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Environmental Homogenization or Heterogenization? The Effects of Globalization on Carbon Dioxide Emissions, 1970–2014

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Received: 9 April 2019; Accepted: 8 May 2019; Published: 14 May 2019



Abstract: Globalization significantly influences climate change. Ecological modernization theory and world polity theory suggest that globalization reduces carbon dioxide emissions worldwide by facilitating economic, political, social, and cultural homogenization, whereas ecological unequal exchange theory indicates that cumulative economic and political disparities lead to an uneven distribution of emissions in developed and less developed countries. This study addresses this controversy and systematically investigates the extent to which different dimensions of globalization influence carbon emissions in developed and less developed countries by treating globalization as a dynamic historical process involving economic, political, and social/cultural dimensions in a long-term, cross-national context. Drawing on data for 137 countries from 1970 to 2014, we find that while globalization, social and cultural globalization in particular, has enabled developed countries to significantly decrease their carbon emissions, it has led to more emissions in less developed countries, lending support to the ecological unequal exchange theory. Consistent with world polity theory, international political integration has contributed to carbon reductions over time. We highlight the internal tension between environmental conservation and degradation in a globalizing world and discuss the opportunities for less developed countries to reduce emissions.

Keywords: globalization; carbon dioxide emissions; ecological modernization theory; world polity theory; ecological unequal exchange theory

1. Introduction

A large body of research has investigated the effects of globalization on carbon emissions [1–10]. Although previous studies acknowledge the important role of globalization, its actual effects remain controversial. On the one hand, ecological modernization theory and world polity theory suggest that the homogenizing tendencies facilitated through globalization lead to the institutionalization of environmental culture and practices across the world [6,9,11,12], resulting in lower levels of carbon emissions worldwide. On the other hand, ecological unequal exchange theory contends that globalization has reinforced the historically entrenched hierarchical positions of developed countries (DCs) and less developed countries (LDCs) in the world system. The cumulative economic and political disparities between countries have contributed to disproportionate emissions in these two types of countries [4,13–15].

The surprisingly mixed results are likely due to the following reasons. First, most discussions in this area focus on one particular aspect of globalization, such as foreign direct investment and international trade [16–19]. Researchers increasingly agree that globalization is a complex phenomenon encompassing economic, political, social, and cultural processes [20–23]. Environmental social scientists also embrace the idea that interactions between human society and the natural environment are multiplex in nature [24,25]. Given these considerations, although the studies that examine the effect of one aspect of globalization provide valuable insights and detailed empirical evidence, they are likely to largely ignore the holistic effects of globalization as well as the effects of other dimensions of globalization. Variations between different dimensions may lead to contrasting environmental consequences, or cancel out specific effects overall.

Second, many empirical studies on globalization and the environmental outcomes assess relationships using cross-sectional data, or panel data that only cover a limited period of time [16,18,26–28]. Globalization, however, takes place in multiple domains across geographical scales, and its effects may take many years to unfold. Although offering insights into developing an understanding of the effects of globalization on carbon emissions, these studies may only provide a snapshot of the association at a given point in time. Meanwhile, ecological unequal exchange theory suggests that the underlying mechanisms may be significantly different between DCs and LDCs. Therefore, it is necessary to differentiate the longitudinal effects of globalization across varying types of countries.

We attempt to bridge gaps in the literature by empirically examining competing viewpoints and systematically investigating the extent to which different dimensions of globalization influence carbon emissions in DCs and LDCs. The KOF Index of Globalization is used to capture the holistic effect of globalization as well as the effects of its sub-dimensions (updated in [20,29]). We employ well-established and rigorous time-series cross-sectional regression modeling techniques, including Prais-Winsten regression models with panel-corrected standard errors [30,31] and pooled ordinary least squares (OLS) regression with Driscoll-Kraay standard errors [32,33], to assess the effects of globalization on carbon emissions in 137 countries between 1970 and 2014.

Our research aims to contribute to current scholarship in two ways. First, we understand globalization as an intricate and collective process involving economic, political, and social/cultural dimensions, and we attempt to carefully examine the effects of each of these dimensions of globalization on carbon emissions. This approach also enables us to incorporate key theoretical components into the analyses and explicitly address current controversies surrounding the environmental effects of multidimensional globalization. Second, given that the 1970s have been considered as marking the beginning of globalization in a modern sense [22,34], based on panel data in 137 countries spanning from 1970 to 2014, our study provides a more inclusive view of the associations between globalization and carbon emissions since the rise of globalization and the extent to which the relationships have varied in DCs and LDCs.

2. The Homogenous Environmental Consequences of Globalization

One of the central debates on globalization concerns whether globalization produces homogenous effects worldwide. Globalization results in the growing importance of global interdependence [23,35], as well as the weakening or even removal of institutional barriers between countries [36,37]. Building on these global universalizing tendencies, the homogenization perspective suggests that globalization promotes modernization through incorporating outlying regions into a modern global system and converging world culture into a common set of attributes and practices [38]. Consequently, developed and less developed countries are expected to experience similar developmental trajectories and face similar environmental opportunities and challenges. Aligned with this perspective, ecological modernization theory and world polity theory discuss the extent to which globalization mitigates environmental degradation and produces beneficial environmental consequences through institutional reforms within and beyond borders.

2.1. Ecological Modernization Theory

Ecological modernization theory focuses on the ecology-inspired and environment-induced transformation of core social institutions of modernity [39–43]. It contends that environmental problems are not the inevitable consequences of industrialization and modernization, and that further modernization can solve these problems through the development of science and technology and the restructuring of market, state, and social institutions [25,39]. Corresponding to the rise of globalization, the theoretical scope of ecological modernization theory has extended beyond European nation-states and incorporated discussions in the newly industrializing countries since the mid-1990s [6,40,44,45].

According to ecological modernization theory, economic homogenization plays an essential role in promoting ecological modernization across the globe. Environmental concerns and reforms have moved beyond the initial superficial stage and are approaching core economic entities in developed societies, and therefore become international standards and codes of conduct encouraged by transnational enterprises and global economic institutions [6,46,47]. Compared to local enterprises, multinational corporations (MNCs) from advanced economies are often more aware of environmental obligations [48], and more concerned with their media coverage and reputation for promoting the public good, which may involve showing how they restrict carbon emissions. As a result, MNCs tend to interact with ecologically responsible domestic partners [49], use cleaner and more efficient energy [50,51], and implement environmental management systems [52,53]. As LDCs become increasingly integrated into the global economy, they are strongly influenced by the global market and economically powerful actors as well as by the associated ecological logic and rationality. Environmental considerations and practices have been gradually institutionalized in the economic domain worldwide [54,55].

Concerning the political dimension, supra-national environmental governance structures have emerged because the nation-state's power and authority has been significantly undermined due to the separation of economic and social activities from geographical territories [37,56], and many environmental issues are in fact global in nature. While acknowledging the importance of multilateral environmental agreements that focus on specific environmental issues, Mol claims that regional institutions, such as the European Union and the North American Free Trade Agreement, may be of greater relevance for effectively addressing environmental issues related to global capitalism [11]. These overarching institutions and arrangements that were originally designed to advance economic integration show promising prospects in internalizing an ecological rationality and greening international trade and investment.

At the national and subnational levels, ecological modernization theorists suggest that, driven by globalization, national environmental governance styles tend to transform from traditional and hierarchical command-and-control regulation types to "modernized" or "smart" types characterized by the application of science and technology, flexibility, innovation, negotiation, cooperation, and interaction between parties [6,57]. The new governance styles are expected to be better equipped to deal with complex and long-term environmental disruptions and to overcome the resistance of powerful polluters, especially global environmental threats that require international collaboration, such as carbon emissions.

Broad coalitions of global civil society groups and movements now spread environmental ethnics and principles and monitor environmental misbehavior of transnational corporations and institutions around the world [11]. Therefore, "the environment is slowly becoming a relatively independent factor in these new institutional arrangements, albeit not equally in all of them" [6]. Environmental movements are observable in most countries, regardless of the developmental stage [58,59].

Concerning the social/cultural dimension, ecological modernization theory once again resonates with the homogenization viewpoint. It suggests that economic homogenization, institutional efforts, and the progress of information and communication technologies trigger the emergence of an environmental culture on an international scale [12,60,61]. Telecommunications and the Internet lift people out of their local context and provide the vision and capability to be concerned regarding environmental issues beyond geographical boundaries. Researchers doubt that environmentalism is limited to highly

industrialized societies, and argue instead that pro-environmental attitudes have become part of global values as a result of cultural diffusion [62,63].

The increasing value attached to the environment and natural resources is likely to benefit LDCs because these countries often exchange their environmental resources for economic resources and power [6]. Meanwhile, empirical studies show that globalization reduces trade barriers and accelerates flows of information and goods, thereby initially reconfiguring the dominant economic activities toward the industrial sector, and then toward the service sector, especially in the Global South [64,65]. More importantly, globalization leads to greater interdependence worldwide [22], and hence, global warming poses a serious challenge not only to countries being directly influenced, but also to human beings as a whole. The need to mitigate climate change is increasingly becoming a global consensus, and the large-scale cross-border flows of capital and technology make this mitigation possible. As globalization progresses, it is likely that, according to this perspective, globalization will have intensified impacts on carbon reductions over time.

2.2. World Polity Theory

Drawing upon the new institutionalism perspective, world polity theory claims that worldwide models pervade almost all domains of social life against the backdrop of globalization, and discusses how this structural isomorphism penetrates individual and collective actors beyond geographical boundaries through various cultural and associational processes in a stateless world [66–68]. The basic assumption is that modern actors, ranging from individuals and organizations to nation-states, all act according to rules and expectations from "a wider world society, polity, and rationalistic culture" [69].

World polity theory specifically focuses on the organizational and cultural changes associated with globalization that explain the rise of the environmental regime worldwide [69,70]. Political globalization that promotes international interactions and collaborations among formal and informal organizations provides arenas that encourage the institutionalization of environmental regimes as well as collective mobilization and action. The world environmental regime is leading nation-states to view environmental protection as one of their core functions. By signing international agreements and participating in world environmental organizations, governments and international bodies work as "international environmental regimes" and collaborate on cross-border environmental problems, including global warming [70,71].

Environmental international NGOs (EINGOs) that focus on curbing greenhouse emissions and climate change have proliferated in recent years [5,70]. They play an important role in amending market failures, setting pro-environmental standards, organizing environmental movements, urging states to adopt policy recommendations and undertake specific measures, and promoting international negotiations and equal ecological exchanges between countries [72–74]. Based on data in 79 countries from 1970 to 2009, Longhofer and Jorgenson [5] find that the countries most embedded in the EINGO network experience a relative decoupling between economic development and carbon emissions over time.

Social and cultural globalization characterized by growing international interactions, information flows, and cultural proximity is considered to stimulate the rise of rational, scientific, and reflexive worldviews [68,69,75]. Increased schooling and environmental awareness emphasize the necessity of a global interdependent environment and ecosystem for sustainable development on the one hand, and help develop the potential for scientific analyses of nature and for informed decision-making on the other hand. The vast expansion of rationalization and scientization all over the globe implies that the emerging environmental culture is not being constructed specifically to meet the needs of advantaged and powerful interest groups, but rather reflects scientific truth, the universal rights of human beings, and all types of societies [67].

World polity research suggests that the world environmental regime has a greater impact in LDCs because it offers institutional and cultural scripts for the solution of environmental problems that would otherwise not be solved through domestic mechanisms [67,76]. Longhofer and Schofer's study [77]

provides empirical evidence that, compared to highly industrialized countries, global forces, rather than domestic factors, promote the institutionalization of environmental ideology and movements, and generate environmental associations within LDCs. Additionally, empirical studies consistently suggest that the presence of EINGOs substantially reduces carbon emissions in LDCs [27,78].

Taken together, both ecological modernization and world polity theories agree on the converging tendencies in environmental reforms and predict beneficial environmental outcomes associated with multiple dimensions of globalization. From these perspectives, we expect that the progress occurring in each dimension of globalization is likely to lead to carbon reductions in both DCs and LDCs over time.

3. The Heterogeneous Environmental Effects of Globalization

On the other side of the globalization debate, theorists suggest that globalization reinforces diverse localities and historical legacies, resulting in heterogeneous outcomes in the economic, political, social, and cultural domains [23,79,80]. They cast doubt on the alleged emergence of a less state-centric world order and a restructuring of new global relations. Instead, it has been contended that international activities remain organized around national interests, and that deeply rooted patterns of inequality and hierarchy are reproduced in the more extensive international arena. As illustrated in ecological unequal exchange theory, these tendencies towards heterogenization are closely related to the asymmetric ecological exchanges occurring within the interstate system and lead to consequent disparities in environmental outcomes between DCs and LDCs.

Rooted in the assumptions of world systems theory and structuralist perspectives, ecological unequal exchange theory posits that a country's hierarchical position in the world system leads to a distinctive social-organizational structure along with characteristic production and consumption patterns, which serve to further constitute domestic environmental opportunities and risks in an uneven manner [8,15,81–83]. Due to their economic, political, and military strength, DCs are more likely to gain disproportionate access to energy and natural resources, and externalize environmental costs through the structural interaction networks of global exchange [8,15,83–85]. The time-space compression accompanied by globalization further facilitates the "disproportionate utilization of ecological systems" by developed nations [15]. Considerable detailed empirical research lends support to this theoretical understanding (for a summary of empirical studies in this regard, please refer to [86]).

Concerning the economic dimension, the import and export dynamics in a globalizing world systematically drain "extractive economies" of their development potential and ecological capacity [10,84,87,88]. Rich countries export non-hazardous and hazardous waste, thus further transferring the environmental burden to poor countries [89,90]. Globalization also reproduces an asymmetrical environmental structure in the social and political domains through associated value systems, involving the undervaluation of raw materials and the emphasis on poverty reduction over environmental protection in LDCs [15].

Furthermore, the global mobility of capital and resources expedites this relocation process from the Global North to the Global South, and increases the proportion of pollution-intensive industries in LDCs [91]. Based on detailed trade and production data from 52 countries gathered between 1980 and 1998, de Melo and Grether find that four of the five most polluting industries from the OECD economies have relocated to poorer countries [92]. These heavily polluting industries consume massive amounts of fossil fuels and require long-distance transport, thus releasing enormous quantities of CO_2. The absence of appropriate environmental regulations, combined with eco-inefficient techniques, facilities, and energy infrastructure, further boosts CO_2 levels, and generates a vicious cycle in LDCs [93]. Jorgenson finds that exports to high-income nations contribute to per capita carbon emissions, and that the effects are more pronounced in lower-income countries and have increased in magnitude over time [88].

Regarding the effects of political globalization, ecological unequal exchange theorists raise doubts concerning the positive image embraced by ecological modernization and world polity scholars [14,15]. Political engagement in the international sphere may in fact maintain or even reinforce existing systematic linkages and disparities, rather than bridge environmental gaps between countries. A closer

examination reveals that many international environmental conventions and treaties dealing with climate change have not achieved their intended objectives and have left LDCs to become potential casualties of environmental change because of the power dynamics between nations [94–97].

Drawing upon world system theory and the ecological unequal exchange perspective, Roberts, Parks, and colleagues provide a series of vivid descriptions and in-depth analysis of global climate negotiations between DCs and LDCs [8,14,26,98–103]. Specifically, one of these studies involving 192 nations' participation in 22 treaties shows that LDCs are more environmentally vulnerable and less likely to participate in international environmental treaties because of their structurally constrained willingness and capacity due to feeble post-colonial political institutions and internally disarticulated economies [101].

Since the ecological unequal exchange theory is essentially a political-economic approach, the consequences of social and cultural globalization are rarely discussed. Within the limited research focusing on these latter aspects, Hornborg challenges the growing global consensus of sustainable development and suggests that the mainstream modern perceptions of "development" are largely "a cultural illusion confusing a privileged position in social space within an advanced position in historical time" [104].

In support of the heterogeneity perspective, glocalization theorists question the alleged rise of cosmopolitanism. They maintain that locality is reproduced in globality, and that individuals retreat to their local communities for security when facing the uncertainty and risks that accompany globalization [105,106]. The "not-in-my-backyard" mentality of many grassroots environmental movements illustrates the impasse between the environmental interests of local communities and the so-called global village [107]. At the same time, an individual's sense of self is reinforced and celebrated in the era of globalization [108]. This combination of locality and individuality highlights the importance of one's own well-being and the surrounding environment but can lead to a more limited recognition of the significance of others' environments. The notion of ecological identity is fragile, and sensitive to personal desires and local environmental issues, resulting in contradictions between actual practices and claimed global environmental concerns [109]. When this viewpoint is combined with ecologically unequal exchange perspective, it is possible that people in DCs are more likely to seek to achieve their goals of protecting their local environment at the expense of LDCs.

In sum, previous research proposes two competing perspectives on the effect of globalization on carbon emissions. In relation to these competing perspectives, as globalization expands in scope and magnitude, its effects are likely to intensify over time. In the following sections, we provide an empirical assessment of the preceding theorization.

4. Data and Methods

4.1. Datasets and Variables

We use national-level panel data from the World Bank [110] and Dreher's KOF Index of Globalization [updated in 20,29]. Because the most recent data of carbon emissions from the World Bank is in 2014, these data span every five years from 1970 to 2014 (i.e., 1970, 1975, 1980, 1985, 1990, 1995, 2000, 2005, 2010, and 2014). The original data contain 2140 observations from 214 countries. There are 332 observations from 11 countries with missing data on the dependent variable (CO_2 emissions per capita), 341 observations from 40 countries with missing data in relation to the KOF Index of Globalization, and 350 observations from 6 countries with missing data on the control variables (economic development, urbanization, and percentage of service sector). All observations with missing values are excluded from the sample. We also exclude 20 countries (58 observations) containing less than five time periods. The final analytical sample is an unbalanced panel dataset of 1059 observations from 137 countries (Table 1).

Table 1. Countries included in the analysis.

Countries				
Albania (8)	Chile (10)	Guyana (10)	Moldova (5)	Singapore (10)
Angola (5)	Colombia (10)	Honduras (10)	Mongolia (7)	Slovak Republic (5)
Argentina (10)	Congo, Dem. Rep. (5)	Hungary (5)	Morocco (8)	Slovenia (5)
Australia (6)	Congo, Rep. (10)	India (10)	Mozambique (5)	South Africa (10)
Austria (8)	Costa Rica (10)	Indonesia (7)	Namibia (6)	Spain (5)
Azerbaijan (5)	Cote d'Ivoire (10)	Iran, Islamic Rep. (8)	Nepal (10)	Sudan (7)
Bahamas (7)	Croatia (5)	Iraq (10)	Netherlands (10)	Suriname (8)
Bangladesh (9)	Cyprus (5)	Ireland (5)	New Zealand (7)	Swaziland (10)
Barbados (9)	Czech Republic (5)	Israel (5)	Nicaragua (5)	Sweden (8)
Belarus (5)	Denmark (10)	Italy (6)	Niger (10)	Switzerland (5)
Belgium (5)	Dominican Republic (10)	Japan (5)	Nigeria (7)	Tajikistan (5)
Belize (6)	Ecuador (10)	Jordan (9)	Norway (10)	Tanzania (6)
Benin (10)	Egypt, Arab Rep. (10)	Kazakhstan (5)	Oman (5)	Thailand (5)
Bhutan (8)	El Salvador (10)	Kiribati (8)	Pakistan (10)	Togo (10)
Bolivia (10)	Estonia (5)	Korea, Rep. (10)	Panama (10)	Trinidad and Tobago (9)
Bosnia and Herzegovina (5)	Ethiopia (7)	Kyrgyz Republic (5)	Paraguay (10)	Tunisia (9)
Botswana (9)	Fiji (10)	Lao PDR (6)	Peru (7)	Turkey (10)
Brazil (10)	Finland (9)	Latvia (5)	Philippines (10)	Uganda (7)
Brunei Darussalam (7)	France (10)	Lebanon (5)	Poland (5)	Ukraine (5)
Bulgaria (8)	Gabon (10)	Lesotho (6)	Portugal (5)	United Arab Emirates (9)
Burkina Faso (10)	Gambia (10)	Macedonia, FYR (5)	Romania (6)	United Kingdom (6)
Burundi (10)	Germany (5)	Madagascar (10)	Russian Federation (5)	Uruguay (7)
Cabo Verde (8)	Ghana (7)	Malawi (10)	Rwanda (10)	Venezuela, RB (10)
Cambodia (5)	Greece (5)	Malaysia (6)	Saudi Arabia (10)	Vietnam (6)
Cameroon (10)	Guatemala (10)	Mali (10)	Senegal (8)	Yemen, Rep. (5)
Central African Republic (10)	Guinea (6)	Malta (9)	Seychelles (7)	Zambia (7)
Chad (10)	Guinea-Bissau (9)	Mauritania (10)	Sierra Leone (10)	Zimbabwe (8)

Note: Values in parentheses are the number of observations.

The dependent variable, CO_2 emissions per capita, is measured as metric tons per capita based on World Development Indicators [110]. The World Bank calculates the amounts of CO_2 released from the burning of fossil fuels and the manufacture of cement, including those produced during the consumption of solid, liquid, and gas fuels, and gas flaring.

As consensus is growing for a multidimensional view of globalization [21,22,111,112], we employ a composite measure, the KOF Index of Globalization (updated in [20,29]), to evaluate the key independent variable of globalization. We chose this Index for three reasons. First, it includes an overall measure of the level of globalization in each country, as well as in three separate dimensions (economic, political, and social/cultural) (for detailed explanations on variables, weights, and methodology used for constructing the index, please refer to [20]). These measures are particularly relevant when examining the hypotheses concerning both the overall effects of globalization and each of its major dimensions. The KOF Index is commonly used to assess the effects of each dimension of globalization on various outcomes [113–116]. Second, the KOF Index has been calculated for more than 200 countries since 1970, a time perceived by many researchers as the beginning of globalization in a modern sense [22]. Finally, this index is widely acknowledged in social science research (see, for example, [113–119]). These studies use the KOF Index to evaluate the level of globalization on a wide range of topics, which suggests the KOF Index is a valid and reliable measure of globalization. Indeed, after a detailed comparison of existing globalization indexes based on coverage of countries and time periods, indicators included, and methodologies, Samimi and colleagues conclude that the "KOF is the best index for measuring globalization" [120].

Economic globalization is measured through both flows (including trade, foreign direct investment, portfolio investment, and income payments to foreign nationals) and restrictions (including hidden import barriers, mean tariff rate, taxes on international trade, and capital account restrictions). These items reveal the extent to which each country is integrated into the world economy.

We measure political globalization using the KOF Index of political globalization, which includes data documenting the presence of embassies in a country, membership in international organizations,

participation in UN Security Council Missions, and the number of international treaties ratified by states. This index reflects how deeply a country is engaged in international politics.

The KOF Index of social and cultural globalization covers three aspects of social and cultural globalization, namely personal contacts (telephone traffic, transfers, international tourism, foreign population, and international letters), information flows (Internet users, television, and trade in newspapers), and cultural proximity (number of McDonald's restaurants, number of IKEA outlets, and trade in books). We are interested in understanding how the flow of people, information, and ideas, as well as cultural convergence generally, contribute to growing cosmopolitism or localism, which in turn are likely to have an influence on carbon release levels. All measurements in relation to the dimensions of the KOF Index of Globalization range from 0 to 100, with higher values indicating a higher level of globalization.

We use World Bank [110] income classifications to categorize countries into developed and less developed countries. Specifically, DCs are those categorized by the World Bank as having high incomes, and others are classified as LDCs. This approach is commonly used in comparative environmental research [121–123]. Because both national per capita income and the criteria for each income group change from year to year, some countries are categorized into different income groups in different years. For example, the Czech Republic was not a high-income country until 2006. We use a dummy variable to indicate a country's level of development (1 = DCs).

We control for economic development, urbanization, and services as percentage of total GDP in the analyses to evaluate the extent to which globalization affects environmental quality, in addition to its effects on these influential factors [110]. Previous research suggests that economic development is closely associated with CO_2 emissions [5,122,124]. We use gross domestic product (GDP, in constant 2005 US dollars) per capita to measure the level of economic development in each country. Through substantially reconstructing patterns of production and lifestyles, urbanization also influences the release of carbon dioxide [125–127]. This variable is calculated using the percentage of people identified as living in urban areas. Finally, service economies are often presumed to be less dependent on natural resources, resulting in lower levels of greenhouse gases [25,128]. We use services as percentage of total GDP to assess the extent to which domestic economies are service-based. Table 2 summarizes the descriptive statistics for all variables.

Table 2. Descriptive statistics.

Variable	Mean	S.D.	Min	Max
CO_2 emissions per capita (metric tons)	3.73	5.05	0.02	56.05
KOF index of globalization	49.20	18.65	12.75	92.81
KOF index of economic globalization	51.09	19.77	8.73	97.74
KOF index of political globalization	58.02	22.78	3.73	98.30
KOF index of social and cultural globalization	40.71	22.51	6.70	93.25
Developed countries	0.20	0.40	0.00	1.00
GDP per capita (constant 2005 US$)	7802.49	12,424.20	127.50	81,947.24
Urbanization (% Population)	51.22	23.18	2.85	100.00
Service sector (% of GDP)	48.67	11.86	10.57	82.17

Notes: N = 137 countries, n = 1059 observations.

Additionally, each dimension of globalization is closely interrelated with other dimensions, and they jointly constitute the process of globalization. For instance, the economic activities of transnational corporations not only increase global production and consumption, but are also integral to the international movements of people, information flow and exchange of ideas beyond the economic domain. Therefore, it is not surprising to find that indicators of different globalization dimensions are closely correlated. To isolate the effect of each dimension of globalization, we control for other dimensions of globalization in the models.

4.2. Method

Because the data consist of repeated observations in a series of countries, we use time-series cross-sectional Prais-Winsten regression models with panel-corrected standard errors (PCSE). This method is commonly used in longitudinal international studies (for example, [122,129,130]). The resulting model allows for the accurate estimation of sampling variability by accounting for panel heteroskedasticity and contemporaneous correlation of the errors [30,31]. Therefore, it effectively rules out potential overconfidence in the results produced by the generalized least-square methods. As there is no theoretical reason to assume that the serial correlations are panel specific, we estimate the model with a common autoregressive (AR) (1) parameter (first-order autocorrelation); thus, the estimation processes are common to all the panels. We control for both year-specific and country-specific errors, analogous to a two-way fixed effects model.

The estimated model is:

$$y_{it} = \beta x_{it} + u_i + w_t + e_{it}$$

where y_{it} denotes CO_2 emissions per capita of the country i at year t. βx_{it} is the vector of coefficients for predictor variables that vary over time. u_i is the country-specific error term. w_t is the year-specific error term that is consistent across countries, and e_{it} is the error term unique to each nation in each time period. Because we used year dummies and country dummies to control for u_i and w_t, e_{it} is the only stochastic element in the model. The inclusion of the unit-specific and period-specific intercepts controls for unobserved heterogeneity across nations and years. This approach is considered robust against potentially omitted variables and more closely approximates experimental conditions [131].

Because the number of countries is larger than the number of years, we also estimate models using pooled OLS regression with Driscoll-Kraay standard errors (DK) to correct for cross-sectional dependence [32,33]. This method has also been commonly employed in cross-national panel studies [123,124,132].

All variables are log-transformed except for the year and country dummies. The coefficients are thus elasticity coefficients, representing the proportional change (in percentages) in CO_2 emissions from a 1 percent change in the predictor, holding all else constant. This approach has been widely adopted in comparative environmental sociological research [5,124,133].

To assess the changing effects of globalization on carbon emissions in DCs and LDCs, we include three-way interactions between globalization, country classification (1 = DCs), and the dummy variable for each year. Therefore, the main effect indicates the effects of globalization, or those of each of its dimensions, on carbon emissions in LDCs in the base year, 1970. The interaction between year dummies and globalization indexes indicates the difference in globalization effects between the base year and the corresponding year in LDCs. The interaction involving year dummies, globalization indexes, and DCs indicates the difference in globalization effects between the base year and the corresponding year and between DCs and LDCs.

5. Results

Tables 3–6 present the results of the regression analyses. To facilitate interpretation, Figures 1–4 illustrate the results that correspond to Tables 3–6, respectively. Each table includes two sets of results from PCSE and DK estimations. The results are basically consistent in the two sets of models. To avoid repetition, all figures and interpretations are based on the DK estimation considering that the number of countries exceeds the number of years.

Table 3 and Figure 1 display the results estimating the overall effects of globalization on carbon emissions. As a reminder, the year- and country-specific intercepts and the interactions between DCs and years are included but not shown in all tables (results available upon request). All interaction terms including DCs are significant, indicating that there are significant differences between DCs and LDCs over time. Additionally, the three-way interaction terms increased in magnitude from 1970 to 2014, meaning the difference gap widened over time.

Table 3. Elasticity coefficients for the two-Way fixed effects Prais-Winsten regression (PCSE) models and pooled OLS regression models with Driscoll-Kraay standard errors (DK) predicting CO_2 emissions, 1970–2014.

	Model 1		Model 2	
	PCSE [a]		DK [b]	
Globalization	−0.081 ***	(0.017)	−0.069 *	(0.033)
Globalization × 1975	0.004	(0.014)	0.002	(0.004)
Globalization × 1980	0.019	(0.024)	0.023 **	(0.008)
Globalization × 1985	0.001	(0.031)	0.006	(0.012)
Globalization × 1990	0.038	(0.036)	0.026 *	(0.013)
Globalization × 1995	0.090 ***	(0.024)	0.110 ***	(0.014)
Globalization × 2000	0.100 ***	(0.027)	0.125 ***	(0.017)
Globalization × 2005	0.179 ***	(0.029)	0.196 ***	(0.026)
Globalization × 2010	0.239 ***	(0.038)	0.255 ***	(0.024)
Globalization × 2014	0.198 ***	(0.036)	0.210 ***	(0.023)
DCs	−4.579 ***	(0.616)	−4.879 ***	(0.388)
Globalization × DCs	1.308 ***	(0.171)	1.383 ***	(0.106)
Globalization × DCs × 1975	−0.662 ***	(0.165)	−0.814 ***	(0.094)
Globalization × DCs × 1980	−0.773 **	(0.236)	−0.908 ***	(0.074)
Globalization × DCs × 1985	−0.746 ***	(0.219)	−0.924 ***	(0.090)
Globalization × DCs × 1990	−1.351 ***	(0.240)	−1.526 ***	(0.097)
Globalization × DCs × 1995	−1.182 ***	(0.185)	−1.409 ***	(0.079)
Globalization × DCs × 2000	−1.226 ***	(0.191)	−1.415 ***	(0.095)
Globalization × DCs × 2005	−1.295 ***	(0.195)	−1.482 ***	(0.109)
Globalization × DCs × 2010	−1.764 ***	(0.251)	−2.073 ***	(0.078)
Globalization × DCs × 2014	−1.972 ***	(0.180)	−2.105 ***	(0.076)
GDP per capita	0.205 ***	(0.020)	0.214 ***	(0.030)
Urbanization	0.058 *	(0.028)	0.056 +	(0.033)
Service sector	−0.012	(0.022)	−0.021	(0.027)
DCs × year dummies	Included		Included	
Country dummies	Included		Included	
Year dummies	Included		Included	
Constant	−0.704 ***	(0.143)	−0.779 ***	(0.201)
R-squared	0.965		0.978	

Notes: N = 137 countries; n = 1059 observations; [a] Panel corrected standard errors in parentheses; [b] Driscoll-Kraay standard errors in parentheses; + $p < 0.1$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$ (two-tailed tests).

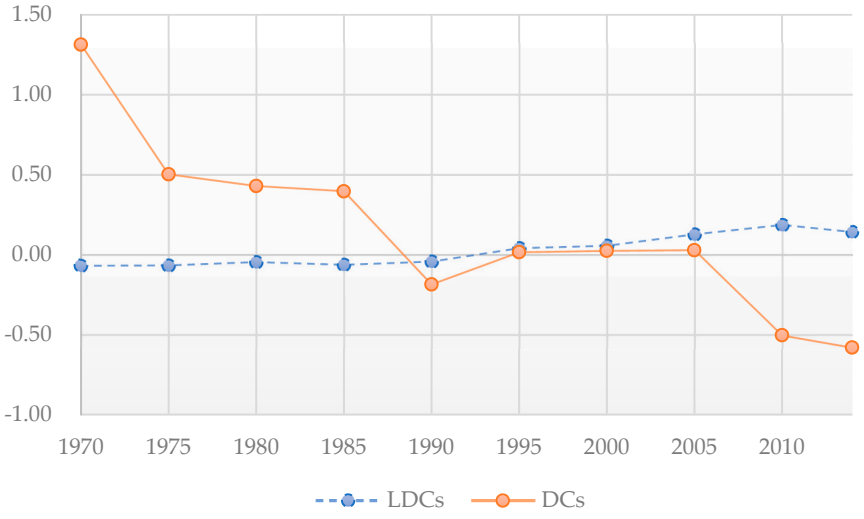


Figure 1. Predicted effects of globalization on CO_2 emissions.

More specifically, in LDCs, the relationship between globalization and carbon emissions per capita was negative in 1970, indicating that a 1% increase in globalization led to a 0.069% decrease in carbon emissions, all else being equal. Turning to the interactions between globalization and years, since LDCs serve as the reference group in the model, these types of interactions show the difference in the effect of globalization between 1970 and the corresponding year within LDCs. Most of the interactions are insignificant. In 1995, the coefficient became significantly positive (0.041 = −0.069 + 0.110, $p < 0.001$). These results suggest that integration to the globe has started to increase carbon emissions in LDCs.

For DCs, the effect of globalization on CO_2 emissions was opposite to that in LDCs. Unlike the negative association in LDCs, globalization was positively related to carbon emissions in 1970 (b = 1.314 = −0.069 + 1.383). This implies that, as DCs strengthened their international connections, their carbon emissions increased accordingly in 1970. All three-way interaction terms are negative and significant. The initial environmentally unfriendly effects of globalization have declined over time. In 1970, a 1% change in globalization was associated with a 1.314% increase in carbon emissions, whereas in 2014, a 1% change in globalization led to a 0.581% (= 1.314% + 0.210% − 2.105%) decrease in emissions.

Therefore, the results reported in Table 3 do not support the homogenizing environmental effects of globalization as predicted by ecological modernization and world polity theories, but rather provide evidence for a growing divergence as proposed in ecological unequal exchange theory. It is also noteworthy that the effect size of the coefficients is much larger in DCs than in LDCs. In other words, the diverging effects of globalization are not symmetrical between the two types of countries.

Tables 4–6 examine the effects of each dimension of globalization on carbon emissions. Table 4 and Figure 2 show the results assessing the impacts of economic globalization, accounting for the other two dimensions and control variables. Most of the interactions involving DCs are not statistically significant, suggesting that economic globalization does not have distinctive effects in DCs and LDCs. Therefore, we focus on the changing effects of economic globalization across years. Compared to the overall effect of globalization, the effect size of economic globalization is much smaller. Economic globalization first reduced carbon emissions in the 1970s and 1980s, but the sustainable effects faded as time passed. By 2014, engagement in international trade and economic openness had significantly increased carbon emissions (b = 0.113 = −0.024 + 0.137).

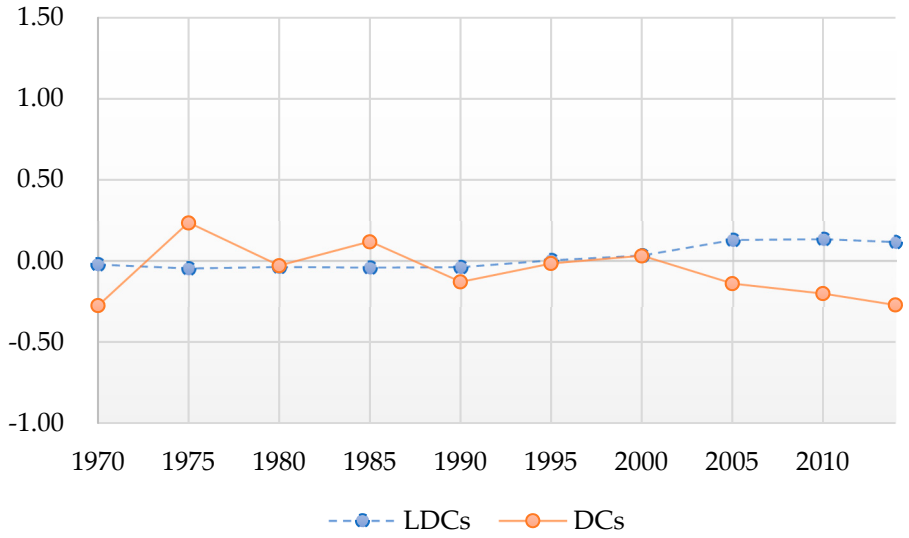


Figure 2. Predicted effects of economic globalization on CO_2 emissions.

Table 4. Elasticity coefficients for PCSE and DK models predicting the impacts of economic globalization (EG) on CO_2 emissions, 1970–2014.

	Model 1		**Model 2**	
	PCSE [a]		**DK** [b]	
EG	−0.040 ***	(0.010)	−0.024	(0.017)
EG × 1975	−0.020 *	(0.008)	−0.024 ***	(0.004)
EG × 1980	−0.009	(0.013)	−0.015 ***	(0.005)
EG × 1985	−0.020	(0.012)	−0.019 **	(0.006)
EG × 1990	−0.005	(0.015)	−0.016 +	(0.009)
EG × 1995	0.025 **	(0.009)	0.026 ***	(0.005)
EG × 2000	0.027 +	(0.014)	0.055 **	(0.017)
EG × 2005	0.118 ***	(0.023)	0.150 ***	(0.019)
EG × 2010	0.130 ***	(0.027)	0.155 ***	(0.011)
EG × 2014	0.121 ***	(0.023)	0.137 ***	(0.014)
DCs	0.716	(1.898)	1.361 *	(0.602)
EG × DCs	−0.090	(0.492)	−0.252	(0.166)
EG × DCs × 1975	0.427	(0.501)	0.533 ***	(0.086)
EG × DCs × 1980	0.119	(0.547)	0.261 *	(0.115)
EG × DCs × 1985	0.306	(0.530)	0.412 *	(0.178)
EG × DCs × 1990	0.051	(0.506)	0.162	(0.167)
EG × DCs × 1995	0.177	(0.500)	0.233	(0.173)
EG × DCs × 2000	0.191	(0.497)	0.251	(0.183)
EG × DCs × 2005	0.016	(0.503)	−0.015	(0.222)
EG × DCs × 2010	−0.008	(0.499)	−0.081	(0.193)
EG × DCs × 2014	−0.210	(0.494)	−0.133	(0.133)
SCG	0.025	(0.017)	0.042 **	(0.014)
PG	0.011	(0.019)	−0.005	(0.026)
GDP per capita	0.200 ***	(0.020)	0.205 ***	(0.027)
Urbanization	0.018	(0.027)	0.018	(0.034)
Service sector	−0.014	(0.022)	−0.015	(0.025)
DCs × year dummies	Included		Included	
Country dummies	Included		Included	
Year dummies	Included		Included	
Constant	−0.747 ***	(0.146)	−0.832 ***	(0.195)
R-squared	0.962		0.977	

Notes: N = 137 countries; n = 1059 observations; [a] Panel corrected standard errors in parentheses; [b] Driscoll-Kraay standard errors in parentheses; + $p < 0.1$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$ (two-tailed tests).

Table 5 and Figure 3 present models assessing the effects of political globalization. Panel 3 shows that the effects fluctuated in LDCs within the studied period, but that they are all negative, indicating a higher level of political globalization is associated with fewer carbon emissions. This suggests that integration into the world polity, including but not limited to environmental international organizations, may provide LDCs with bargaining power, cultural scheme, and associational resources to act environmentally. For DCs, political globalization had led to more carbon releases over the period from 1970 to 2005 as shown in Panel 3. Political connections in the global system also contributes to carbon reductions since 2010 in DCs.

Table 5. Elasticity coefficients for PCSE and DK models predicting the impacts of political globalization (PG) on CO_2 emissions, 1970–2014.

	Model 1		Model 2	
	PCSE [a]		DK [b]	
PG	−0.112 **	(0.039)	−0.144 ***	(0.040)
PG × 1975	0.079 +	(0.045)	0.087 ***	(0.021)
PG × 1980	0.099 *	(0.047)	0.116 **	(0.040)
PG × 1985	0.104 *	(0.043)	0.116 **	(0.037)
PG × 1990	0.091 *	(0.043)	0.117 **	(0.037)
PG × 1995	0.071	(0.045)	0.096 *	(0.047)
PG × 2000	0.065	(0.047)	0.082 +	(0.043)
PG × 2005	0.057	(0.050)	0.057	(0.047)
PG × 2010	0.082	(0.053)	0.087+	(0.047)
PG × 2014	0.043	(0.053)	0.039	(0.048)
DCs	−1.275 **	(0.405)	−1.672 ***	(0.263)
PG × DCs	0.427 ***	(0.102)	0.535 ***	(0.064)
PG × DCs × 1975	−0.381 ***	(0.114)	−0.486 ***	(0.064)
PG × DCs × 1980	−0.203	(0.157)	−0.341 ***	(0.089)
PG × DCs × 1985	−0.223 *	(0.098)	−0.334 ***	(0.062)
PG × DCs × 1990	−0.456 ***	(0.113)	−0.593 ***	(0.072)
PG × DCs × 1995	−0.254 *	(0.125)	−0.383 ***	(0.083)
PG × DCs × 2000	−0.247 *	(0.120)	−0.372 ***	(0.067)
PG × DCs × 2005	−0.159	(0.131)	−0.232 **	(0.080)
PG × DCs × 2010	−0.516 ***	(0.145)	−0.702 ***	(0.063)
PG × DCs × 2014	−0.650 ***	(0.136)	−0.722 ***	(0.089)
EG	−0.034 **	(0.011)	−0.032 *	(0.013)
SCG	0.010	(0.017)	0.023 +	(0.014)
GDP per capita	0.209 ***	(0.022)	0.219 ***	(0.028)
Urbanization	0.002	(0.031)	−0.008	(0.032)
Service sector	−0.016	(0.023)	−0.020	(0.026)
DCs × year dummies	Included		Included	
Country dummies	Included		Included	
Year dummies	Included		Included	
Constant	−0.322	(0.202)	−0.294	(0.277)
R-squared	0.963		0.977	

Notes: N = 137 countries; n = 1059 observations; [a] Panel corrected standard errors in parentheses; [b] Driscoll-Kraay standard errors in parentheses; + $p < 0.1$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$ (two-tailed tests).

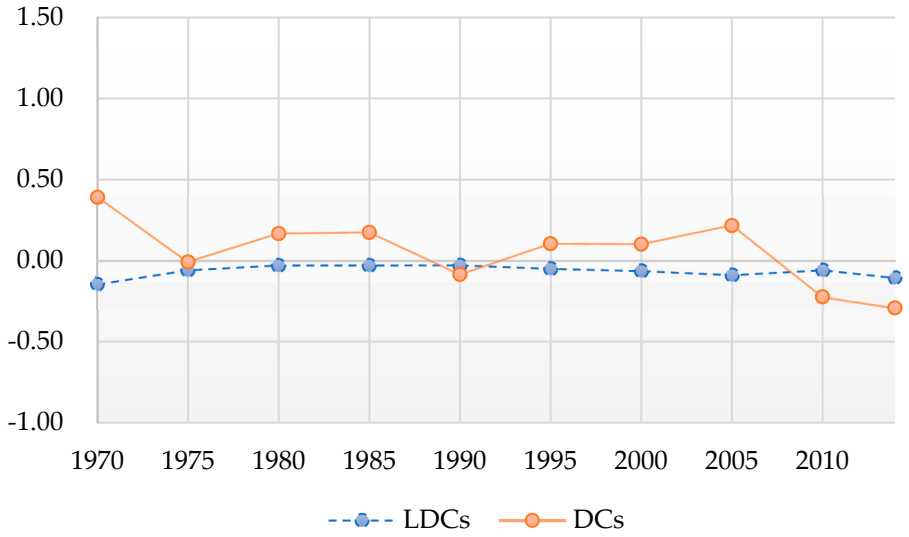


Figure 3. Predicted effects of political globalization on CO_2 emissions.

Table 6 and Figure 4 show the results of evaluating the effects of social and cultural globalization. Compared to the other two dimensions of globalization, social and cultural globalization has a bigger effect on carbon emissions. For LDCs, the global flows of people, ideas, and information did not significantly influence carbon emissions in 1970 (b = −0.007, $p > 0.1$). Since 1975, however, the coefficients of interaction terms between social and cultural globalization and years have been significantly positive and have increased in magnitude, suggesting that the unsustainable effects of carbon emissions had intensified in these countries. Global social interactions and cultural proximity may help spread energy- and resource-intensive lifestyles, resulting in growing carbon emissions. Contrary to the situation in LDCs, the unsustainable effects of social and cultural globalization have decreased in DCs. In 1970, a 1% increase in global social interactions and cultural proximity was associated with a 1.128% increase in carbon releases (b = 1.128 = −0.007 + 1.135, $p < 0.001$), whereas the same amount of increase led to a 0.672% (b = 0.672 = −0.007 + 1.135 + 0.170 − 1.970) decrease in carbon emissions in 2014.

Table 6. Elasticity coefficients for PCSE and DK models predicting the impacts of social and cultural globalization (SCG) on CO_2 emissions, 1970–2014.

	Model 1		**Model 2**	
	PCSE [a]		**DK** [b]	
SCG	−0.029	(0.022)	−0.007	(0.015)
SCG× 1975	0.011	(0.016)	0.010 *	(0.004)
SCG× 1980	0.030	(0.024)	0.025 **	(0.009)
SCG× 1985	0.016	(0.028)	0.008	(0.014)
SCG× 1990	0.052 +	(0.027)	0.033 *	(0.014)
SCG× 1995	0.074 ***	(0.021)	0.075 ***	(0.007)
SCG× 2000	0.105 ***	(0.023)	0.114 ***	(0.008)
SCG× 2005	0.159 ***	(0.026)	0.167 ***	(0.011)
SCG× 2010	0.184 ***	(0.029)	0.185 ***	(0.012)
SCG× 2014	0.167 ***	(0.028)	0.170 ***	(0.008)
DCs	−3.641 ***	(0.921)	−3.942 ***	(0.559)
SCG× DCs	1.055 ***	(0.263)	1.135 ***	(0.154)
SCG× DCs × 1975	−0.559*	(0.241)	−0.584 ***	(0.071)
SCG× DCs × 1980	−0.999 ***	(0.288)	−1.032 ***	(0.094)
SCG× DCs × 1985	−0.983**	(0.324)	−0.980 ***	(0.089)
SCG× DCs × 1990	−0.968**	(0.363)	−1.057 ***	(0.167)
SCG× DCs × 1995	−1.130 ***	(0.299)	−1.353 ***	(0.150)
SCG× DCs × 2000	−1.236 ***	(0.304)	−1.422 ***	(0.164)
SCG× DCs × 2005	−1.505 ***	(0.305)	−1.740 ***	(0.182)
SCG× DCs × 2010	−1.834 ***	(0.355)	−2.115 ***	(0.140)
SCG× DCs × 2014	−1.868 ***	(0.280)	−1.970 ***	(0.128)
EG	−0.017 +	(0.010)	−0.011	(0.020)
PG	0.003	(0.019)	−0.013	(0.026)
GDP per capita	0.196 ***	(0.019)	0.203 ***	(0.028)
Urbanization	0.042	(0.030)	0.042	(0.033)
Service sector	−0.020	(0.024)	−0.033	(0.026)
DCs × year dummies	Included		Included	
Country dummies	Included		Included	
Year dummies	Included		Included	
Constant	−0.672 ***	(0.124)	−0.717 ***	(0.174)
R-squared	0.966		0.978	

Notes: N = 137 countries; n = 1059 observations; [a] Panel corrected standard errors in parentheses; [b] Driscoll-Kraay standard errors in parentheses; + $p < 0.1$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$ (two-tailed tests).

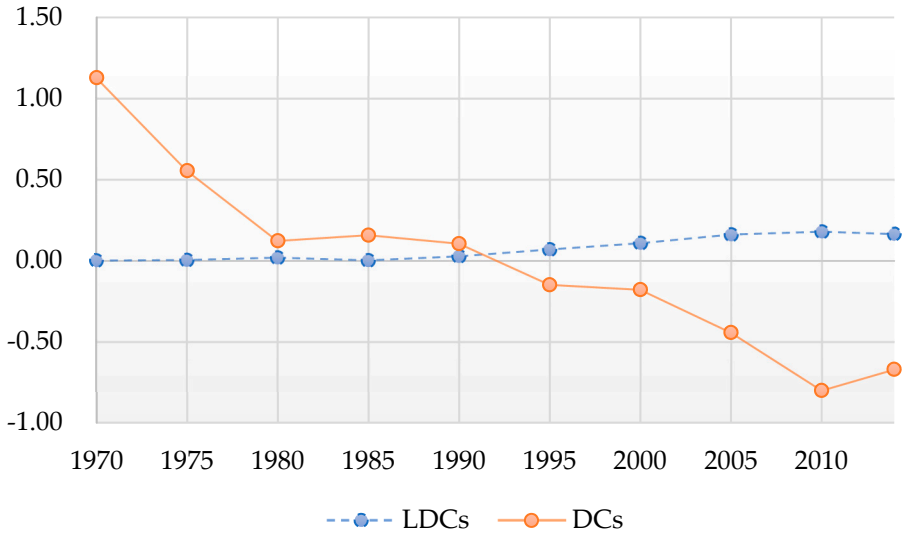


Figure 4. Predicted effects of social and cultural globalization on CO_2 emissions.

Turning to the control variables, their effects are in general consistent across all the models. The coefficients of GDP per capita are positive and significant. This is consistent with previous findings that economic development significantly contributes to global climate change [128,134]. After accounting for other variables, urbanization has no significant effect in most models. Based on cross-national panel data, Jorgenson and colleagues demonstrate that the estimated effects of urbanization on per capita carbon emissions substantially decreased in high-income countries from 1960 to 2010, but increased in countries in Africa and Asia during the same time period [126]. Therefore, it is possible that the effect of urbanization varies in DCs and LDCs, and thus is not apparent in models with combined samples. The service sector (% GDP) is negatively associated with carbon emissions, but none of the coefficients are significant. This suggests that a post-industrial economic structure may decrease greenhouse gas releases, but the effect is likely to coincide with other socio-structural predictors like globalization, economic development and urbanization.

Finally, we perform a series of sensitivity analyses on the findings, including the multicollinearity issue, the use of an alternative globalization index, and the inclusion of other important variables into the analyses (see the supplemental file, and all results available upon request). The main findings are essentially the same, suggesting that the results are robust.

6. Discussion and Conclusions

In this paper, we examine the relationships between globalization and CO_2 emissions in 137 countries from 1970 to 2014. Prior research proposes two major contrasting perspectives. Ecological modernization and world polity theorists predict homogenizing tendencies of global economy, culture, and institutions and suggest that environmental issues such as global warming will be attenuated worldwide due to improved science and technology, a diffusion of environmental culture, and international collaboration. On the other hand, ecological unequal exchange theorists adopt a heterogenization perspective, considering that globalization reinforces the world order in which DCs and LDCs are systematically different in terms of wealth, power, social structure, and environmental opportunities because of their unequal positions in the world system.

By applying Prais-Winsten regression models with panel-corrected standard errors and pooled OLS regression with Driscoll-Kraay standard errors to cross-national panel data, we empirically test these two perspectives and assess the effects of globalization overall and its three major dimensions (economic, political, and social/cultural) on CO_2 emissions, using the KOF index of globalization. Taken together, our results lend support to the ecological unequal exchange theory. After accounting for levels of economic development, urbanization, and economic structure, we find that, in general, the

pro-environmental influence of globalization has expanded in developed economies, especially since the 2000s, while it gradually declined in LDCs over the four decades. A detailed exploration into the effect of each dimension shows that social/cultural globalization has contributed to carbon reduction in DCs, while leading to an increase in carbon emissions in LDCs. Economic globalization has slightly increased carbon emissions, and the effects do not differ between DCs and LDCs. Interestingly, and consistent with ecological modernization and world polity theories, international political connections have enabled both DCs and LDCs to slightly curb carbon emissions over time.

Although we do not examine the underlying mechanisms, current literature suggests that these asymmetric effects are likely be attributable to a combination of factors. Economic growth remains a top priority for many LDCs. In a globalized world, it is not feasible to take an isolationist approach and avoid communicating with other nations. Global dependency and the desire to develop their domestic economies can put LDCs in a weak bargaining position, making it difficult to advance their industrial and economic capacity. This unequal global division hinders LDCs from taking up opportunities to move toward a low-carbon, high-value development future. On the cultural/social dimensions, the pursuit of comfort and convenience, as well as local well-being, can trump distant global concerns on future environmental change. In particular, consumerist ideologies and practices in DCs are welcomed or even celebrated as "ideal", "modern" and "advanced" ways of life by people in LDCs and have greatly shaped patterns of consumption as well as individual feelings, identity and status [135–137]. The global embrace of consumerism has legitimated and spread unsustainable lifestyles and dissolved individual responsibility towards the environment by putting personal desires above all else. The rise of consumerism resonates with the growth needs in many LDCs and is supported by producers and policy makers, resulting in vast carbon emissions [138]. At the same time, although it has been claimed that international organizations do not fully achieve their goals, it is promising to see that supra-national institutions and the world environmental regime appear to have effectively spread environmental culture and mobilized resources in LDCs.

Apart from the pro-environmental effect of political globalization identified, our findings also lend additional support to the ecological modernization theory. Based on the magnitude of coefficients, the effects of globalization are more pronounced in DCs. In other words, the sustainable effects of globalization in DCs are much bigger than their environmentally unfriendly effects in LDCs. Although globalization has provided DCs with opportunities to cut down their carbon emissions, progress has not been entirely at the expense of LDCs. In line with the ecological restructuring process proposed by ecological modernization theory, it is possible that global connections and exchanges of information have facilitated the institutionalization of environmental norms and practices, and this may have a spillover effect in LDCs in the long run.

Although our results suggest that LDCs in general suffer environmentally from globalization, this issue is unlikely to be resolved without involving globalization in some form [6,139]. Despite globalization's asymmetrical effects, it is too soon to conclude that it is the major negative force behind the world's unbalanced CO_2 emissions. Globalization per se is an objective trend and contributes to the rise of a closely connected world. Its effects depend on whether human agency is used to spread information on sustainability and promote cooperation among nations, or to take advantage of existing imbalances and transfer environmental risks to other countries. Shrinking social and physical spaces have blurred the formerly unambiguous distinction between local and global environmental problems. With increasing communication and exchange, environmental degradation cannot be mitigated within specific geographical territories alone. For almost all countries, unprecedented global connectivity precludes options for deciding whether to be included or excluded from the globalization process. It is thus not possible for LDCs to overcome major environmental obstacles, such as the global transfer of pollution and appropriation of environmental space, on their own [139]. It requires both international and national collaboration to ensure sustainable development for all, and to narrow the environmental gap between the Global South and North.

Our study systematically details the effects of multidimensional globalization on carbon emissions worldwide. To better understand this phenomenon, future research needs to investigate the following unresolved questions. First, it is important to thoroughly understand the pathways and their complex interactions through which globalization influences carbon emissions. This paper provides an integrated picture of the effects of globalization, but the specific mechanisms remain largely unknown. It is interesting that previous studies have identified several theoretical explanations and that seemingly contrary theories all have supporting evidence. Perhaps each theory is only revealing a partial truth. The institutional powers and value systems associated with these processes are contingent on each other and geared toward a dynamic equilibrium in a codependent but unequal world system. Second, researchers should explore the underlying meaning of globalization in different countries in greater depth. Although the use of the KOF index allows us to systematically examine the effect of globalization from three dimensions, it should be noted that as no measures are perfect, the KOF index per se is not free from defects. In particular, most of the variables used to construct the indices seem to be "value-free", while their meaning is likely to be substantially different for countries occupying unequal structural positions. For instance, the KOF Index of economic globalization focuses on economic exchange and openness, whereas it overlooks the exploitative relationships between countries. In other words, global economic flows may indicate profits and capital accumulation in DCs, but destruction of traditional industries and fragile economic structure in LDCs. Jorgenson and colleagues have conducted a series of studies and show that exports to DCs contribute to environmental degradation in LDCs, such as deforestation, threatened mammals, per capita ecological footprints, and water pollution [140]. In a similar way, the KOF Index of political globalization evaluates countries' official interaction in the international political arena, but the competition between countries is largely ignored. In another study, Jorgenson and Clark [141] find that militarily powerful nations are able to secure and defend their advantages and over utilize global environmental space. Third, to provide a more comprehensive analysis of globalization's environmental consequences, future research could explore the influence of globalization on other important environmental outcomes and whether the results follow a similar pattern in DCs and LDCs. Finally, future studies could investigate to what extent varying degrees of exposure to the outside world affect the environment on a smaller geographical scale within countries. If the heterogenization perspective is correct, then it may be that environmental risks can be observed as unevenly distributed at the provincial or city level, and that the global victims of excessive carbon release are in fact the disadvantaged groups in poor countries.

Author Contributions: Conceptualization, Y.W., T.Z., and H.C.; methodology, Y.W.; formal analysis, Y.W.; resources, H.C. and Z.R.; data curation, Y.W.; writing—original draft preparation, Y.W.; writing—review and editing, Y.W. and H.C.

Funding: This research was funded by the National Social Science Fund of China, grant number 16CSH023.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Barkin, J.S. The Counterintuitive Relationship between Globalization and Climate Change. *Glob. Environ. Politics* **2003**, *3*, 8–13. [CrossRef]
2. Clark, B.; York, R. Carbon metabolism: Global capitalism, climate change, and the biospheric rift. *Theory Soc.* **2005**, *34*, 391–428. [CrossRef]
3. Dunlap, R.E.; Brulle, R.J. (Eds.) *Climate Change and Society: Sociological Perspectives*; Oxford University Press: New York, NY, USA, 2015; ISBN 978-0-19-935612-6.
4. Givens, J.E.; Jorgenson, A.K. Global integration and carbon emissions, 1965–2005. In *Overcoming Global Inequalities*; Political Economy of the World-System Annuals; Wallerstein, I.M., Chase-Dunn, C., Suter, C., Eds.; Paradigm Publishers: Boulder, CO, USA, 2014; pp. 168–183.
5. Longhofer, W.; Jorgenson, A. Decoupling reconsidered: Does world society integration influence the relationship between the environment and economic development? *Soc. Sci. Res.* **2017**, *65*, 17–29. [CrossRef] [PubMed]

6. Mol, A.P.J. *Globalization and Environmental Reform: The Ecological Modernization of the Global Economy*; MIT Press: Cambridge, MA, USA, 2001.
7. Prell, C.; Feng, K. The evolution of global trade and impacts on countries' carbon trade imbalances. *Soc. Netw.* **2016**, *46*, 87–100. [CrossRef]
8. Roberts, J.T.; Parks, B.C. Ecologically Unequal Exchange, Ecological Debt, and Climate Justice: The History and Implications of Three Related Ideas for a New Social Movement. *Int. J. Comp. Sociol.* **2009**, *50*, 385–409. [CrossRef]
9. Spaargaren, G.; Mol, A.P.J.; Buttel, F.H. (Eds.) *Environment and Global Modernity*, 1st ed.; SAGE Publications Ltd.: London, UK, 2000; ISBN 978-0-7619-6767-5.
10. Stretesky, P.B.; Lynch, M.J. A cross-national study of the association between per capita carbon dioxide emissions and exports to the United States. *Soc. Sci. Res.* **2009**, *38*, 239–250. [CrossRef]
11. Mol, A.P.J. Ecological Modernization and the Global Economy. *Glob. Environ. Politics* **2002**, *2*, 92–115. [CrossRef]
12. Mol, A.P.J.; Sonnenfeld, D.A. (Eds.) *Ecological Modernisation Around the World: Perspectives and Critical Debates*; Frank Cass Publishers: London, UK, 2000; ISBN 978-0-7146-5064-7.
13. Hornborg, A.; McNeill, J.R.; Alier, J.M. (Eds.) *Rethinking Environmental History: World-System History and Global Environmental Change*; Altamira Press: Walnut Creek, CA, USA, 2007.
14. Parks, B.C.; Roberts, J.T. Globalization, Vulnerability to Climate Change, and Perceived Injustice. *Soc. Nat. Resour.* **2006**, *19*, 337–355. [CrossRef]
15. Rice, J. Ecological Unequal Exchange: Consumption, Equity, and Unsustainable Structural Relationships within the Global Economy. *Int. J. Comp. Sociol.* **2007**, *48*, 43–72. [CrossRef]
16. Grimes, P.; Kentor, J. Exporting the Greenhouse: Foreign Capital Penetration and CO_2 Emissions 1980–1996. *J. World-Syst. Res.* **2003**, *9*, 261–275. [CrossRef]
17. Jorgenson, A.K.; Dick, C.; Mahutga, M.C. Foreign Investment Dependence and the Environment: An Ecostructural Approach. *Soc. Probl.* **2007**, *54*, 371–394. [CrossRef]
18. Peters, G.P.; Minx, J.C.; Weber, C.L.; Edenhofer, O. Growth in emission transfers via international trade from 1990 to 2008. *PNAS* **2011**, *108*, 8903–8908. [CrossRef]
19. Prell, C.; Sun, L. Unequal carbon exchanges: Understanding pollution embodied in global trade. *Environ. Sociol.* **2015**, *1*, 256–267. [CrossRef]
20. Dreher, A.; Gaston, N.; Martens, W.J.M. *Measuring Globalisation Gauging Its Consequences*; Springer: New York, NY, USA, 2008; ISBN 0-387-74067-8.
21. Giddens, A. *Runaway World: How Globalisation Is Reshaping Our Lives*; Profile Books Ltd.: London, UK, 2002; ISBN 1-86197-429-9.
22. Guillén, M.F. Is Globalization Civilizing, Destructive or Feeble? A Critique of Five Key Debates in the Social Science Literature. *Annu. Rev. Sociol.* **2001**, *27*, 235–260. [CrossRef]
23. Held, D.; McGrew, A.; Goldblatt, D.; Perraton, J. *Global Transformations: Politics, Economics and Culture*; Stanford University Press: Stanford, CA, USA, 1999; ISBN 978-0-8047-3627-5.
24. Pellow, D.N.; Brehm, H.N. An Environmental Sociology for the Twenty-First Century. *Annu. Rev. Sociol.* **2013**, *39*, 229–250. [CrossRef]
25. Spaargaren, G.; Mol, A.P.J. Sociology, environment, and modernity: Ecological modernization as a theory of social change. *Soc. Nat. Resour.* **1992**, *5*, 323–344. [CrossRef]
26. Roberts, J.T.; Grimes, P.E.; Manale, J. Social roots of global environmental change: A world-systems analysis of carbon dioxide emissions. *J. World-Syst. Res.* **2003**, *9*, 277–315. [CrossRef]
27. Shandra, J.M.; London, B.; Whooley, O.P.; Williamson, J.B. International Nongovernmental Organizations and Carbon Dioxide Emissions in the Developing World: A Quantitative, Cross-National Analysis. *Sociol. Inq.* **2004**, *74*, 520–545. [CrossRef]
28. Song, S.-K.; Shon, Z.-H. Emissions of greenhouse gases and air pollutants from commercial aircraft at international airports in Korea. *Atmos. Environ.* **2012**, *61*, 148–158. [CrossRef]
29. Dreher, A. Does Globalization Affect Growth? Evidence from A New Index of Globalization. *Appl. Econ.* **2006**, *38*, 1091–1110. [CrossRef]
30. Beck, N. Time-Series–Cross-Section Data: What Have We Learned in the Past Few Years? *Annu. Rev. Political Sci.* **2001**, *4*, 271–293. [CrossRef]

31. Beck, N.; Katz, J.N. What to Do (and Not to Do) with Time-Series Cross-Section Data. *Am. Political Sci. Rev.* **1995**, *89*, 634–647. [CrossRef]
32. Driscoll, J.C.; Kraay, A.C. Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data. *Rev. Econ. Stat.* **1998**, *80*, 549–560. [CrossRef]
33. Hoechle, D. Robust standard errors for panel regressions with cross-sectional dependence. *Stata J.* **2007**, *7*, 281–312. [CrossRef]
34. Bordo, M.D.; Taylor, A.M.; Williamson, J.G. (Eds.) *Globalization in Historical Perspective*; University of Chicago Press: Chicago, IL, USA, 2007.
35. Berking, H. 'Ethnicity is Everywhere': On Globalization and the Transformation of Cultural Identity. *Curr. Sociol.* **2003**, *51*, 248–264. [CrossRef]
36. Brenner, N. Beyond state-centrism? Space, territoriality, and geographical scale in globalization studies. *Theory Soc.* **1999**, *28*, 39–78. [CrossRef]
37. Castells, M. *The Rise of the Network Society*; Wiley-Blackwell: Chichester, UK, 2010; ISBN 978-1-4443-1951-4.
38. Holton, R. Globalization's Cultural Consequences. *Ann. Am. Acad. Political Soc. Sci.* **2000**, *570*, 140–152. [CrossRef]
39. Mol, A.P.J. *The Refinement of Production: Ecological Modernization Theory and the Chemical Industry*; Van Arkel: Utrecht, The Netherlands, 1995; ISBN 978-90-6224-979-4.
40. Mol, A.P.J.; Sonnenfeld, D.A. Ecological Modernisation Around the World: An Introduction. In *Ecological Modernisation around the World: Perspectives and Critical Debates*; Mol, A.P.J., Sonnenfeld, D.A., Eds.; Frank Cass: London, UK, 2000; pp. 3–14.
41. Mol, A.P.J.; Spaargaren, G. Ecological modernisation theory in debate: A review. *Environ. Politics* **2000**, *9*, 17–49. [CrossRef]
42. Spaargaren, G. *The Ecological Modernization of Production and Consumption: Essays in Environmental Sociology*; Landbouw Universiteit Wageningen: Wageningen, The Netherlands, 1997.
43. Mol, A.P.J. Ecological modernization: Industrial transformations and environmental reform. In *The International Handbook of Environmental Sociology*; Redclift, M., Woodgate, G., Eds.; Edward Elgar: Cheltenham, UK; Northampton, MA, USA, 1997; pp. 138–149.
44. Mol, A.P.J. Environment and Modernity in Transitional China: Frontiers of Ecological Modernization. *Dev. Chang.* **2006**, *37*, 29–56. [CrossRef]
45. Spaargaren, G.; Mol, A.P.J. Carbon flows, carbon markets, and low-carbon lifestyles: Reflecting on the role of markets in climate governance. *Environ. Politics* **2013**, *22*, 174–193. [CrossRef]
46. Huber, J. Towards industrial ecology: Sustainable development as a concept of ecological modernization. *J. Environ. Policy Plan.* **2000**, *2*, 269–285. [CrossRef]
47. Huber, J. Pioneer countries and the global diffusion of environmental innovations: Theses from the viewpoint of ecological modernisation theory. *Glob. Environ. Chang.* **2008**, *18*, 360–367. [CrossRef]
48. Cole, M.A.; Elliott, R.J.R.; Shimamoto, K. Globalization, firm-level characteristics and environmental management: A study of Japan. *Ecol. Econ.* **2006**, *59*, 312–323. [CrossRef]
49. Garcia-Johnson, R. *Exporting Environmentalism: U.S. Multinational Chemical Corporations in Brazil and Mexico*, 1st ed.; The MIT Press: Cambridge, MA, USA, 2000; ISBN 978-0-262-57136-4.
50. Cole, M.A.; Elliott, R.J.R.; Strobl, E. The environmental performance of firms: The role of foreign ownership, training, and experience. *Ecol. Econ.* **2008**, *65*, 538–546. [CrossRef]
51. Dardati, E.; Saygili, M. Multinationals and environmental regulation: Are foreign firms harmful? *Environ. Dev. Econ.* **2012**, *17*, 163–186. [CrossRef]
52. Albornoz, F.; Cole, M.A.; Elliott, R.J.R.; Ercolani, M.G. In Search of Environmental Spillovers. *World Econ.* **2009**, *32*, 136–163. [CrossRef]
53. Koop, G.; Tole, L. What is the environmental performance of firms overseas? An empirical investigation of the global gold mining industry. *J. Prod. Anal.* **2008**, *30*, 129–143. [CrossRef]
54. Adams, B. *Green Development: Environment and Sustainability in a Developing World*, 3rd ed.; Routledge: London, UK; New York, NY, USA, 2008; ISBN 978-0-415-39508-3.
55. Park, J.; Sarkis, J.; Wu, Z. Creating integrated business and environmental value within the context of China's circular economy and ecological modernization. *J. Clean. Prod.* **2010**, *18*, 1494–1501. [CrossRef]
56. Bokser-Liwerant, J. Globalization and Collective Identities. *Soc. Compass* **2002**, *49*, 253–271. [CrossRef]
57. Jänicke, M. Ecological modernisation: New perspectives. *J. Clean. Prod.* **2008**, *16*, 557–565. [CrossRef]

58. Kim, D.-S. Environmentalism in Developing Countries and the Case of a Large Korean City. *Soc. Sci. Q.* **1999**, *80*, 810–829. [PubMed]
59. Rootes, C. (Ed.) *Environmental Movements: Local, National and Global*; Routledge: London, UK; New York, NY, USA, 2014; ISBN 978-1-317-99483-1.
60. Dryzek, J.S. *The Politics of the Earth: Environmental Discourses*; OUP Oxford: Oxford, UK, 2013; ISBN 978-0-19-969600-0.
61. Spaargaren, G. Ecological modernization theory and the changing discourse on environment and modernity. In *Environment and Global Modernity*; Spaargaren, G., Mol, A.P.J., Buttel, F.H., Eds.; SAGE Publications Ltd.: London, UK, 2000; pp. 41–71. ISBN 978-0-7619-6767-5.
62. Brechin, S.R.; Kempton, W. Global environmentalism: A challenge to the postmaterialism thesis? *Soc. Sci. Q.* **1994**, *75*, 245–269.
63. Dunlap, R.E.; York, R. The globalization of environmental concern and the limits of the postmaterialist values explanation: Evidence from four multinational surveys. *Sociol. Q.* **2008**, *49*, 529–563. [CrossRef]
64. Grossman, G.M.; Krueger, A.B. Environmental Impacts of a North American Free Trade Agreement. In *The Mexican-U.S. Free Trade Agreement*; Garber, P., Ed.; MIT Press: Cambridge, MA, USA, 1993.
65. Grossman, G.M.; Krueger, A.B. Economic growth and the environment. *Q. J. Econ.* **1995**, *110*, 353–377. [CrossRef]
66. Boli, J.; Thomas, G.M. World Culture in the World Polity: A Century of International Non-Governmental Organization. *Am. Sociol. Rev.* **1997**, *62*, 171–190. [CrossRef]
67. Meyer, J.W. World Society, Institutional Theories, and the Actor. *Annu. Rev. Sociol.* **2010**, *36*, 1–20. [CrossRef]
68. Meyer, J.W.; Boli, J.; Thomas, G.M.; Ramirez, F.O. World Society and the Nation-State. *Am. J. Sociol.* **1997**, *103*, 144–181. [CrossRef]
69. Meyer, J.W.; Frank, D.J.; Hironaka, A.; Schofer, E.; Tuma, N.B. The Structuring of a World Environmental Regime, 1870–1990. *Int. Organ.* **1997**, *51*, 623–651. [CrossRef]
70. Frank, D.J.; Hironaka, A.; Schofer, E. The nation-state and the natural environment over the twentieth century. *Am. Sociol. Rev.* **2000**, *65*, 96–116. [CrossRef]
71. Porter, G.; Brown, J.W.; Chasek, P.S. *Global Environmental Politics*, 3rd ed.; Westview Press: Boulder, CO, USA, 2000; ISBN 978-0-8133-6845-0.
72. French, H.F. *Vanishing Borders: Protecting the Planet in the Age of Globalization*, 1st ed.; W. W. Norton & Company: New York, NY, USA, 2000; ISBN 978-0-393-32004-6.
73. Schofer, E.; Hironaka, A. The Effects of World Society on Environmental Protection Outcomes. *Soc. Forces* **2005**, *84*, 25–47. [CrossRef]
74. Wapner, P. Governance in Global Civil Society. In *Global Governance*; Young, O., Ed.; MIT Press: Cambridge, MA, USA, 1997; pp. 65–84.
75. Inglehart, R.; Baker, W.E. Modernization, Cultural Change, and the Persistence of Traditional Values. *Am. Sociol. Rev.* **2000**, *65*, 19–51. [CrossRef]
76. Boli, J.; Thomas, G.M. *Constructing World Culture: International Nongovernmental Organizations Since 1875*; Stanford University Press: Stanford, CA, USA, 1999.
77. Longhofer, W.; Schofer, E. National and Global Origins of Environmental Association. *Am. Sociol. Rev.* **2010**, *75*, 505–533. [CrossRef]
78. Jorgenson, A.K.; Dick, C.; Shandra, J.M. World Economy, World Society, and Environmental Harms in Less-Developed Countries. *Sociol. Inq.* **2011**, *81*, 53–87. [CrossRef]
79. Hirst, P.; Thompson, G.; Bromley, S. *Globalization in Question*, 3rd ed.; Polity Press: Cambridge, UK; Malden, MA, USA, 2015; ISBN 978-0-7456-9734-5.
80. Robertson, R. Glocalization: Time-space and homogeneity-heterogeneity. In *Global Modernities*; Theory, Culture & Society; Featherstone, M., Lash, S., Robertson, R., Eds.; Sage: London, UK; Thousand Oaks, CA, USA, 1995; pp. 25–44. ISBN 0-8039-7947-9.
81. Emmanuel, A. *Unequal Exchange: A Study of the Imperialism of Trade*, 1st ed.; Monthly Review Press: New York, NY, USA, 1972; ISBN 978-0-85345-188-4.
82. Martinez-Alier, J. *The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation*; Edward Elgar Publishing: Cheltenham, UK, 2003.
83. Rice, J. Ecological Unequal Exchange: International Trade and Uneven Utilization of Environmental Space in the World System. *Soc. Forces* **2007**, *85*, 1369–1392. [CrossRef]

84. Bonds, E.; Downey, L. Green Technology and Ecologically Unequal Exchange: The Environmental and Social Consequences of Ecological Modernization in the World-System. *J. World-Syst. Res.* **2012**, *18*, 167–186. [CrossRef]
85. Hornborg, A. *The Power of the Machine: Global Inequalities of Economy, Technology, and Environment*; Altamira Press: Walnut Creek, CA, USA, 2001; ISBN 978-0-7591-1691-7.
86. Rice, J. The Transnational Organization of Production and Uneven Environmental Degradation and Change in the World Economy. *Int. J. Comp. Sociol.* **2009**, *50*, 215–236. [CrossRef]
87. Bunker, S.G. *Underdeveloping the Amazon: Extraction, Unequal Exchange, and the Failure of the Modern State*, 1st ed.; University of Illinois Press: Urbana, IL, USA, 1985; ISBN 978-0-226-08032-1.
88. Jorgenson, A.K. The sociology of ecologically unequal exchange and carbon dioxide emissions, 1960–2005. *Soc. Sci. Res.* **2012**, *41*, 242–252. [CrossRef]
89. Andersson, J.O.; Lindroth, M. Ecologically unsustainable trade. *Ecol. Econ.* **2001**, *37*, 113–122. [CrossRef]
90. Frey, R.S. The transfer of core-based hazardous production processes to the export processing zones of the periphery: The maquiladora centers of northern Mexico. *J. World-Syst. Res.* **2003**, *9*, 317–354. [CrossRef]
91. Copeland, B.A.; Taylor, M.S. North-South trade and the environment. *Q. J. Econ.* **1994**, *109*, 755–787. [CrossRef]
92. De Melo, J.; Grether, J.-M. Globalization and Dirty Industries: Do Pollution Havens Matter? In *Challenges to Globalization: Analyzing the Economics*; Baldwin, R.E., Winters, L.A., Eds.; University of Chicago Press: Chicago, IL, USA, 2004; pp. 167–205.
93. Davis, S.J.; Caldeira, K.; Matthews, H.D. Future CO_2 Emissions and Climate Change from Existing Energy Infrastructure. *Science* **2010**, *329*, 1330–1333. [CrossRef]
94. Dauvergne, P. Globalization and the Environment. In *Global Political Economy*; Ravenhill, J., Ed.; Oxford University Press: Oxford, UK, 2011; pp. 450–480.
95. Linnér, B.-O.; Jacob, M. From Stockholm to Kyoto and beyond: A review of the globalization of global warming policy and North–South relations. *Globalizations* **2005**, *2*, 403–415. [CrossRef]
96. Seyfang, G. Environmental mega-conferences—From Stockholm to Johannesburg and beyond. *Glob. Environ. Chang.* **2003**, *13*, 223–228. [CrossRef]
97. Stiglitz, J.E. *Globalization and Its Discontents*, 1st ed.; W. W. Norton & Company: New York, NY, USA, 2003; ISBN 978-0-393-32439-6.
98. Roberts, J.T. Predicting Participation in Environmental Treaties: A World-System Analysis. *Sociol. Inq.* **1996**, *66*, 38–57. [CrossRef]
99. Roberts, J.T. Global Inequality and Climate Change. *Soc. Nat. Resour.* **2001**, *14*, 501–509. [CrossRef]
100. Roberts, J.T. *Trouble in Paradise: Globalization and Environmental Crises in Latin America*; Routledge: London, UK; Armonk, NY, USA, 2013.
101. Roberts, J.T.; Parks, B.C.; Vásquez, A.A. Who Ratifies Environmental Treaties and Why? Institutionalism, Structuralism and Participation by 192 Nations in 22 Treaties. *Glob. Environ. Politics* **2004**, *4*, 22–64. [CrossRef]
102. Roberts, J.T.; Grimes, P.E. World-system theory and the environment: Toward a new synthesis. In *Sociological Theory and the Environment: Classical Foundations, Contemporary Insights*; Dunlap, R.E., Ed.; Rowman & Littlefield Publishers, Inc.: Lanham, MD, USA, 2002; pp. 167–196.
103. Roberts, J.T.; Parks, B.C. Fueling Injustice: Globalization, Ecologically Unequal Exchange and Climate Change. *Globalizations* **2007**, *4*, 193–210. [CrossRef]
104. Hornborg, A. Zero-sum world challenges in conceptualizing environmental load displacement and ecologically unequal exchange in the world-system. *Int. J. Comp. Sociol.* **2009**, *50*, 237–262. [CrossRef]
105. Hall, S. The Local and the Global: Globalization and Ethnicity. In *Culture, Globalization and the World System: Contemporary Conditions for the Representation of Identity*; King, A.D., Ed.; Macmillan: London, UK, 1991; pp. 19–39.
106. Meyer, B.; Geschiere, P. (Eds.) *Globalization and Identity: Dialectics of Flow and Closure*; Blackwell Publishers: Oxford, UK, 1999; ISBN 0-631-21238-8.
107. Devine-Wright, P. Think global, act local? The relevance of place attachments and place identities in a climate changed world. *Glob. Environ. Chang.* **2013**, *23*, 61–69. [CrossRef]
108. Wang, Y. Globalization and Territorial Identification: A Multilevel Analysis across 50 Countries. *Int. J. Public Opin. Res.* **2016**, *28*, 401–414. [CrossRef]

109. Connolly, J.; Prothero, A. Green consumption: Life-politics, risk and contradictions. *J. Consum. Cult.* **2008**, *8*, 117–145. [CrossRef]
110. World Bank. World Development Indicators. Available online: http://data.worldbank.org/data-catalog/world-development-indicators (accessed on 10 January 2019).
111. Brady, D.; Beckfield, J.; Zhao, W. The Consequences of Economic Globalization for Affluent Democracies. *Annu. Rev. Sociol.* **2007**, *33*, 313–334. [CrossRef]
112. Robinson, W.I. Globalization and the sociology of Immanuel Wallerstein: A critical appraisal. *Int. Sociol.* **2011**, *26*, 723–745. [CrossRef]
113. Çakmaklı, A.D.; Boone, C.; van Witteloostuijn, A. When Does Globalization Lead to Local Adaptation? The Emergence of Hybrid Islamic Schools in Turkey, 1985–2007. *Am. J. Sociol.* **2017**, *122*, 1822–1868. [CrossRef]
114. Koster, F. Globalization, Social Structure, and the Willingness to Help Others: A Multilevel Analysis Across 26 Countries. *Eur. Sociol. Rev.* **2007**, *23*, 537–551. [CrossRef]
115. Kunovich, R.M. The Sources and Consequences of National Identification. *Am. Sociol. Rev.* **2009**, *74*, 573–593. [CrossRef]
116. Machida, S. Does Globalization Render People More Ethnocentric? Globalization and People's Views on Cultures. *Am. J. Econ. Sociol.* **2012**, *71*, 436–469. [CrossRef]
117. Essary, E.H. Speaking of Globalization: Frame Analysis and the World Society. *Int. J. Comp. Sociol.* **2007**, *48*, 509–526. [CrossRef]
118. Mewes, J.; Mau, S. Globalization, socio-economic status and welfare chauvinism: European perspectives on attitudes toward the exclusion of immigrants. *Int. J. Comp. Sociol.* **2013**, *54*, 228–245. [CrossRef]
119. Pichler, F. Cosmopolitanism in a global perspective: An international comparison of open-minded orientations and identity in relation to globalization. *Int. Sociol.* **2012**, *27*, 21–50. [CrossRef]
120. Samimi, P.; Lim, G.C.; Buang, A.A. Globalization Measurement: Notes on Common Globalization Indexes. *Knowl. Manag. Econ. Inf. Technol.* **2011**, *1*, 1–20.
121. Jorgenson, A.K. The Effects of Primary Sector Foreign Investment on Carbon Dioxide Emissions from Agriculture Production in Less-Developed Countries, 1980–99. *Int. J. Comp. Sociol.* **2007**, *48*, 29–42. [CrossRef]
122. Jorgenson, A.K.; Clark, B. Are the Economy and the Environment Decoupling? A Comparative International Study, 1960–2005. *Am. J. Sociol.* **2012**, *118*, 1–44. [CrossRef]
123. Knight, K.W. Temporal variation in the relationship between environmental demands and well-being: A panel analysis of developed and less-developed countries. *Popul. Environ.* **2014**, *36*, 32–47. [CrossRef]
124. Knight, K.W.; Schor, J.B. Economic Growth and Climate Change: A Cross-National Analysis of Territorial and Consumption-Based Carbon Emissions in High-Income Countries. *Sustainability* **2014**, *6*, 3722–3731. [CrossRef]
125. Clement, M.T. Urbanization and the Natural Environment: An Environmental Sociological Review and Synthesis. *Organ. Environ.* **2010**, *23*, 291–314. [CrossRef]
126. Jorgenson, A.K.; Auerbach, D.; Clark, B. The (De-) carbonization of urbanization, 1960–2010. *Clim. Chang.* **2014**, *127*, 561–575. [CrossRef]
127. Marcotullio, P.J.; Hughes, S.; Sarzynski, A.; Pincetl, S.; Sanchez Peña, L.; Romero-Lankao, P.; Runfola, D.; Seto, K.C. Urbanization and the carbon cycle: Contributions from social science. *Earths Future* **2014**, *2*, 496–514. [CrossRef]
128. York, R.; Rosa, E.A.; Dietz, T. Footprints on the Earth: The Environmental Consequences of Modernity. *Am. Sociol. Rev.* **2003**, *68*, 279–300. [CrossRef]
129. Jorgenson, A.K.; Givens, J. The Changing Effect of Economic Development on the Consumption-Based Carbon Intensity of Well-Being, 1990–2008. *PLoS ONE* **2015**, *10*, e0123920. [CrossRef]
130. York, R. Structural Influences on Energy Production in South and East Asia, 1971–2002. *Sociol. Forum* **2007**, *22*, 532–554. [CrossRef]
131. Hsiao, C. *Analysis of Panel Data*, 2nd ed.; Cambridge University Press: Cambridge, UK, 2003.
132. Cheon, A.; Urpelainen, J. How do Competing Interest Groups Influence Environmental Policy? The Case of Renewable Electricity in Industrialized Democracies, 1989–2007. *Polit Stud.* **2013**, *61*, 874–897. [CrossRef]
133. York, R.; Rosa, E.A. Choking on Modernity: A Human Ecology of Air Pollution. *Soc. Probl.* **2012**, *59*, 282–300.

134. Canadell, J.G.; Quéré, C.L.; Raupach, M.R.; Field, C.B.; Buitenhuis, E.T.; Ciais, P.; Conway, T.J.; Gillett, N.P.; Houghton, R.A.; Marland, G. Contributions to accelerating atmospheric CO_2 growth from economic activity, carbon intensity, and efficiency of natural sinks. *PNAS* **2007**, *104*, 18866–18870. [CrossRef] [PubMed]
135. Nguyen, H. Globalization, Consumerism, and the Emergence of Teens in Contemporary Vietnam. *J. Soc. Hist.* **2015**, *49*, 4–19. [CrossRef]
136. Stearns, P.N. *Consumerism in World History: The Global Transformation of Desire*; Routledge: London, UK, 2002; ISBN 978-0-203-18323-6.
137. Wilk, R. Consumption, human needs, and global environmental change. *Glob. Environ. Chang.* **2002**, *12*, 5–13. [CrossRef]
138. Lange, H.; Meier, L. *The New Middle Classes: Globalizing Lifestyles, Consumerism and Environmental Concern*; Springer Netherlands: Dordrecht, The Netherlands, 2009; ISBN 978-1-4020-9938-0.
139. Caselli, M. *Some Reflections on Globalization, Development and the Less Developed Countries*; Centre for the Study of Globalisation and Regionalisation, University of Warwick: Coventry, UK, 2004.
140. Jorgenson, A.K. Environment, Development, and Ecologically Unequal Exchange. *Sustainability* **2016**, *8*, 227. [CrossRef]
141. Jorgenson, A.K.; Clark, B. The Economy, Military, and Ecologically Unequal Exchange Relationships in Comparative Perspective: A Panel Study of the Ecological Footprints of Nations, 1975–2000. *Soc. Probl.* **2009**, *56*, 621–646. [CrossRef]



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