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Olivos, Francisco; Palomo Vélez, Gonzalo; Olivos-Jara, Pablo; Minhui, Liu

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Educational attainment and environmental concern in China: An instrumental variable approach

Francisco Olivos,[1] Gonzalo Palomo-Vélez,[2] Pablo Olivos-Jara,[3] and Minhui Liu[4]
[1]*The Chinese University of Hong Kong, Hong Kong, Hong Kong,* [2]*University of Groningen, Groningen, The Netherlands,* [3]*Universidad de Castilla-La Mancha, Ciudad Real, Spain, and* [4]*Lingnan University, Tuen Mun, Hong Kong*

Formal education is theorised to be an essential vehicle to promote and trigger pro-environmental attitudes and behavioural changes among citizens via the increase of public awareness and concern. However, robust estimations of its causal effect on individuals' concern for the environment are scarce. This study aimed to estimate the effect of educational attainment on environmental concern in China, addressing the problem of endogeneity. China is the largest emitter of CO_2 and faces severe environmental problems due to its rapid process of industrialisation and urbanisation. The findings show that educational attainment has a robust positive causal effect on environmental concern in China. After addressing potential endogeneity issues using an instrumental variable approach, the effect is stronger than a conventional ordinal least squares estimation. Thus, education is a crucial path of action to promote environmental concern and subsequent pro-environmental behaviour in China.

Keywords: China, educational attainment, environmental concern, instrumental variable.

Climate change is one of the most pressing problems that the world is currently facing. The rise in average global temperature seen during the past decades is not just a consequence of naturally occurring climate variations but also an effect of increasing anthropogenic greenhouse gas emissions (Rosenzweig et al., 2008). Moreover, if no action is taken to reduce these emissions, global temperatures are expected to continue rising in the coming years, having profound ecological and social impacts (IPCC, 2018). China is the largest emitter of CO_2 (Liu et al., 2013) and faces severe environmental problems due to its rapid process of industrialisation and urbanisation (Chen, Chen, & Fath, 2014). China is also a centralised society, and the top-down management system hampers addressing complicated environmental issues that require public participation (Zhang, Geng, & Sun, 2017). However, formal education might still be an essential vehicle to promote and trigger pro-environmental attitudinal and behavioural changes among Chinese citizens via the increase of public awareness and concern about climate. Increased concern about environmental issues might facilitate the adoption of environmental public policies, and encourage individual actions aimed at reducing carbon footprint.

Correspondence: Francisco Olivos, The Chinese University of Hong Kong, Hong Kong, Hong Kong. E-mail: fjolivos@link.cuhk.edu.hk

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A large body of research has shown that environmental considerations such as biospheric values, environmental self-identity, and environmental concern are positively related to pro-environmental behaviours (e.g., Balundė, Perlaviciute, & Steg, 2019; Gatersleben, Murtagh, & Abrahamse, 2014; de Groot & Steg, 2008). Environmental concern—the general (cognitive and affective) evaluation of environmental protection (e.g., Weigel & Weigel, 1978)—has become a relevant research field concerning the promotion of sustainable behaviour. Indeed, recent studies have shown that environmental concern (EC) is positively related to different pro-environmental behaviours either directly or indirectly (Enzler, Diekmann, & Liebe, 2019; Landry, Gifford, Milfont, Weeks, & Arnocky, 2018; Tam & Chan, 2017). Moreover, some literature has also linked EC with specific climate change mitigation actions. For instance, research has shown that American citizens who score higher in biospheric EC (i.e., being concerned about global sustainability problems because of their potential consequences on nature itself) tend to experience climate-change-related threats as having profound adverse effects in their lives and those of their families. Such negative perceptions of climate change threats, in turn, lead them to carry out more pro-environmental actions (Helm et al., 2018). Similarly, both general environmental and climate change concerns positively influence the degree to which people accept the use of renewable energy sources such as solar, wind, and hydroelectric energy to help prevent climate change (Spence et al., 2010).

However, although this research agenda has been relatively productive, some scholars have started to voice concerns about the overrepresentation of Western samples in environmental sustainability research. As a matter of fact, only a few studies on related topics have been conducted in Asia (Xue et al., 2014). Some researchers have even questioned whether Western-based environmental theories (e.g., the proposition that postmaterialist values hamper environmental sustainability; Inglehart, 1995) can be appropriately applied when studying non-Western populations (Pampel, 2014). Thus, recent calls have pointed to the need to study which factors might be associated with global EC, climate change mitigation actions, and pro-environmental behaviour more broadly, in demographic and culturally divergent non-Western societies (Milfont, 2012; Rasool & Ogunbode, 2015; Tam & Chan, 2017). This underrepresentation contrasts with non-Western societies' large share of environmental pollution (e.g., the mass of mismanaged plastic waste by Southeast and East Asia; Jambeck et al., 2015). As such, the present research examines one crucial factor that might influence EC in China: educational attainment. Although education is acknowledged as one of the factors that could generate positive changes in EC (for a review of predictors of EC, see Newman & Fernandes, 2016), robust estimations of its causal effect on individuals' concern for the environment are scarce. Therefore, in this study, we estimate the causal effect of educational attainment on EC among Chinese citizens.

This study applies an instrumental variable (IV) approach (Angrist & Imbens, 1995; Bollen, 2012; Bollmann, Rouzinov, Berchtold, & Rossier, 2019), which is a common tool in other social sciences but underused in social psychology (Bollen, 2012; MacKinnon & Pirlott, 2015). Thus, this article makes a broader methodological contribution to the discipline. We seek to highlight the value of this quasi-experimental method and the importance of addressing correlation between independent variables and the error term in the statistical model (endogeneity) in observational studies. An observational study refers to one where researchers observe a phenomenon and cannot manipulate or decide who is or is not exposed to it (Rosenbaum, 2010), such as personality, place of residency, or educational level. Fully controlled randomisation in experiments is the gold standard of social psychologists. However, the availability of large-scale surveys and big data offers new opportunities for social psychological research different from the experimental approaches. Thus, a more diverse pool of causal tools will enable the exploration of rich data and, simultaneously, allow for strong causal inference.

This article is structured as follows. First, the theoretical framework about the relationship between educational attainment and EC is discussed. Several research traditions in social psychology provide theoretical predictions of the positive effect of schooling on EC. Next, the problem of endogeneity is introduced as well as its solution through IVs. Given those theoretical and methodological considerations, our data, measurement, and analytical strategy are then presented. The theoretical prediction is tested in the Results section, including robustness checks and a comparison with a traditional correlational approach. Finally, we discuss our results in the Conclusion.

How Does Educational Attainment Influence EC?

Research has shown that education (both formal and informal) tends to have a positive effect on EC as well as on specific pro-environmental behaviours such as willingness to pay for greener products (Heyl et al., 2013; Witzke & Urfei, 2001; Xu et al., 2012). Indeed, Jensen (2002), in his theoretical analysis of Kollmuss and Agyeman (2002), suggested that although education and knowledge do not lead to pro-environmental behaviours, per se, they still affect other factors that might motivate such actions (e.g., values, concern). For example, the literature has suggested that more educated people are more likely to exhibit higher levels of environmental knowledge, develop positive environmental attitudes, and report higher EC (Diamantopoulos et al., 2003; Samdahl & Robertson, 1989; Zimmer, Stafford, & Stafford, 1994). Educational attainment also seems to affect pro-environmental behaviours. Different studies have shown a positive relationship between educational level and the likelihood of engaging in sustainable behaviours such as consumption of recycled paper products, the boycott of overpackaged items, avoiding turning on the heat, and turning off the tap (Lynn & Longhi, 2011).

Similarly, Post and Meng (2018) reported that individuals who completed secondary and postsecondary education were more likely to prioritise the protection of the environment over economic growth than are those who did not finish secondary education. Besides, individuals who prioritised the environment over economic growth due to their educational attainment were also more likely to engage in pro-environmental behaviours such as donating money to an environmental cause, participating in demonstrations for the environment, and joining an environmental charity. However, given that omitted individual or contextual variables (e.g., values, personality traits, personal norms) may affect both individuals' educational attainment and EC, causal conclusions from these positive associations are usually hard to draw. Because of this, understanding the theoretical paths that could connect educational attainment and EC might provide a better explanation of this relationship.

Although theorisations about how education could affect EC are relatively scarce, some scholars have made proposals contributing to theory-building in this regard. Moreover, theories about the effect on pro-environmental behaviours can also inform about the effect on EC due to potential shared mechanisms. For instance, Chankrajang and Muttarak (2017) suggested that education could positively influence pro-environmental behavior and attitudes via the acquisition of knowledge. Indeed, formal schooling may provide individuals with the knowledge and skills required to understand environmental problems. They are often complex because of their (usually embedded) political roots and implications, science-related terminology, and associated risks (Chankrajang & Muttarak, 2017; Zhao, Gao, Wu, Wang, & Zhu, 2014). Thus, knowledge is also a key predictor of EC. Early research on this topic has suggested that educational attainment seems to be positively associated with environmental knowledge (Ostman & Parker, 1987). Similarly, a more recent study (Haron, Paim, & Yahaya, 2005) has reported that participants who had not completed high school tended to have less environmental knowledge than did those who had. As a matter of fact, Krosnick et al. (2006) showed that certainty about climate change is a function of knowledge and previous thoughts.

Education does not seem to be associated with just higher environmental knowledge but also with higher environmental curiosity. Insights from consumer research have suggested that when making purchase decisions, relatively highly educated individuals are likely to evaluate and seek information about the sustainability aspects of different products and make their purchase decisions based on that assessment (Swenson, Wells, & Wells, 2018). These effects might not necessarily derive from years of schooling, per se, but more broadly from the adoption of more sustainability-oriented educational programs and study plans. Indeed, systematic literature reviews have indicated that environmental education programs generally yield positive outcomes among young adults (M. J. Stern, Powell, & Hill, 2014) and children (Ardoin, Bowers, Roth, & Holthuis, 2018). That being said, at least from a theoretical viewpoint, some authors have argued that schooling could still influence the comprehension of environmental problems and sustainability-related information, no matter the emphasis and contents of an educational program. For example, Post and Meng (2018) proposed that educational attainment can promote social change through either cognitive change or its influence on collectively accepted values and norms. Regarding the former, the authors suggested that as schooling tends to be positively linked with (tested) intelligence (Carlsson, Dahl, Öckert, & Rooth, 2015), the cognitive change derived from it might enable the understanding of relatively complex environmental processes such as climate change, and thus affect EC and environmental attitudes.

Finally, the positive influence of education on EC might not come only from increasing cognitive processing and learning of skills required to understand difficult environmental information but also derive from the effect of education on moral development. A potential alternative explanation for the link between educational attainment and EC (and environmental behaviour) is associated with people's moral development. Moral judgements predict the willingness to prioritise humanitarian and EC over personal and national self-interest, such as willingness to sacrifice one's life to save (human and nonhuman) others (Crimston, Bain, Hornsey, & Bastian, 2016). Because schooling years go hand in hand with individual growth and development, it could be the case that the increment in EC is a by-product of individuals' moral psychological development promoted by education. Indeed, some literature has suggested that although it is usual to register growth in moral judgement as individuals grow old, education attainment would be a stronger predictor of the development of moral judgement than would mere chronological age, per se (Rest, 1994). Moreover, research has suggested that due to attendance to formal education, complex biological and morally rooted concepts and biocentric reasoning can be introduced earlier than shown in the developmental literature—around the Grades 2 and 5 of primary school (Severson & Kahn, 2010; Villanueva, Villarroel, & Antón, 2018).

In sum, the literature has suggested that educational attainment and EC are positively related. Either via direct paths or indirect ones, attaining higher educational levels seems to predict higher EC. However, how can we be confident that such a relation is not just a by-product of omitted variables? In other words, how can we deal with the endogeneity problem behind this seemingly causal relationship?

The Problem of Endogeneity

Estimating the causal effect of educational attainment on EC brings a methodological challenge. Education is a highly endogenous variable. In statistical terms, a variable is endogenous when there is a correlation between an independent variable and the error term. Bollen (2012) explained this problem following a standard formalisation of an ordinary least squares model:

$$y_i = \alpha + \beta X_i + \varepsilon_i \quad (1)$$

where y_i is a continuous or could be approximate to a continuous dependent variable for the ith case [$i = 1, 2,$

..., N, with N sample size], EC in our case. It is affected by an independent variable X_i—educational attainment in this study—with a coefficient β, α is the regression intercept, and ϵ_i is an error term. In simple words, the error term is the difference between the estimated relationship between education and EC and the actual relationship. Imagine a two-way scatter plot with years of schooling in the y-axis and EC in the x-axis. Every observation has a position in this space. Then, with a statistical model (e.g., linear model), we will draw a line that represents the relationship between these two variables. This line usually lacks perfect goodness of fit, and it cannot cross all the points in the space. Therefore, the sum of the deviations from the regression line will be the error term. A crucial assumption of this model is that the error term (ϵ_i) is uncorrelated with the independent variable, $\mathrm{Cov}(X_i, \epsilon_i) = 0$. If the statistical model does not fulfil this assumption, the estimation could be biased and inconsistent.

Figure 1 illustrates the most common situations in which educational attainment could be correlated with the error term, and the possible solution through an IV. Figure 1a is the fundamental violation described earlier where the educational attainment could be correlated with the error term, $\mathrm{Cov}(X_i, \epsilon_i) \neq 0$. The first situation is a reciprocal relation (Figure 1b) between EC and educational attainment. In our theoretical predictions, we expect an effect of education on EC. Nevertheless, studies in social cognition have suggested that making climate change consequences feel temporally close increases goal-pursuit behaviour (Bashir, Wilson, Lockwood, Chasteen, & Alisat, 2014). Thus, climate change concern affects behaviours that promote educational achievement. In addition, students who are aware of climate change or have developed pro-environmental behaviour could be prone to achieve tertiary or postgraduate education and act as scientists. The effects could be found in both directions, which creates a correlation of the covariate with the error term. Second, a correlation between educational attainment and the error term is created when there is measurement error (Figure 1c). For instance, older people could not exactly recall their exact years of schooling if they had dropped out. Any stigma attached to incomplete education could also bring about a measurement error because this is deterrence for providing accurate years of schooling. ξ is the true educational attainment without error, which affects EC and the measured educational attainment. The third case is an omitted variable or confounder (Figure 1d). For example, a positive correlation between educational attainment and EC could be explained because a third variable affects both positively; for instance, noncognitive traits that promote educational achievement and EC. This apparent relationship is explained by a confounder. In our case, an omitted variable bias is more plausible than is a reciprocal relationship, and potential confounders are countless. Researchers usually control this bias by including control variables in the models. Z is part of ϵ, which leads ϵ to correlate with X. However, even if a large number of control variables is considered in observational studies, unobserved confounders will remain. If we omit any of them from our estimation, we will introduce a bias or only provide an association that could not represent an actual causal effect. When this endogeneity is not addressed, we could obtain underestimated or overestimated effects.

Researchers in the social sciences have addressed the IVs method as a powerful tool to solve the problem of endogeneity (Angrist & Imbens, 1995; Bollen, 2012; Bollmann et al., 2019), which is represented in Figure 1e. An IV strengthens the causal inference in observational data, although it is underutilised in the social sciences such as sociology and social psychology (Bollen, 2012). In the IV method, an exogenous variable represents the random assignment, and that variable must be associated with the dependent variable only by its effect on the independent variable (MacKinnon & Pirlott, 2015). Meanwhile, that IV cannot be correlated with the error term in the explanatory equation. Using an IV helps to estimate the causal relationship between an independent variable and a dependent variable: The independent variable could be considered as randomised from its prediction by the IV and thereby rules out the effect of confounding variables on that relationship. There are also challenges to this method. As Gage, Munafò, and Davey Smith (2016) revealed, it is difficult to identify valid instruments that are genuinely not related to potential confounders and not subject to reverse causality. Most importantly, testing the validity of such a putative instrument with certainty seem to be impossible, as there may be confounding factors that cannot be measured.

In our analysis, an IV approach is adopted to address the endogeneity of educational attainment. Our IV should satisfy the two assumptions to be valid: (a) to have a relevant effect on educational attainment (relevance criterion) and (b) affect EC only through educational attainment (exclusion criterion). The empirical evidence supporting the relevance of the variable is reported in the analysis section. The requirement of exclusion is theoretically supported. In this study, we use China's 9-years Compulsory Education Law (CEL) as an instrument for educational attainment.[1] If CEL is a valid instrument, it must be uncorrelated with EC. As a governmental policy that affected respondents in their childhood and aimed to increase the educational level of the population, the most obvious way in which it affects EC is through respondents' education. At the

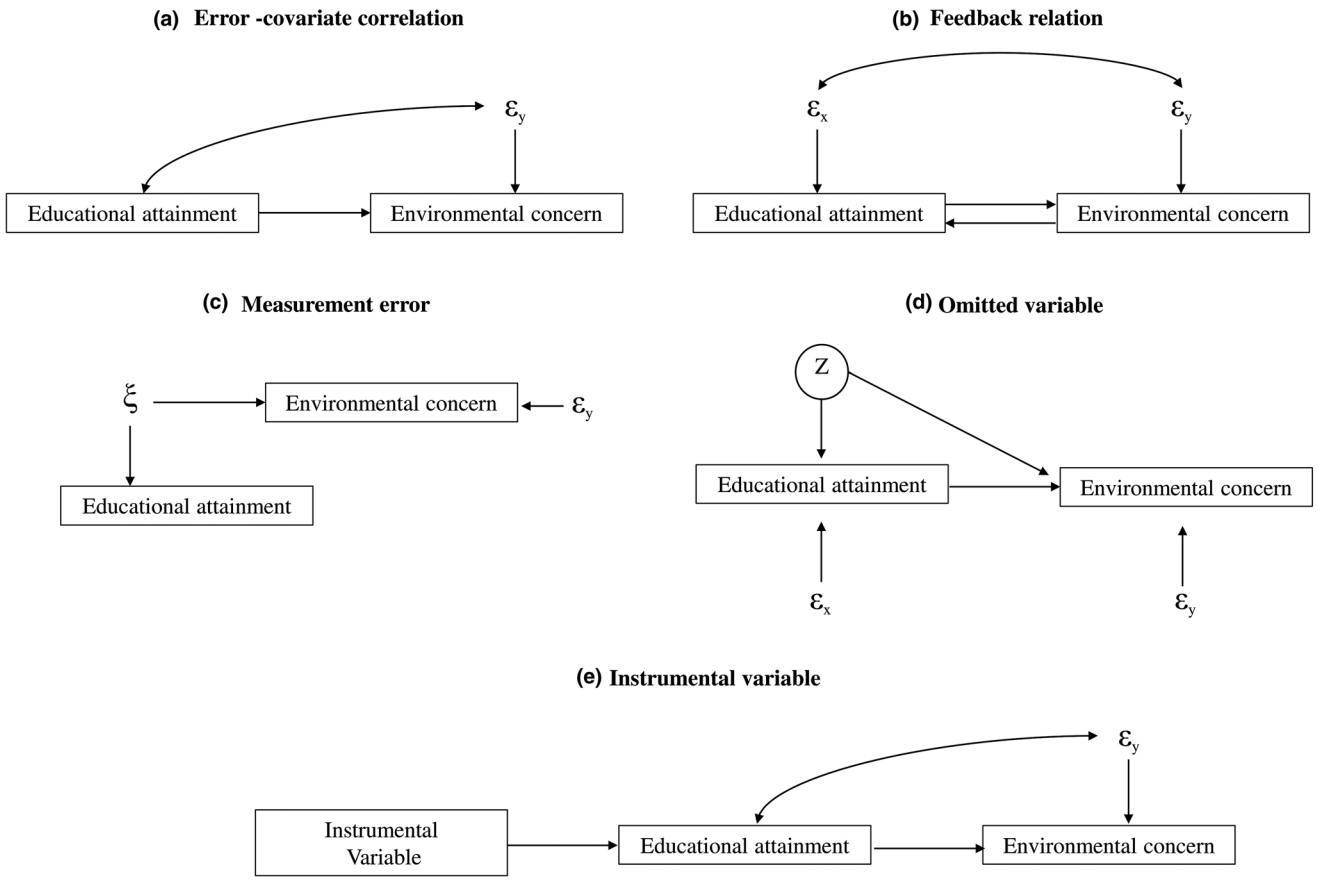

Figure 1 Causes of educational attainment–environmental concern correlation and instrumental variable solution. *Note*. Directed acyclic graphs adapted from Bollen (2012).

same time, as a state policy, it is a decision independent from any individual-level variable. Therefore, the principle of exclusion is hardly violated. Several studies in econometrics have provided similar arguments to support the use of state policies as IVs (e.g., M. Rosenzweig & Wolpin, 2000). The law was passed on April 12, 1986, and officially went into effect on July 1, 1986. However, provinces could have different effective dates for implementing the law. Thus, we instrumentalised years of schooling by the specific provincial date of application of the law. Children over 15 years old when the law became effective were not affected by the law and thus served as our comparison group.[2] Other studies in the Chinese context have used this law to successfully instrumentalise educational attainment (Fang, Eggleston, Rizzo, Rozelle, & Zeckhauser, 2012; Liu, 2007; Xie & Mo, 2014). Following these studies, we only consider people born after 1961 to avoid effects of the cultural revolution. In environmental economics, CELs have been used to assess the effect of education on pro-environmental behaviours in European countries (Meyer, 2015) and Thailand (Chankrajang & Muttarak, 2017).

Previous studies have used IVs to address the endogeneity of education in different fields. Other alternatives to CELs are genetic information (Cuellar-Partida et al., 2016; Viinikainen et al., 2018) and other school policies. Public data sets with genetic information for a representative sample are rarely available, and, to our knowledge, they have not been gathered for Asian samples. Other school policies and supply-side indicators that could instrumentalise educational attainment are student–teacher ratios, per-pupil expenditure, and school availability (Pons & Gonzalo, 2002). However, historical and disaggregated data, at the time when the respondents were school age, are not available for China. Chinese CEL is the best available exogenous information, which is considered a more plausible instrument than are genetic risk scores and state school characteristics (Nguyen et al., 2016).

Method

Data

We analysed data from the second (2012) wave of the Chinese Family Panel Studies (CFPS), which is a nationally representative longitudinal survey of Chinese communities, families, and individuals. CFPS is unique data that include a question about EC as well as details of respondents' residence when the CEL was applied.[3] All members over age 9 in the household were interviewed, and the household was sampled in a multistage (county, village, household) probability draw (Xie & Lu, 2015). Additional respondents' information was obtained from the baseline survey to accurately identify where they were living during the application of the law. In the second wave, this information is only available for new sampled households, but the month of birth was not reported. The specific date is a piece of information necessary to determine whether respondents were affected by the CEL. Therefore, we only considered respondents surveyed in both waves. The cross-wave retention rate of the baseline families in 2012 was 85.3% (Xie et al., 2017). The baseline used computer-assisted personal interviewing and added computer-assisted telephone interviewing in the second wave for non-co-residing family members. As we will explain later, the bandwidth selection led us to select 3,615 final observations.

Measurements

Our dependent variable is the EC measured in the second wave of the CFPS. Following previous research (cf. Wong & Wan, 2011), and given that being aware about the problems regarding the environment lies at the foundational basis of EC (Dunlap & Jones, 2002), we operationalised EC broadly as perceived severity of environmental problems. Additionally, the perception of severity of a threat becomes part of the psychological belief system and arises as a strong indicator of resistance against traumatic experiences such as environmental stressors (Olivos, Pérez-Sales, Eiroa, Barbero, & Vergara, 2020). Respondents were asked, "*How would you rate the severity of the environmental problem in China?"* on a scale of 0 (not severe) to 10 (extremely severe). If the respondent does not think such a problem exists, he or she would record "0." This variable reports a response rate of 84.5%. Although a multi-item measurement is preferable, data availability limits us to utilise a single-item indicator. However, it is a common practice in studies measuring EC and provides a higher level of comparability across context (e.g., Echavarren, 2017; Givens & Jorgenson, 2011; Sundström & McCright, 2014).

Years of schooling is used as the main predictor. The self-declared maximum educational level is used to generate the continuous indicator of years of schooling with a range from 0 to 22 years. Almost all cases of the sample reported this value (99.9%).

Analytical Strategy

The analyses are conducted using two-stage least squares estimations (2SLS). Following standard econometric notation (Young, 2009), we consider an extension of Equation 1:

$$Y_i = \alpha + \beta X_i + Wy' + \varepsilon_i \quad (2)$$

where Wy' is a vector of exogenous variables, and X_i represents the endogenous predictor (years of schooling), which is correlated with the error term [$\mathrm{Cov}(X_\mathrm{i}, \epsilon_i) \neq 0$]. As explained, a simple model like this could provide a biased and inconsistent estimation. Therefore, we introduce an exogenous IV Z_i (0 = 15 years old or older, 1 = less than 15 years old when years the CEL was applied) that affects years of schooling, but is uncorrelated with the error term [$\mathrm{Cov}(Z_i, \epsilon_i) = 0$]. Therefore, this variable strips out the problematic portion of X'_i that is correlated with the error term:

$$X'_i = \pi_0 + \pi_1 Z_i + Wy' + \omega_i \quad (3)$$

The predicted values from this equation represent the portion of X_i that is determined by Z_i and other exogenous variables $\mathrm{W_i}$ uncorrelated with the error term. Everything else that explained X_i is contained in the residual ω_i. For instance, personality trait is a variable that explains years of schooling, but it is not correlated with the instrument Z_i. Thus, it will be contained in the residual (ω_i) of Equation 3. Finally, in the second stage, we estimate the model of EC against years of schooling replacing X_i by the instrumentalized predictor X'_i:

$$Y_i = \alpha + \beta X'_i + Wy' + \varepsilon_i \quad (4)$$

Despite obvious strengths, this estimation shares the limitations of any study using an IV approach. The assumption of the effect of the instrument on the outcome only through the main predictor cannot be tested. Therefore, we can only argue theoretically that the CEL has no direct or indirect effect on the EC more than the effect through schooling. In this regard, Nguyen et al. (2016) compared three instruments to estimate the causal effect of education on dementia in the United States. For them, CELs are not correlated with any individual variable because they are identified from the state and year of birth. Indeed, in the study, CELs are considered more plausible IVs than genetic risk score and state school

characteristics. A second limitation is in the scope. The average treatment effect of education cannot be estimated for the entire population of interest (Heckman & Urzúa, 2010). Instead, the IV approach recovers only the local average treatment effect, which is the average treatment effect for a subset of the Chinese population. The causal inference is about X'_j and not X_j. Thus, our estimation only applies to those who receive treatment if and only if they are induced by the exogenous instrument.

Results

Although several studies have suggested the validity of CELs as instruments of educational attainment (e.g., Meyer, 2015; Nguyen et al., 2016), the first step in the analysis is to show whether the CEL induced years of schooling substantively (relevance criterion). The comparison in the average years of schooling indicates a significant difference between respondents under the age of 15 and older respondents. We can observe this difference in different age groups. Individuals between 15 and 20 years old at the moment of the reform have finished 6.28 years of schooling on average, whereas those between 10 and younger than 15 years old have attained 7.40 years of schooling. The t test suggests that this difference is statistically significant, $t = -8.43$, $df = (5388)$; $p < .000$.

In addition, we implemented a data-driven bandwidth selection for the local polynomial regression discontinuity point estimator (Calonico, Cattaneo, & Farrell, 2018). Based on this procedure, we choose an ad hoc interval of age when the CEL was applied in the province of residence. All observations within this interval are included and equally weighted whereas all observations outside the interval are excluded. The estimated mean square error (MSE) optimal bandwidth with triangular kernel weights suggests that the optimal interval of analysis are respondents in the range between 3.204 years under the age of 15 (treated group) and 3.204 years older (control group). The common bandwidth that minimises the MSE of the sum of the regression coefficients also suggests a similar interval (3.551). We used the latest that enabled a larger sample size. Table 1 summarises results of the effect of the CEL on educational attainment using regression discontinuity. This estimation approximates the regression function only near the cutoff (year of the CEL application) and within the bandwidth. As suggested by the regression discontinuity design literature (Gelman & Imbens, 2019), linear and quadratic orders of the local polynomial are used in this adjustment (linear and quadratic). In both cases, the results suggest an increase in the years of schooling due to the CEL. Overall, this analysis confirms the relevance of our IV in inducing the theorised predictor.

Table 1
Regression Discontinuity of Years of Schooling After Compulsory Education Law

	Before law	After law
No. of observations	7,091	8,300
Effective no. of observations	2,152	1,762
Regression discontinuity		
	Linear polynomial β	Quadratic polynomial β
Compulsory Law	0.56*	0.81*
	(0.33)	(0.49)

Note. Year of birth as been included as a covariate in both models.
*$p < .1$.

Table 2 reports the main findings of the analysis. Model 1 reports an OLS regression with the year of birth (time trend), gender, and hukou[4] as control variables. This is a common model that does not account for the endogeneity of education attainment. In contrast to a causal inference approach, this estimation is only correlational. The control by year of birth is essential to address the educational expansion process of China and other time trends. The coefficient indicates that one additional year of schooling increases the EC 0.10 points, $p < .000$. However, as mentioned, this effect could be biased by any omitted variable such as socioeconomic status or personality traits. Model 2 includes our IV. This model suggests a much stronger effect of years of schooling on EC as predicted by the OLS model, $\beta = 0.37$, $p < .000$. The Cragg-Donald Wald F statistic is far above the threshold of 10, which suggests the relevance of our IV. Thus, without addressing endogeneity, the importance of education for EC is underestimated. The difference with an OLS estimation is the main novel finding and suggests the need of addressing the causal inference in future research. Figure 2 shows the predicted EC by years of schooling based on the IV estimation. The comparison of extremes is illustrative. Although respondents without formal education have an EC of 3.35 points, respondents who achieved tertiary education or 15 years of schooling have 8.91 points in a range from 0 to 10.

Models 3 and 4 report additional robustness checks. These analyses enable us to explore the stability of our estimates to alternative specifications and potential model variations (Neumayer & Plümper, 2017). Robustness checks are required to show the validity and credibility of our results. First, a placebo test is conducted. Researchers could argue that the results are an

Table 2
Estimated Effects of Years of Schooling on Respondents' Environmental Concern

Variable	Model 1 OLS	Model 2 2SLS	Model 3 Placebo	Model 4 Alternative bandwidth
Years of schooling	0.10**	0.37**	−0.16	0.41**
	(0.01)	(0.17)	(0.20)	(0.19)
Observations	3,615	3,615	2,620	3,313
Cragg-Donald Wald *F*	–	22.60	13.85	18.59

Note. All models include year of birth gender and hukou of the respondent. Robust *SE*s clustered at community level are in parentheses. OLS = ordinal least squares estimation; 2SLS = two-stage least squares estimations.
** $p < .05$; *** $p < .01$.

artefact, and the relevance of the CEL might be tested. The analysis depends on the effect that CEL has on educational attainment. Therefore, we intentionally introduce a model misspecification. CEL is replaced by another treatment that should not have an effect on educational attainment. Like a placebo-controlled study, an alternative cutoff point (placebo) should have no real effect because it is not related to educational attainment. We chose 10 years old as the cutoff instead of 15.[5] As Model 3 suggests, the effect of education is not significant, which suggests robustness against a placebo cutoff point. Second, although the analysis suggests a specific bandwidth, we modified it to question whether the effect is only applicable to this specification. A robust effect should also be constant upon variation of the bandwidth. Model 4 reports the results for the alternative and symmetrical bandwidth (3.204 years) using the MSE-optimal. The effect of years of schooling was still significant and in the same direction. In sum, our findings indicate that years of schooling increases the EC of the Chinese population under analysis. This effect increases when endogeneity is addressed.

Discussion

This study aimed to estimate the effect of educational attainment on EC in China, addressing the problem of endogeneity. The findings show that educational attainment has a robust positive causal effect on EC in China. This implies the importance of educational attainment in Chinese society, and its significant role in today's China to promote sustainability. In addition, we proved that this line of research is appropriate and relevant in the Chinese cultural context, and the statistical results are

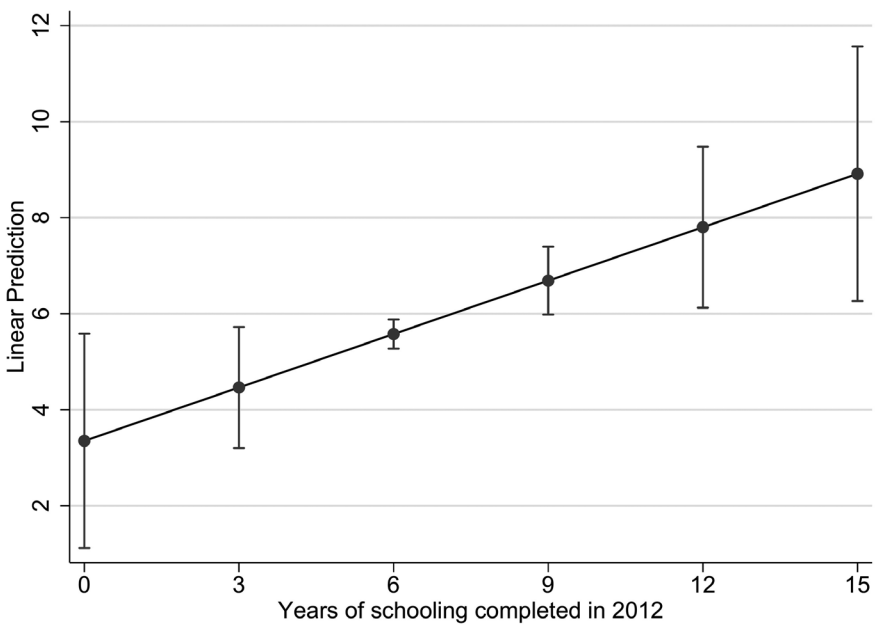

Figure 2 Linear prediction of environmental concern by years of schooling (95% confidence interval).

consistent with findings from Western populations. A future study could contribute to such evidence by applying data from Japan and Korea, which are also culturally influenced by Confucianism and in different stages of economic development. After addressing potential endogeneity issues using a novel methodological approach, the effect is stronger than a conventional OLS estimation. Overcoming the limitations of previous studies based on correlation, we ruled out potential confounders and potential bidirectionality. It also raises doubts about existing evidence that could underestimate the effect of education on individuals' environmental concerns or other variables related to pro-environmental behaviour or climate change attitudes. Future studies using observational data might incorporate quasi-experimental tools. Henceforth, and consistent with what has been established in the global education 2030 agenda (Leicht, Heiss, & Byun, 2018), education is a crucial path of action to promote EC and subsequent pro-environmental behaviour in the largest emitter of CO_2 in the world—China. The literature has shown that EC is a precondition of pro-environmental behaviours against the climate change effects, such as willingness to pay, the boycott of overpackaged items, and turning up the heat, among others. In sum, this research highlights the link between EC and educational attainment and points out its relevance as a key subject for climate change understanding.

Experiments have been, for a long time, the most robust empirical strategy used in social psychology. Despite the increasing availability of high-quality observational data in social psychological research, issues of endogeneity in correlational analyses are seldom addressed. Thus, approaches such as IVs provide opportunities for a credibility revolution (Angrist & Pischke, 2010) in psychological studies relying on statistical associations. Indeed, related long-standing social and environmental psychology- research questions that in one way or another suffer from the problem of endogeneity could be potentially tackled using this or another causal method for observational studies. For example, an IV such as information regarding where a person grew up (e.g., rural vs. urban area; cf. Martin & Czellar, 2017) could be harnessed to study the directionality of the association between nature connectedness and exposure to green areas (i.e., Does higher connection with nature lead to higher preference for green areas, or it is the other way around?). Other potential IVs could be used to test a causal explanation for the relation between pro-environmental behaviour and well-being (cf. Wang & Kang, 2019). Indeed, previous literature has shown that the use of an IV approach to study research topics where the manipulation of independent variables is not feasible is a suitable alternative to draw causal conclusions from otherwise correlational data. In fact, some recent examples have already noted the value of the IV approach by using it, for example, to address the directionality of the association between environmental identity and biospheric values (Martin & Czellar, 2017). Similarly, other research investigating the relation between environmental motivations and adoption of energy-efficient measures have used people's personal experience with extreme weather events to solve the question about the causality direction of this association (Udalov, Perret, & Vasseur, 2017). In other words, as personal experience with extreme weather is likely to be associated to environmental motivation, but not to the adoption of energy-efficient measures, such a variable met the criteria to be used as an IV to draw (causal) conclusions regarding this association that otherwise would only have a correlational scope. Moreover, in the context of climate change, Sohlberg (2016) showed that political party elites influence public opinion on climate change (and not the other way around) by applying an IV based on countries' political representation systems. In short, Sohlberg (2016) proposed that political elites from countries where there were just a few big parties (as compared to countries with multiple parties and, therefore, multiple views on social issues) would influence people's personal actions to fight climate change due to the fact that when political elites are not divided on environmental issues, people tend to perceived climate change as a threat.

Although our conclusions are only generalisable to the population within the bandwidth, our results show that the role of education in today's China is significant in promoting sustainability. After the educational expansion in recent decades, the potential effects of years of education could still be more comprehensive because educational curriculums at all levels also require the promotion of awareness and climate change action. In this regard, a gap between environmental education policy and practices has been diagnosed (Zhan, He, & So, 2019) in primary education. Both the lack of environmental programs adapted to the local environment and lecture-based teaching hinder effective environmental curriculums. Moreover, recent studies have shown that greener education of higher education institutions in China needs to be improved (Xiong et al., 2013), with those funded by local governments as least successful in addressing environmental issues. Therefore, China should not exclusively rely on the increasing educational levels of the general population for climate action—progress in environmental curriculums is also necessary.

Beyond IV's strengths, social psychologists might consider limitations of IVs. First, the exclusion criterion remains always untested. Researchers might use previous studies and a strong rationale to logically argue the effect on the outcome of interest only through the key predictor.

In social psychology, it is particularly difficult because individual behaviours and cognition have latent constructs that could open a path to affect the outcome. Second, the causal inference only applies to the induced effect of the IV. In our case, the estimated effect of education on EC only refers to the portion of variance explained by the IV. The effect of the remaining variation of educational attainment is not taken into account. Overall, under certain circumstances such as weak IVs or effects of the IV on the outcome due to confounders (Bound, Jaeger, & Baker, 1995; Martens, Pestman, de Boer, Belitser, & Klungel, 2006), estimations without IV could be even more accurate than estimations with an invalid IV.

Further studies might address some of the limitations of this study. Due to our single-item approach, different kinds of ECs cannot be untangled. Value-belief-norm theory (Stern & Dietz, 1994) differentiates three kinds of EC (egoistic, altruistic, and biospheric), and they could have different relationships with education. In addition, this single-country study provides a theoretical framework and analytical strategy that could be extended to other cases in the East Asian and Southeast Asian regions. Finally, this study has provided robust evidence of a causal pathway between education and EC. However, it cannot be equated to a direct effect of education because the effect could be through any of the theoretical mechanism discussed earlier. Education could promote either moral development, knowledge acquisition, or both. Indeed, following previous research combining the use of an IV approach and mediation (cf. Sohlberg, 2016), future studies could therefore expand on these results by testing whether the causal effect of educational attainment on EC is in fact due to an increase in any of the mentioned mechanisms. Importantly, such studies should focus on the pathway from education to the mechanism(s), and from the latter to EC. That being said, the robust effect of education is very much the key component in future attempts to understand EC and potential constructs that could generate behavioural change. Overall, and beyond the limitations, this article is an invitation to address endogeneity in environmental and social psychology to provide more robust evidence to fight climate change.

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Conflict of Interest

The authors declare that they have no conflicts of interest with respect to their authorship or the publication of this article.

Authors' Contribution

Francisco Olivos conceived of the presented idea. Gonzalo Palomo-Velez and Pablo Olivos-Jara developed the theory. Francisco Olivos and Minhui Liu designed the research and conducted the analyses. All authors discussed the results and contributed to the final article.

Data Availability Statement

The data that support the findings of this study are openly available in the China Family Panel Studies public repository at http://doi.org/10.18170/DVN/45LCSO.

Notes

1 CEL did not include changes in curriculum, and China has a highly standardised educational system. Therefore, the effect is hardly confounded by educational curriculum.
2 For instance, if a 13-year-old student had studied for 8 years, they cannot drop out. They were obligated by the new law to complete at least 9 years of schooling. In contrast, if the student was 16 years old when the law started, they must not continue compulsorily or return to the school in case they had dropped out to complete the 9 years.
3 Respondents were about their residence when 12 years old. We assume that they maintain this residence up to 15 years old.
4 System of household registration in China.
5 Additional models using 12 and 17 years were estimated. The results were consistent. Models provided under request.

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