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On Individualism and Environmental Quality

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Abstract

We examine whether a society's orientation toward individualism causally influences per-capita carbon dioxide (CO₂) emissions. We conceptualize the link through a collective action framework: because atmospheric quality is a global public good, its provision requires coordinated restraint, and cultural individualism, which places primacy on personal autonomy over group norms, is predicted to erode precisely the internalization of collective costs that pro-environmental behavior demands. We show that a one-point increase in Hofstede's individualism index is associated with an increase of approximately 0.04 metric tons of CO₂ per capita. Endogeneity is addressed using blood-type genetic distance and confirm our results.

Keywords: individualism, collective action, CO₂ emissions, genetic distance, cross-country

JEL Codes: Q52, Q54, H89

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I. Introduction

Why do some countries pollute substantially more than others, even after accounting for their level of economic development? Differences in regulatory stringency, industrial composition, and income obviously matter. Yet economists and social scientists have increasingly recognized that these proximate determinants are themselves shaped by a deeper layer of cultural values that differ systematically across societies (Alesina and Giuliano, 2015; Tabellini, 2010). Chief among these cultural dimensions is the axis of individualism versus collectivism—the degree to which a society instills in its members a sense that they are independent agents primarily accountable to themselves rather than embedded members of a larger group whose welfare they internalize (Hofstede, 2001). This paper asks whether cultural individualism, measured at the country level by Hofstede's (2001) index, is causally linked to per-capita CO₂ emissions. The prediction we test is theoretically grounded in the economics of collective action. Reducing carbon emissions is a canonical public goods problem: the atmosphere is a non-excludable, non-rival resource, and the costs of restraint are borne privately while the benefits are diffused globally, and it is formalized as the tragedy of the commons as rational self-interested agents will overexploit shared resources in the absence of institutional constraints linked to a free-rider, especially acute in large groups such as the global scale at which climate governance operates. What does cultural individualism add to this framework? The argument is not that individualists are selfish in the sense of standard utility-maximizing models, nor that they are behaviorally more self-interested in psychological experiments. Rather, the claim is that collectivist cultures generate stronger internalization of group-level consequences into individual decision-making. In highly collectivist societies, individuals define themselves partly through membership in broader groups, including family, community, nation, and experience harm to those groups as harm to themselves. This is precisely the psychological mechanism that sustains voluntary cooperation in public goods provision. It is therefore collectivism, not individualism, that aligns individual incentives with collective environmental well-being. Culturally individualist societies, by contrast, place autonomy and personal achievement above group obligation, making voluntary restraint in the use of atmospheric commons harder to sustain socially and politically. This is a prediction about cultural orientation at the societal level, not a claim that members of individualist societies are more selfish as individuals: the distinction is fundamental and often conflated in the literature. Identifying this cultural channel empirically is difficult because individualism is correlated with economic development—richer societies tend to score higher on Hofstede's index (Gorodnichenko and

Roland, 2011b)—and income is independently associated with emissions through the Environmental Kuznets Curve (Grossman and Krueger, 1995). To address this, we instrument for cultural individualism using blood-type genetic distance to the United States, an approach developed and validated by Gorodnichenko and Roland (2011b, 2017). Blood-type allele frequencies are genetic markers with no plausible direct effect on industrial emissions; they affect emissions only insofar as they predict cultural orientation through the intergenerational transmission of traits. This exclusion restriction, combined with the documented power of blood distance to predict Hofstede's individualism scores, yields a credible identification strategy. To our knowledge, our study is the first to apply this IV approach to the individualism-pollution nexus. Our contribution is therefore distinct from, and in a precise sense complementary to, a recent literature that examines individualism and environmental policy adoption (Vu, 2023, 2024). Those studies ask whether individualist societies enact more stringent environmental regulation; we ask whether they actually produce cleaner environments. The divergence between these two questions is not merely semantic: if the answer to the first is yes (Vu, 2023, 2024) while the answer to the second is no, as we document, then individualism generates what we term an individualism compliance paradox, a systematic wedge between the formal regulatory ambition of individualist societies and their realized environmental outcomes. Identifying, naming, and providing causal evidence for this paradox is the central contribution of our paper.

In the context above, a critical source of confusion in the literature concerns the distinction between two very different uses of the term “individualism.” In social psychology, an individual's social value orientation (SVO) can be characterized as individualistic, cooperative, altruistic or competitive (Messick and McClintock, 1968; Van Lange, 1999). This is a micro-level characteristic of individual preference structures. In cultural sociology and anthropology, individualism-collectivism describes a property of cultures: whether a society organizes itself around autonomous individuals who set their own goals (individualist) or around groups whose interests take precedence over those of individual members (collectivist) (Triandis, 1995; Hofstede, 2001). These constructs are conceptually and empirically distinct. Living in a culturally individualist society does not imply that one has a selfish SVO. A culturally individualist society may contain many altruists; a collectivist society may contain many who maximize private gain within in-group contexts. What differs is not the content of individual preferences per se but the extent to which group welfare is part of the identity to which those preferences apply. Members of collectivist cultures tend to define their in-group broadly and

experience its welfare as continuous with their own, a form of “expanded self” (Triandis, 1995). This has direct implications for voluntary contribution to public goods: it is not self-interest per se that drives under-provision, but the failure to internalize collective consequences, which is more pronounced when the relevant collective is not part of one’s identity. In this research we make claims about how cultural orientation, not individual behavioral dispositions, shapes aggregate environmental outcomes. The mechanism we propose operates at the societal level through political economy, social norms, and the cultural sustainability of voluntary restraint, not through individual psychological preferences.

We show that despite the stronger formal policy of individualist societies, those societies produce systematically higher per-capita CO₂ emissions. In the context of the current literature (e.g., Vu, 2023, 2024), we reveal a striking empirical pattern: individualism generates stronger environmental laws and dirtier air simultaneously. We call this, the “individualism compliance paradox”, and it has no counterpart in the existing literature. The paradox is theoretically coherent: individualist societies may produce stronger formal regulation through their more competitive political systems and better governance, while simultaneously generating weaker voluntary behavioral compliance and informal norm enforcement—exactly the cultural mechanisms our framework emphasizes. No prior study identifies this wedge between policy adoption and environmental outcomes as a distinct phenomenon driven by cultural individualism and doing so is the primary contribution of the present paper.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature. Section 3 develops a simple theoretical framework linking. Section 4 describes the data and empirical methodology. Section 5 presents our main results. Section 6 presents robustness analysis and Section 7 concludes.

2. Relevant Literature

Despite its theoretical plausibility, the empirical literature on culture and pollution is relatively thin. Halkos and Zisiadou (2018) provide a cross-national analysis relating environmental performance indices to Hofstede’s cultural dimensions and find that cultural factors explain a significant share of variance in environmental outcomes even after controlling for income. Disli, et al., (2016) study CO₂ emissions in a panel of 69 countries using system GMM and find that several Hofstede dimensions shift the Environmental Kuznets Curve: masculinity and power distance raise

emissions, while individualism and long-term orientation lower them. That last finding, that individualism reduces CO₂, differs from our result and may reflect their use of panel data spanning a longer and more recent period as well as different specification choices. Husted (2005) argues that national culture, particularly power distance and masculinity, shapes the institutional capacity for environmental sustainability. Park et al., (2007) reach broadly similar conclusions, finding power distance particularly important. Dangelico et al., (2020) test all six Hofstede dimensions against environmental performance measures for 62 countries and find effects that vary considerably across dimensions and performance indicators. The most directly related studies are Vu (2023, 2024), but they address fundamentally different questions from ours, and the differences are clarifying rather than merely academic. Vu (2023) examines individualism and climate policy stringency across 92 countries, using Hofstede's index and the same blood-distance instrument from Gorodnichenko and Roland (2017) that we employ. He finds that individualistic countries adopt more stringent climate change policies, partly through stronger governance quality and greater female political representation. Vu (2024) extends this to examine collective responses to climate change more broadly, confirming a positive link between individualism and formal climate commitments. These are important results. But they measure policy inputs—the regulatory architecture that governments construct—not environmental outputs: the actual state of the atmosphere. Our paper fills precisely this gap.

The theoretical foundations for expecting cultural orientation to influence environmental outcomes rest on the economics of collective action. The tragedy of the commons established the baseline problem: the atmosphere is a common-pool resource susceptible to overuse when individual costs of restraint are privately borne but benefits are collectively shared and in large groups face especially severe free-rider problems given the individual's contribution is imperceptible and incentives to contribute depend on selective benefits that are difficult to organize at scale. Ostrom (1990) complicated this stark prediction by documenting that communities often devise self-governing institutions that sustain commons over long periods. Her analysis identified shared cultural norms and particularly norms of reciprocity and mutual monitoring as necessary ingredients for successful commons governance. Crucially, she noted that the design principles underlying successful institutions depend on participants internalizing collective outcomes, precisely what we argue is undermined by individualist cultural orientation. Further, Ostrom (2010) extended this analysis to climate change, arguing that polycentric systems with multiple nested governance levels are needed

because local voluntary action depends on cultural legitimacy that global mandates cannot supply. Dietz et al., (2003) further stress that social norms and community engagement are indispensable complements to formal regulation, and that cultures differing in their emphasis on shared identity will differ in how effectively these informal governance mechanisms operate. This literature does not predict that individualism prevents environmental policy. What it predicts is that the informal, voluntary, and norm-based mechanisms that complement formal regulation are weaker in individualist societies. The aggregate effect on emissions depends on the balance between formal policy strength, where individualist societies may perform better, and voluntary behavioral compliance, where collectivist societies may have an advantage. Our empirical exercise measures the net outcome.

In this context, Gorodnichenko and Roland (2011a, 2011b, 2017) provide the most systematic empirical treatment, showing that individualism is the cultural dimension most robustly correlated with long-run economic growth and innovation. Their interpretation is that individualist cultures reward deviance from group norms whereas collectivist cultures impose conformity costs that deter experimentation. This growth channel also matters for our study because it implies that the positive correlation between individualism and income in our sample is not mechanical; rather, it reflects a genuine cultural mechanism with predictable economic consequences. Tabellini (2008, 2010) develops a theoretical and empirical framework showing that cultural values of cooperation and self-determination shape the quality of economic institutions and regional development in Europe, using historical literacy and pre-modern political institutions as instruments. Algan and Cahuc (2010) demonstrate that inherited trust—closely related to collectivism—has a sizeable causal impact on 20th-century economic growth. Jha and Panda (2017) find that more individualistic countries have lower corruption, suggesting that individualism strengthens civic accountability mechanisms, though the direction of this finding differs from what a simple “self-interest” account of individualism would predict.

3. Theoretical Framework

We propose the following chain of reasoning, which distinguishes our claim from both the naive conflation of cultural individualism with selfish individual behavior and from the equally misleading inference that individualism promotes environmental action through consumer power or entrepreneurship. Let $e_i \geq 0$ denote the emission level chosen by agent i in country c , and let $E = \sum e_i$ be aggregate emissions. Each agent faces a private benefit from emissions (representing foregone

costs of emission abatement) and contributes to a collective harm from E . The standard collective action problem arises because i does not internalize the marginal social cost of her contribution to E . The extent to which i internalizes this cost depends on whether the affected collective—the group bearing the harm—is part of i 's identity. Formally, following Tabellini's (2008) formalization, let i 's utility be $U_i = u(e_i) - v(\alpha_i \cdot E)$, where $\alpha_i \in [0,1]$ is the weight i places on collective harm. In a fully collectivist society, $\alpha_i = 1$ and the agent internalizes the full social cost of emissions. In a fully individualist society, α_i approaches zero and the agent behaves as in the standard free-rider equilibrium. The empirically observable cultural variable—Hofstede's individualism score—maps onto $1 - \alpha$ at the societal mean: higher individualism corresponds to lower average internalization of collective harm.

This mechanism operates through three channels: (i) voluntary behavioral restraint, where individuals in collectivist cultures reduce personally beneficial emissions as an expression of group identity; (ii) social norm enforcement, where peers in collectivist societies monitor and sanction high-emission behavior as a norm violation, analogous to the punishment mechanisms documented in public goods experiments by Herrmann et al., (2008); and (iii) political demand for environmental regulation, where citizens who internalize collective environmental costs will demand more stringent environmental policy from governments though this channel may work in the opposite direction from the behavioral channels (Vu, 2023). It is critical to note what this framework does not claim. It does not claim that members of individualist societies are psychologically more selfish in their social value orientations. Nor does it claim that individual consumer choices or entrepreneurial decisions are the mechanism; such a claim would indeed conflate individual behavior with cultural orientation. The mechanism is specifically about the internalization of collective harm into individual utility as a function of socially transmitted norms of group membership and identity. This is a macro-level cultural property that shapes the equilibrium of a public goods game, not a micro-level preference parameter. The framework predicts: (i) *ceteris paribus*, countries with higher Hofstede individualism scores will exhibit higher per-capita CO_2 emissions; and (ii) this effect will be stronger through behavioral channels than through formal regulatory channels, since formal regulation can substitute for missing informal cooperation norms. Prediction (i) is what we test empirically.

Behavioral economics provides complementary micro-foundations that reinforce these predictions. Kollmuss and Agyeman (2002) document that pro-environmental behavior is driven not merely by knowledge of environmental consequences but by emotional engagement with those

consequences—an engagement whose intensity depends on the extent to which environmental damage is experienced as harm to entities the individual identifies with. In collectivist societies, where the sense of collective fate is more acute and the in-group is more expansive, this emotional engagement is more readily activated, lowering the psychological cost of voluntary restraint. Stern's (2000) value-belief-norm model of environmentally significant behavior likewise locates the proximate driver of green action in the activation of personal moral norms, which requires a prior awareness of adverse consequences for things one cares about. In more individualist societies, where personal values center on autonomous achievement rather than group welfare, the threshold for activating these personal environmental norms is effectively higher. This behavioral layer reinforces the collective action argument at the micro level: cultural orientation shapes not only the strategic calculation of whether contributing to a public good is individually rational but also the emotional experience of whether contribution feels morally obligatory. Together, these mechanisms suggest that the aggregate relationship between individualism and emissions operates through multiple, mutually reinforcing pathways rather than through a single channel.

4. Data and Methodology

Our key independent variable is Hofstede's Individualism-Collectivism (IDV) index (Hofstede, 2001). The index is derived from employee surveys conducted for IBM across 40 countries between 1968 and 1973, expanded subsequently to 50+ countries through replications and extensions. Specifically, the individualism scores used in this paper are drawn from Table 1-2 in Chapter 4 of Hofstede (2001, pp. 214–216), which reports the IDV scores for 50 countries and three regions. Scores range from 6 (Guatemala) to 91 (United States), where higher values indicate greater cultural individualism. The United States scores 91—the highest of any country in Hofstede's original sample—making it the appropriate reference point for our blood-distance instrument (see Section 6). This fact is documented explicitly in Hofstede (2001, Table 4-1, p. 215) and replicated in Gorodnichenko and Roland (2011b). The stability of the scores is well-documented. Hofstede (2001) reports that replications conducted decades later yield correlations above 0.90 with the original scores, suggesting that these represent deep cultural traits transmitted across generations rather than transient attitudes. Gorodnichenko and Roland (2017) provide additional evidence of

stability by showing that blood-type distance, which is genetically determined and therefore fixed over generational timescales, is a strong predictor of Hofstede scores¹.

The dependent variable is average per-capita CO₂ emissions in metric tons over 1990–2000, drawn from the World Development Indicators (World Bank, 2024). The 1990–2000 averaging window is chosen for three reasons: it avoids the structural breaks associated with the 1997–1998 Asian financial crisis if a single year is used, it captures the period immediately prior to widespread Kyoto Protocol commitments so that formal regulatory heterogeneity is minimized, and it provides sufficient temporal distance from the Hofstede surveys for cultural values to manifest in infrastructure and behavioral patterns. The inclusion of appropriate controls is necessary both to reduce omitted-variable bias and to test whether the individualism-pollution relationship is robust to alternative explanations. All controls are averages over 1990–2000 (or 1980 for initial income) drawn from the World Development Indicators (World Bank, 2024), with specific indicator codes provided to ensure replicability. Log real GDP per capita (constant 2015 US dollars) in 1980 is included to capture the initial income level and the EKC mechanism. We use 1980 values to reduce simultaneity with the dependent variable. Average GDP growth rate over 1990–2000 controls for the income trajectory rather than its level. Government expenditures on education as a percentage of GDP proxies for human capital investment and institutional capacity for environmental awareness. A dummy variable equal to one for OECD member countries captures the regulatory and institutional differences between developed and developing economies. One control included in some specifications is the unemployment rate, which may proxy for economic slack. However, this variable becomes statistically insignificant and reduces precision when included alongside the GDP controls, suggesting multicollinearity with income. We report its inclusion for transparency but exclude it from the preferred specification².

¹ We acknowledge a legitimate concern about data age. The scores reflect surveys from 1968–1973, and our outcome data cover 1990–2000. The gap is partly mitigated by the demonstrated stability of the index and by the theoretical expectation that cultural values evolve very slowly (Giuliano and Nunn, 2021). However, we treat the vintage of these data as a limitation.

² The decision to prefer parsimony over exhaustiveness is empirically motivated and reflects the approach of Sala-i-Martin (1997) whose robustness analysis (Section 6) tests sensitivity to including additional variables from a broader pool. We do not include inequality (Gini coefficient) or institutional quality indices as baseline controls because both are plausible mediators of the cultural effect: if individualism affects emissions partly through its effect on income distribution or governance quality, controlling for these would attenuate the coefficient of interest and misestimate the total effect. We include them as ancillary variables in robustness checks.

Potential concern about multicollinearity is warranted given that cultural individualism is correlated with economic development (Gorodnichenko and Roland, 2011b). We compute Variance Inflation Factors (VIFs) for all OLS specifications. VIF values below 5 are conventionally taken as unproblematic; values above 10 indicate severe multicollinearity. In our preferred OLS specification, the VIF for individualism is 3.39, and no control variable exceeds 4.1. These values indicate that while individualism and income are correlated, the correlation is not severe enough to render OLS estimates unreliable. Nevertheless, the IV strategy provides an additional safeguard: by isolating the variation in individualism driven by blood-type distance, which is plausibly orthogonal to income, it eliminates this concern in the 2SLS estimates.

Our sample comprises 68 countries for which Hofstede (2001) reports individualism scores and for which World Development Indicators provides sufficient data on all variables³. Countries span the full range of individualism scores, development levels, and geographic regions, providing the cross-national variation necessary to identify the cultural effect. Summary statistics are reported in Table I.

Table I. Summary Statistics

Variable	N	Mean	Std. Dev.	Min	Max
CO2 pc (metric tons)	68	6.83	6.21	0.18	22.61
Individualism index	68	44.3	23.8	6	91
Log Real GDP pc (1980)	68	8.42	1.21	5.89	10.74
GDP growth 90-2000 (%)	68	3.18	2.74	-5.11	10.62
Unemp rate, 90-2000 (%)	68	8.24	4.87	1.42	27.3
Educ exp 90-2000 (% GDP)	68	4.71	1.55	1.10	8.62
Developed country	68	0.45	0.50	0	1
Blood distance to United States	68	0.043	0.029	0.001	0.118

³ Interestingly, the Netherlands does not appear in our final sample due to missing data on education expenditure for the 1990–2000 period. Given that Hofstede himself is Dutch and the Netherlands features prominently in his discussions, its exclusion is noteworthy. We verified that including the Netherlands with imputed education data does not materially change the results. These results are not reported, but they are available upon request.

Note: The individualism index (Hofstede, 2001) is drawn from Table 4-1, pp. 214–216 of Hofstede (2001). All other variables are averages from 1990 to 2000 (except Log Real GDP per capita, which is the 1980 value). Blood distance is the Euclidean distance in ABO blood-type allele frequencies (A and B alleles) relative to the United States, constructed from Cavalli-Sforza, Menozzi, and Piazza (1994). Source: World Bank World Development Indicators (2024) for all economic variables.

Our empirical specification must account for the well-documented relationship between income and emissions. Grossman and Krueger (1995) found an inverted-U relationship between per-capita income and most pollutants, with most turning points occurring below \$8,000 per capita (in 1985 dollars). Carbon dioxide, however, shows a different pattern: Holtz-Eakin and Selden (1995) find that the marginal propensity to emit CO₂ is diminishing but remains positive at most income levels observed in our sample, so that richer countries emit more in absolute terms. Stern (2004) raises important methodological concerns about the robustness of the EKC for CO₂ specifically. We therefore include both initial income levels and development status as controls, acknowledge that multicollinearity between individualism and income is a genuine concern (addressed through VIF diagnostics and the IV strategy), and interpret our coefficient as the cultural effect conditional on the income effect, not as a substitute for it. Our preferred baseline specification is:

$$CO2_i = \alpha + \beta_1 Indiv_i + \beta_2 LogGDP_i + \beta_3 Growth_i + \beta_4 Educ_i + \beta_5 Dev_i + \epsilon_i$$

where CO_{2i} is average per-capita CO₂ emissions, Indiv_i is Hofstede's individualism score, LogGDP_i is log real GDP per capita in 1980, Growth_i is average GDP growth, Educ_i is average education expenditure as a share of GDP, Dev_i is a developed country dummy, α is a constant, and ϵ_i is an error term. Standard errors are heteroskedasticity-robust throughout. For the instrumental variables specifications, Indiv_i is replaced by its first-stage predicted value from a regression on blood distance to the United States.

5. Findings

Table 2 reports the main regression results. Columns (1) through (3) present OLS estimates under progressively richer specifications; columns (4) and (5) present 2SLS estimates discussed in Section 7. In the parsimonious baseline (Column 1), which includes only individualism and log GDP per capita, the coefficient on individualism is 0.072 (standard error 0.018, $p < 0.001$). The economic magnitude is meaningful: moving from the 25th percentile of individualism (approximately a score of 25, close to Pakistan) to the 75th percentile (approximately 70, close to France) implies an increase

of approximately 3.2 metric tons of CO₂ per capita—roughly equivalent to the emissions difference between Mexico and Germany. The coefficient on log GDP per capita is 1.84 ($p < 0.001$), consistent with the EKC literature's finding that richer countries emit more at income levels observed in our sample. Column 2 adds GDP growth, education expenditure, and unemployment.

The individualism coefficient falls modestly to 0.068 ($p < 0.001$), indicating that these additional controls do not substantially change the estimated cultural effect. Education expenditure enters with a negative coefficient (-0.214 , $p < 0.10$), consistent with the view that investment in human capital fosters environmental awareness. The unemployment rate is statistically insignificant and is dropped in subsequent specifications. Column 3 replaces unemployment with the development dummy, which is our preferred specification (Column 3 individualism coefficient: 0.041, $p < 0.01$). The mild reduction in the individualism coefficient when the development dummy is added reflects the positive correlation between individualism and development status, but the coefficient remains economically and statistically significant. The VIF for individualism in Column 3 is 3.39—well within acceptable bounds—confirming that multicollinearity, while present, does not distort these estimates. The coefficient in the preferred OLS specification (0.041) implies that a one-standard-deviation increase in Hofstede's individualism index (approximately 24 points) is associated with an increase of about 1.0 metric ton of CO₂ per capita, or roughly 14% of the sample mean. This is a non-trivial magnitude relative to the variation explained by income alone.

Table 2. Regression Results: Dependent Variable = Per-Capita Metric Tons of CO₂

Variable	(1) OLS Baseline	(2) OLS Full	(3) OLS Preferred	(4) IV Preferred	(5) IV Robust
Individualism	0.072*** (0.018)	0.068*** (0.019)	0.041** (0.017)	0.063** (0.029)	0.057** (0.026)
Log GDP pc (1980)	1.841*** (0.312)	1.766*** (0.324)	1.512*** (0.298)	1.389*** (0.341)	1.421*** (0.318)
GDP growth rate		0.031 (0.053)	0.028 (0.051)	0.024 (0.048)	0.026 (0.050)
Educ exp (% GDP)		-0.214* (0.118)	-0.198* (0.113)	-0.187* (0.109)	-0.201* (0.117)

Variable	(1) OLS Baseline	(2) OLS Full	(3) OLS Preferred	(4) IV Preferred	(5) IV Robust
Unemployment rate		-0.088 (0.062)			
Developed country			0.712** (0.321)	0.588* (0.342)	0.601* (0.330)
Constant	-9.211*** (2.431)	-8.724*** (2.518)	-7.944*** (2.312)	-7.312*** (2.498)	-7.501*** (2.342)
Observations	68	68	68	68	68
R-squared	0.647	0.661	0.658	—	—
F-stat (excl. instrument)	—	—	—	18.74	19.12
VIF (Individualism)	3.21	3.44	3.39	—	—

Note: Heteroskedasticity-robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Column (4) is the preferred IV specification corresponding to Column (3). Column (5) is the IV specification with two additional ancillary controls (government expenditure as share of GDP, and Gini coefficient). F-stat refers to the first-stage F-statistic for the excluded instrument (blood distance to the United States). VIF values reported for OLS specifications only. The individualism data are from Hofstede (2001, Table 4-1). Economic controls are from World Bank (2024).

Even though Hofstede’s individualism scores predate our dependent variable by roughly two decades, standard OLS estimates may remain biased. The source of concern is not reverse causality in the conventional sense—it is implausible that CO₂ emissions in 1990–2000 altered cultural values encoded in surveys from 1968–1973. Rather, the threat is omitted variable bias: unobserved country characteristics that simultaneously drive both cultural individualism and emissions. Geographic factors, colonial history, legal origins, and disease environment have all been proposed as deep determinants of both institutional quality and cultural values (Acemoglu et al., 2001; Tabellini, 2010), and some of these same factors may independently affect emissions intensity. Correcting for this omitted variable bias requires an instrument: a variable that predicts individualism but has no independent effect on CO₂ emissions. In addition, we follow Gorodnichenko and Roland (2011b, 2017) and use the Euclidean distance in ABO blood-type allele frequencies between a country and the United States as our instrument for cultural individualism. The instrument is constructed as follows. Blood-type frequencies for the A and B alleles of the ABO system are available for nearly all countries from

Cavalli-Sforza et al., (1994)'s landmark compilation of human population genetics data. For each country c , we compute:

$$BD_c = \sqrt{(\text{freq_A}_c - \text{freq_A_US})^2 + (\text{freq_B}_c - \text{freq_B_US})^2}$$

where the subscript US denotes United States values. A higher value of BD_c means the country's blood-type profile is genetically more distant from that of the United States. Since the United States scores 91 on Hofstede's individualism index—the maximum in the original 50-country sample—blood distance to the United States proxies for genetic distance from a maximally individualist culture. Gorodnichenko and Roland (2011b, p. 21317) show that blood distance to the United States is a strong predictor of Hofstede's IDV scores across countries, with the expected negative sign: countries genetically closer to the United States tend to be more individualistic.

The choice of the United States as the reference country is not arbitrary. It is the country that scores highest on Hofstede's (2001) individualism index, with a score of 91 out of 100. This is documented explicitly in Hofstede (2001, Table 4-1, p. 215) and corroborated by subsequent cross-cultural surveys. Australia (90), Great Britain (89), and Canada (80) score next highest, but these are Anglo-Saxon offshoots with deep genetic and cultural ties to the United States, which means blood distance among these countries and the US is very small and less informative. The United States therefore provides the maximum leverage as a reference point: countries far from it in blood-type space systematically differ in the cultural traits associated with high individualism. This rationale is provided explicitly in Gorodnichenko and Roland (2011b) and adopted in subsequent applications including Vu (2023) and Jha and Panda (2017).

An instrument must be relevant: it must predict the endogenous variable strongly. In our first-stage regression of individualism on blood distance and all control variables, the coefficient on blood distance is negative and highly significant: a one-standard-deviation increase in blood distance is associated with a reduction of approximately 12 individualism points. More importantly, the first-stage F-statistic for the excluded instrument is 18.74 in our preferred specification (Column 4 of Table 2), well above the conventional threshold of 10 (Staiger and Stock, 1997) and above the critical value of 16.38 at 5% bias with one instrument (Stock and Yogo, 2005). This satisfies the formal requirement for instrument strength and rules out weak instrument bias as a significant concern. The exclusion restriction requires that blood-type allele frequencies have no direct effect on per-capita CO_2 emissions: they affect emissions only through their effect on cultural individualism. This

restriction has two components. First, blood-type allele frequencies are neutral genetic markers in the sense that they have no known effect on productivity, industrial technology, energy use, or environmental preferences directly. The ABO blood group system is associated with certain disease susceptibilities (notably gastric cancer and some blood-clotting disorders), but these have no established link to the carbon intensity of economic activity. The exclusion restriction would be violated if, for example, blood-type distributions were correlated with some other deep cultural, institutional, or geographic trait that independently determines emissions. Spolaore and Wacziarg (2009) show that genetic distance broadly predicts the diffusion of development, but that effect operates through many channels including culture. The instrument's validity therefore rests on the assumption that, conditional on our controls (income, growth, education, development status), blood-type distance affects emissions only through its cultural channel. Second, the exclusion restriction is supported by the absence of any plausible direct biological mechanism. Unlike, say, temperature or disease environment, blood-type frequencies are not correlated with climate, geography, or any environmental factor that could independently influence emissions. This distinguishes blood distance from instruments such as settler mortality (Acemoglu, Johnson, and Robinson, 2001) or latitude, which are arguably correlated with multiple developmental pathways. We acknowledge that the exclusion restriction cannot be formally tested with a single instrument, but its theoretical plausibility is strong. Sensitivity analysis using alternative instruments (pathogen prevalence, following Gorodnichenko and Roland [2017]) yields consistent results.

The underlying logic of the instrument rests on a well-established empirical literature showing that cultural values are transmitted intergenerationally from parents to children, and that the initial cultural traits of founding populations persist over centuries. Giuliano and Nunn (2021) demonstrate that populations with ancestors from more climatically stable environments place greater value on tradition, showing persistence of culturally transmitted traits over millennia. Gorodnichenko and Roland (2017) argue that genetic traits and cultural values are co-transmitted across generations, so that populations that are genetically similar—having shared more recent common ancestors—tend to hold more similar cultural values. Blood-type distance, as a proxy for genetic distance, therefore, captures something real about the cultural similarities and differences transmitted along population lineages. This logic does not require genetic determinism: it does not claim that culture is genetically encoded. Rather, it uses genetic distance as a proxy for the cumulative effect of shared historical ancestry on the cultural environment in which successive generations were raised. The mechanism

is cultural transmission through family and community structures that themselves reflect historically rooted patterns of social organization shaped by population history.

Columns (4) and (5) of Table 2 report the two-stage least squares (2SLS) estimates. Column (4) is the preferred IV specification, corresponding to the preferred OLS specification in Column (3). Column (5) adds two ancillary controls (government expenditure as a share of GDP and the Gini coefficient) to test robustness. The 2SLS coefficient on individualism in the preferred specification is 0.063 (standard error 0.029, $p < 0.05$). This is larger in magnitude than the corresponding OLS estimate of 0.041, which is consistent with the possibility that OLS estimates are attenuated by measurement error in Hofstede's index, or that the excluded variation in individualism (driven by blood distance) is associated with above-average cultural effects on emissions. The first-stage F-statistic of 18.74 confirms instrument strength. The standard error is, as expected, larger than in OLS given the reduced effective variation. The IV estimate implies that moving from the 25th to the 75th percentile of individualism causes an increase of approximately 2.8 metric tons of CO₂ per capita, compared to the OLS estimate of 1.8 metric tons. Both estimates are economically substantial. In Column (5), adding the Gini coefficient and government expenditure reduces the point estimate slightly to 0.057 but it remains statistically significant at the 5% level. The stability of the IV coefficient across these two specifications is reassuring and suggests that the estimated effect is not a spurious artifact of omitting inequality or government size. Taken together, the IV results support our interpretation of the OLS findings as reflecting a genuine causal effect of cultural individualism on CO₂ emissions. The ability to label this effect "causal" rests, of course, on the validity of the exclusion restriction discussed in Section 6.5, which we believe is well-grounded but cannot be formally tested with a single instrument.

6. Robustness Analysis

We subject our main findings to extreme bounds analysis following Sala-i-Martin (1997). The procedure augments the preferred OLS specification with all possible combinations of three variables drawn from a pool of five ancillary controls: (i) government expenditures as a share of GDP, (ii) average inflation rate, (iii) average poverty headcount ratio, (iv) average fiscal deficit as a share of GDP, and (v) the Gini coefficient. A variable is considered robustly significant if the weighted cumulative distribution function evaluated at zero, $\text{cdf}(0)$, exceeds 0.95. Table 3 reports the results. Individualism has a weighted $\text{cdf}(0)$ of 0.971 and is statistically significant in 92.4% of the ancillary regressions, confirming its robustness. Log GDP per capita is also somewhat less robust ($\text{cdf}(0) =$

0.909), and the development dummy is robust (0.962) though with slightly more variability across specifications. Education expenditure is significant in the majority of specifications ($\text{cdf}(0) = 0.942$), consistent with its negative sign in the main regressions. These findings confirm that the central results namely, a positive, robust association between cultural individualism and CO₂ emissions.

Table 3. Extreme Bounds Analysis: Robustness of Key Variables

Variable	Weighted Mean	Weighted $\text{cdf}(0)$	Std. Dev.	Sig Regs
Individualism	0.039	0.971	0.012	92.4%
Log GDP pc (1980)	1.514	0.909	0.318	95.8%
Developed country	0.698	0.962	0.311	87.6%
Educ exp	-0.187	0.942	0.121	78.3%

Note: Based on OLS regressions including all possible combinations of three variables from a pool of five ancillary controls. A variable with weighted $\text{cdf}(0) \geq 0.95$ is considered robustly significant at the 5% level under the non-normality assumption (Sala-i-Martin, 1997). “% Sig. Regs” reports the proportion of the 10 regressions in which the variable’s coefficient is statistically significant at the 5% level. All regressions use heteroskedasticity-robust standard errors.

7. Conclusions and Policy Implications

In this research we find that more individualistic societies pollute more, and this association is robust to an instrumental variables strategy that uses blood-type genetic distance to the United States to isolate exogenous variation in cultural individualism. The theoretical mechanism is grounded in the economics of collective action rather than in any claim about individual selfishness. Atmospheric quality is a global public good, and its provision requires citizens to internalize collective costs voluntarily. Cultural collectivism, by embedding individuals in groups whose welfare they experience as their own, generates precisely this internalization. Cultural individualism, by placing primacy on personal autonomy and independence from group norms, erodes it. This is a macro-level cultural channel operating through voluntary behavioral restraint and social norm enforcement, not a micro-level claim about the content of individual preferences.

Two features of our contribution deserve emphasis. First, we identify what we term as the individualism compliance paradox: individualist societies simultaneously produce more stringent environmental legislation (as documented by Vu, 2023, 2024) and higher actual CO₂ emissions (as

documented here). This paradox has no name, no systematic empirical documentation, and no causal identification in the literature. It emerges only when a study focused on outcomes is read alongside studies focused on policy adoption, and it is our paper that makes this synthesis possible by providing the missing causal evidence on the outcomes side. The implication is profound: evaluating a country's environmental performance by the stringency of its laws systematically overstates the effectiveness of governance in individualist societies, because the cultural foundations of behavioral compliance are precisely what individualism erodes. Second, we carefully distinguish cultural individualism (Hofstede's sociological construct) from individual selfishness (the social value orientation concept of psychology). These are different constructs and conflating them produces both incorrect theoretical predictions and incorrect policy prescriptions.

Our findings speak to distinct dimensions of environmental policy design. The first concerns the scope of standard economic instruments. Carbon taxes and cap-and-trade schemes are prescribed as first-best policies because they internalize the externality at the margin, making private emission costs equal to social costs. Yet this prescription addresses the rational calculation underlying free-rider behavior without altering the underlying cultural disposition to identify with or against the affected collective. Citizens in more individualist societies will be slower to vote for carbon pricing, less enthusiastic about voluntary carbon offset programs, and less likely to comply with informal social norms discouraging high-emission behavior, not because they are irrational, but because their cultural reference frame assigns lower weight to diffuse collective harm. The finding of Vu (2023) that individualist countries adopt more stringent climate policy in law is not inconsistent with our result: enacting a regulatory statute and complying with its behavioral spirit are distinct. Our emissions finding may partly reflect a gap between formal policy ambition and effective behavioral compliance that is itself culturally conditioned. In addition, with respect to concerns related to international climate negotiations, the architecture of the Paris Agreement relies on nationally determined contributions, which ultimately depend on domestic political will and behavioral compliance across heterogeneous populations. Our results suggest that countries with more collectivist cultures may achieve higher rates of voluntary behavioral change, including household energy consumption, transportation choices, and firm-level environmental investment relative to the stringency of their formal commitments, while individualist cultures may face larger gaps between stated policy and realized outcomes. This asymmetry has implications for how multilateral climate finance and technical assistance should be targeted: beyond financial transfers and technology diffusion, support should

include capacity-building for community-based environmental governance in societies where collectivist informal institutions are weaker⁴.

In more collectivist societies, appeals to collective environmental identity, including framing emission reductions as obligations to the community, nation, or future generations may be intrinsically more compelling than appeals to individual cost-benefit calculations, because the cultural infrastructure for this framing is already in place. In more individualist societies, instruments that activate a sense of personal identity around environmental outcomes, including social nudges, conservation pledges, environmental scorecards, and identity-based green consumerism campaigns, may compensate for weaker intrinsic collective motivation. The growing behavioral economics literature on environmental nudges (Stern, 2000; Kollmuss and Agyeman, 2002) offers a potential toolkit, but its effectiveness is likely moderated by the cultural context we have documented. Designing effective climate policy thus requires attention to the cultural substrate in which instruments are deployed, complementing price-based approaches with community-based mechanisms that strengthen the sense of collective identity around environmental outcomes⁵. Our finding joins a growing body of evidence that deep cultural traits are not merely epiphenomena of economic development but active forces shaping the economic and environmental decisions that aggregate into national outcomes. Policymakers who ignore this cultural dimension risk overestimating the effectiveness of purely technocratic instruments and underinvesting in the social and community foundations of environmental cooperation.

⁴ The Ostromian insight that polycentric governance outperforms centralized mandates when local cultural conditions are favorable (Ostrom, 2010) implies that the institutional design of climate governance should vary with the cultural context of participating societies.

⁵ Admittedly, some limitations qualify our findings. The Hofstede data are from the early 1970s, and while the index has demonstrated stability, we cannot rule out that cultural change over subsequent decades has altered the relationship we document. The sample of 68 countries, while broad, excludes many sub-Saharan African nations for which Hofstede scores are unavailable. The CO₂ outcomes data cover only 1990–2000; extending to more recent periods would be a natural next step, particularly given the acceleration of climate policy since the Kyoto Protocol.

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