects, only that non-linear effects do not find support in the data. Any potential linear life-cycle effects cannot be identified independently of time effects, and are taken out of the estimations by the detrending procedure.

Although control variables are not strictly necessary, we sometimes extend our specification with two time-changing variables that capture respondents' real income (in 100,000 NOK, base year 2013) and education level (lower than secondary, secondary, higher education). These have been extensively analyzed as potential determinants of environmental preferences by, among others, Gelissen (2007), Franzen and Meyer (2010), Pampel and Hunter (2012), Jorgenson and Givens (2014), Lo (2014) and Johnson and Schwadel (2019). Summary statistics for all relevant variables are included in Table 2.

Main Findings

We start our analysis by briefly looking at the cross-sectional relationship between age and individual preferences for environmental protection in Figure 1. The figure shows a strong inverted-U-shaped environmental concern function, which reaches its maximum value at 42.82 years.

Figure 1 provides some initial, suggestive verification that older individuals place less emphasis on protecting the environment. Yet, this figure obviously conflates time, cohort and life-cycle effects. To better understand life-cycle effects independently of cohort and time effects, we estimate Equations 1 and 2 using the fully balanced rotating panel covering the periods 1989–1993 and 2001–2013. The key findings are summarized in Figure 2 (and Appendix Table A1).[4]

The downward sloping line in Figure 2 indicates a negative relationship between the (detrended) change in support for environmental protection and an individual's age. Further, we find the first difference to be positive at young ages and negative at old ages. As argued above, these results provide strong evidence of an inverted-U-shaped life-cycle effect in environmental concerns. In terms of effect size, remember that our first-difference model effectively

[3]Note that the residual in Equation 1 is not independent of the time dummies, as these are designed to take out any common effects across individuals within a period. That is, β_t includes any average age effects. In Appendix B, we assess the robustness of our main findings using two alternative estimation approaches.

[4]Appendix Table A1 also covers the results from a number of robustness checks. Specifically, we show that excluding individuals with extreme changes in their expressed environmental preferences over time (that is, shifts of 9 or more on the 11-point scale) leaves our results unaffected. Similarly, excluding respondents from the 1989–93 surveys (which had a slightly narrower response scale; see above) does not affect our findings. Finally, our results are likewise robust to including additional controls for individuals' income and education.

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Table 2. Summary statistics

Variable	*N*	Mean	St. Dev.	Min	Max
$Pref_{ict}$: Preference for environmental protection	4,622	5.752	2.235	0	10
$\Delta Pref_{ict}$: Change in preference for environmental protection	2,311	−0.168	2.357	−10	9
Age	4,622	45.900	14.732	17	79
Income	4,622	5.793	3.644	0	51.301
Education	4,622	2.203	0.740	1	3

Note: *Preference for Environmental Protection* is coded from 0 ('Environmental protection measures should not be taken so far as to affect our standard of living') to 10 ('More should be done for environmental protection, even if it means people have their standard of living reduced to a considerable extent, yourself included'). *Change in Preference for Environmental Protection* is the within-person change in environmental concerns across two survey waves. *Income* measures respondents' real income in NOK 100,000 (base year 2013), while *Education* is measured in three stages as lower than secondary, secondary or higher education. The data are derived from a fully balanced rotating panel including surveys from 1989–1993 and 2001–2013.

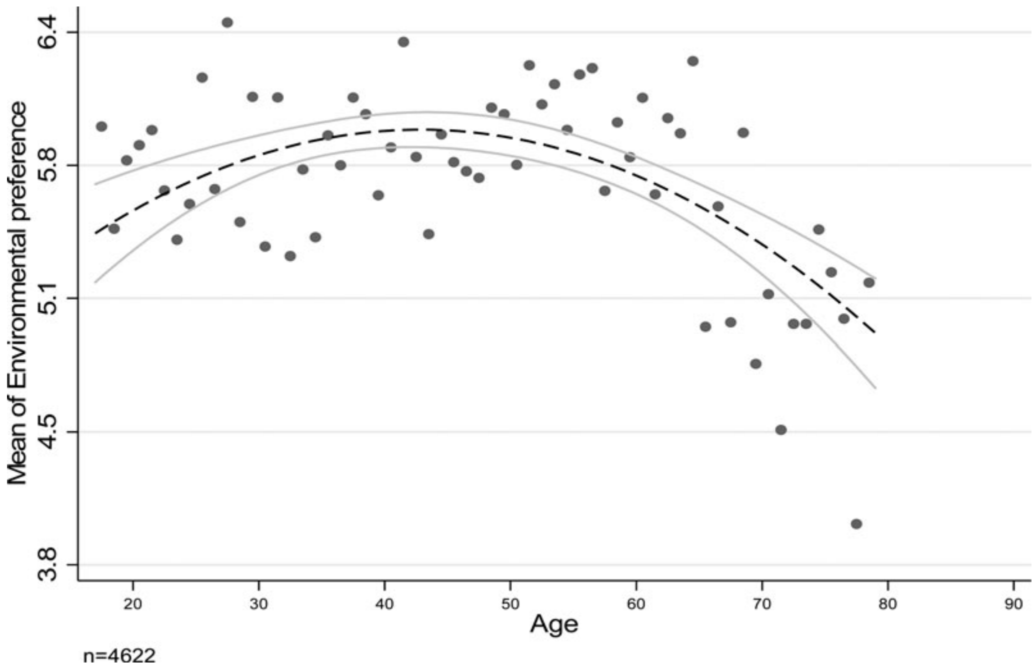

Figure 1. Cross-sectional relationship between age and preferences for environmental protection
Note: the figure depicts the relation between respondents' age and their preferences for protecting the environment measured on an 11-point scale. Dots reflect average preferences in one-year age bins, while the dotted line is a simple quadratic function fitted through the underlying data (with 95 per cent confidence intervals). Data cover a fully balanced rotating panel including surveys from 1989–1993 and 2001–2013.

considers the survey-to-survey rate of change in expressed preferences. As such, each dot in Figure 2 is the average change in support for environmental protection among all people in the sample of a specific age. Given the four-year gap between surveys, the predicted decline in environmental preferences for 64 year olds is 0.168 compared to when they were 60 years old.[5] Extrapolating, the preferences of 72 year olds are predicted to be 0.624 lower than those of 60 year olds. At a mean value for environmental preferences of 5.7, this can be considered a substantively meaningful decline. Referring back to Figure 1, it indicates that a substantial

[5]Appendix Table A2 provides more detailed predicted (four-year) changes in environmental preferences across age groups, expressed as a percentage of the standard deviation of observed preference changes.

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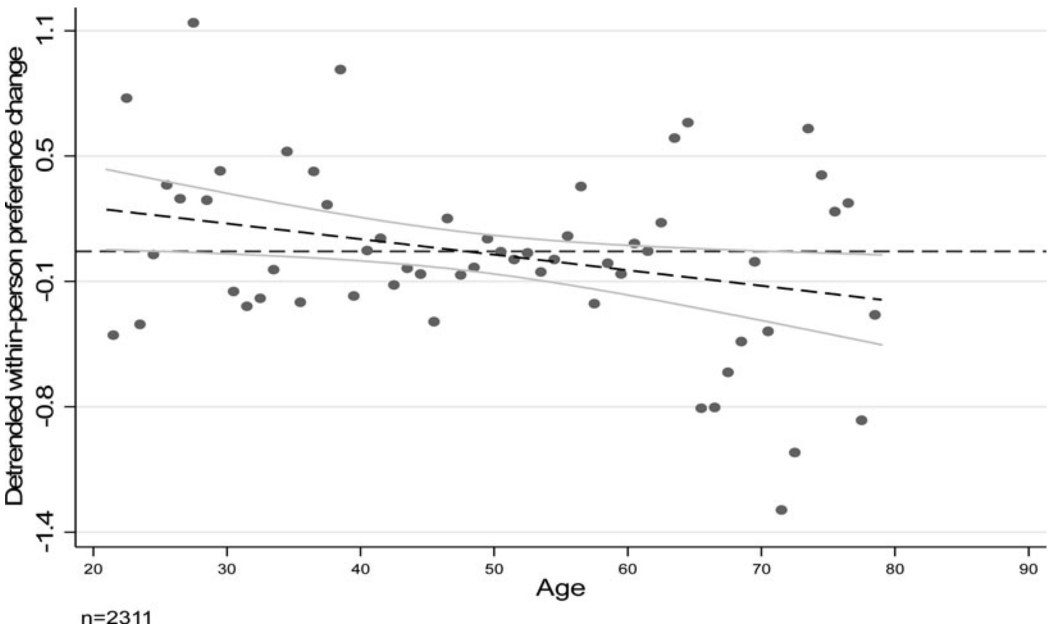

Figure 2. Gradient of change in preferences for environmental protection by age
Note: the vertical axis depicts the de-trended within-person change in respondents' preferences for protecting the environment (with these preferences measured on an 11-point scale), while the horizontal axis depicts respondents' age at the time of the second survey. Dots reflect averages in one-year age bins, while the dotted line is a linear function fitted through the underlying data (with 95 per cent confidence intervals). The dataset covers a fully balanced rotating panel including surveys from 1989–1993 and 2001–2013.

share of the decline in environmental preferences between 60 and 72 years of age may be due to life-cycle effects.

Our findings are important, as the observed life-cycle effects will at least partly mitigate any cohort effect towards greater environmental concerns (Inglehart 1971; Inglehart 1981; Inglehart 1990; Inglehart and Abramson 1994). Especially in rapidly aging societies – such as most advanced economies – and the concomitant increase in the median voter's age, this may have a considerable impact on future environmental policies.[6]

Conclusion

Environmental protection is a costly investment in the short term, but may yield substantial long-term benefits. As both the elderly (due to shorter remaining life spans) and the young (due to a lack of offspring and deficient knowledge/understanding of environmental risks) may discount these future benefits more, popular support for environmental protection might display an inverted-U-shaped life-cycle effect that reaches its peak during middle age. Within rapidly ageing

[6]We experimented with a replication of our analysis on the German SOEP dataset (1984–2016). While this covers annual surveys of a large sample of individuals ($N \approx 85{,}000$), it unfortunately has two main limitations for our analysis. First, the panel suffers from extensive attrition and roll-over (for example, 50 per cent of respondents answers four or fewer survey rounds), which induces important concerns about self-selection (for example, 5 per cent of respondents answers 25 or more surveys) and sample representativeness. Secondly, the key question of relevance in the dataset is 'How concerned are you about the environment?'. Its three answer options – 'very concerned', 'somewhat concerned', 'not at all concerned' – induce strong clustering on the middle option (55 per cent of all responses) and drastically limit within-person variation over time (65 per cent of year-on-year 'changes' is zero). Even so, replicating the analysis using this dataset confirms our negative and statistically significant point estimate for the age variable. Yet, it is substantively small and suggests that – unlike in Norway – ageing plays only a trivial role in the temporal variation in environmental concerns in Germany. Full details available upon request.

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Western societies, this may make future policies *less* rather than *more* environmentally friendly. As such, it could mitigate any cohort effects tending towards greater concerns about environmental protection among younger generations.

Ours is the first study on environmental concerns to employ panel data. This is important since it helps us identify *non-linear* life-cycle effects that are independent of cohort and time effects (Cheng, Powdthavee and Oswald. 2017). Furthermore, we make an important methodological contribution to the literature by exploiting the first-derivative properties of the environmental concern function. Based on data from overlapping panels embedded in Norwegian Election Survey data over the period 1989–2013, our results provide evidence of an inverted-U-shaped life-cycle effect in environmental concerns. Particularly among the elderly, we observe that becoming older has a substantively meaningful negative effect on expressed preferences for environmental protection. Extrapolating from our main findings, ageing is predicted to reduce the environmental preferences of 72 year olds by roughly 11 per cent relative to 60 year olds.[7]

Although our panel dataset provides crucial benefits over previous work using repeated cross-sectional data, it has some limitations. Ideally, we would prefer to observe individuals' environmental preferences over a much longer time frame (for example, from age 18 to their late 70s or 80s) and cover a wider range of indicators of environmental preferences (including behavioural indicators such as consumption patterns). This would strengthen confidence in the estimated effects that are attributable to age, and allow us to generate more sophisticated measures as well as cross-reference the results across indicators. Creating such a dataset would be an important investment for future scholarship.

Finally, it is important to observe that our non-linear life-cycle effect does not necessarily negate changes over time arising from generational differences. We cannot assess this since our approach is unable to identify such cohort effects. Future research should aim to disentangle the *relative* importance of cohort versus life-cycle influences on environmental attitudes. Based on our findings, this is critical for predicting future developments in preferences towards environmentally friendly policies. This is emphatically *not* a simple task; it requires individual-level survey data covering long timespans as well as innovative research designs.

Supplementary material. Data replication files for the analysis using Stata are available on Harvard Dataverse at: https://doi.org/10.7910/DVN/FO4HLG, (see also https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/64DIJQ) and online appendices at: https://doi.org/10.1017/S0007123419000607.

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[7]It would be interesting in future research to assess whether, and to what extent, this result depends on individuals having (grand)children.

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