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Ecologically unequal exchange, recessions, and climate change: A longitudinal study

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ABSTRACT

This study investigates how the ecologically unequal exchange of carbon dioxide emissions varies with economic recessions. I propose a country-specific approach to examine (1) the relationship between carbon dioxide emissions in developing countries and the “vertical flow” of exports to the United States; and (2) the variations of the relationship before, during, and after two recent economic recessions in 2001 and 2008. Using data on 69 developing nations between 2000 and 2010, I estimate time-series cross-sectional regression models with two-way fixed effects. Results suggest that the vertical flow of exports to the United States is positively associated with carbon dioxide emissions in developing countries. The magnitude of this relationship increased in 2001, 2009, and 2010, and decreased in 2008, but remained stable in non-recession periods, suggesting that economic recessions in the United States are associated with variations of ecologically unequal exchange. Results highlight the impacts of U.S. recessions on carbon emissions in developing countries through the structure of international trade.

1. Introduction

Global climate change is one of the most serious problems of the 21st century. Responsibility for and vulnerability to climate change are unevenly distributed among countries occupying different positions in the global economy ([Intergovernmental Panel on Climate Change, 2014](#)). Nevertheless, the solutions to climate change require an unprecedented level of international cooperation. Understanding how the structural relationships among countries affect climate change and its mitigation is an important step toward solutions. Sociological research on ecologically unequal exchange has established that the structure of international trade is associated with the uneven distribution of environmental harms to the disadvantage of developing countries (e.g., [Bunker, 1984](#); [Jorgenson and Clark, 2011](#)). In particular, the “vertical flow” of exports from developing countries to developed countries is a mechanism through which developed countries partially displace carbon dioxide emissions associated with their high levels of consumption to developing countries ([Jorgenson, 2011, 2012](#)). The vertical flow of exports also suppresses resource consumption in developing countries to levels below globally sustainable thresholds (e.g., [Rice, 2007](#)), which indicates under-consumption and under-development, and thus undermines the capability of these countries to cope with climate change.

Sociologists have yet to investigate if and how economic recessions affect ecologically unequal exchange through the structure of international trade. It is important to fill this gap because increasing evidence suggests that developed countries are in a period of slow growth and frequent recessions (e.g., [Gordon, 2012](#); [Piketty, 2014](#)). Economic recessions affect many aspects of societies, including consumption, investment, and international trade (e.g., [Petev et al., 2011](#); [Zimmermann, 1997](#)), and thus potentially affect ecologically unequal exchanges between developed countries and developing countries.

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Among developed countries, the United States is the largest importer and the largest emitter of consumption-based carbon dioxide emissions¹ (Davis and Caldeira, 2010; United Nations, 2015), and experienced two recessions in the past two decades. Prior research finds that in the United States the growth rates of carbon emissions² with per unit of increase in GDP during economic expansions are lower than their reduction rates during recessions (Shahiduzzaman and Layton, 2015), while the opposite is observed in cross-national analyses (York, 2012). The mixture of findings could potentially imply that the structure of trade between the United States and other countries becomes more ecologically unequal during recessions, which might facilitate emissions reductions in the United States during recessions but inhibit emissions reductions in its trade partners.

Using a country-specific approach, this study investigates if and how recent economic recessions affect the ecologically unequal exchange of carbon dioxide emissions between developing countries and the United States. I examine (1) the association between per capita carbon dioxide emissions in developing countries and the vertical flow of exports to the United States; and (2) if and how this association changes before, during, and after recent U.S. recessions.

The results suggest that the ecologically unequal exchange of carbon emissions occurs via the vertical flow of exports from developing countries to the United States. In addition, U.S. economic recessions are associated with variations of ecologically unequal exchange: the structure of trade between the United States and developing countries became more ecologically unequal in recession years 2001, 2009, and in post-recession year 2010, but became less unequal in recession year 2008. The variations are likely associated with changes in the amount of carbon emissions displaced from the United States to developing countries. The findings highlight the impacts of U.S. recessions on carbon emissions in developing countries through the structure of international trade, and suggest that such impacts should be considered when assessing the implications of recessions for climate mitigation.

The present study advances and connects areas of sociological research on ecologically unequal exchange, climate change, and economic recessions. I investigate the understudied relationship between economic recessions and ecologically unequal exchange, in a period when economic recessions become an increasingly important feature of the economic pattern of the Global North. I employ a novel approach that allows researchers to incorporate into analyses events like recessions that are both country- and time-specific. I also consider both the transnational and domestic implications of recessions for climate change and climate mitigation in a global context through the framework of ecologically unequal exchange.

This paper begins with an overview of the literature on ecologically unequal exchange. Next, I review empirical studies on the ecologically unequal exchange of carbon dioxide emissions, and explain their implications for climate change and global climate justice. Third, I review the literature on the impacts of economic recessions on climate change, and discuss why it is important to study potential variations of ecologically unequal exchange during recessions. Fourth, I propose a country-specific approach to analyze such variations and explain the reasons to focus on the United States. Fifth, I describe the data and methods used in the analyses. Then I present the results and discuss their implications, before concluding the paper with suggestions for future research.

2. Literature review

2.1. Ecologically unequal exchange

The theory of ecologically unequal exchange extends the classical trade dependence perspective³ to understand the uneven environmental impacts of the structure of international trade. Bunker's (1984) pioneering research on the Brazilian Amazon draws attention to a vertical net flow of energy and materials from a developing country near the bottom of the global trade hierarchy to powerful developed countries that impose an export-oriented extractive economy upon the former. Bunker argues that this disrupts the socioeconomic and environmental conditions in developing countries and inhibits the development of alternative economies.

Building on Bunker's work and other earlier research, Hornborg (1998) argues that although international trade is often considered to be a fair market transaction in neoclassical economics, in such transactions economic value is inversely related to productive potential⁴: raw materials with high productive potential are assigned low prices by the market, and vice versa. The vertical flow of exports with high productive potential (mostly primary and secondary sector outputs) from developing countries to developed countries is under-compensated economically. As a result, developing countries that undertake export-oriented resource extraction and commodity production acquire few economic gains from the exports, even though they bear high environmental costs, often in the forms of increased domestic pollution and resource depletion.

The theory of ecologically unequal exchange posits that the vertical flow of exports is a mechanism of unequal exchange through which more powerful, developed countries externalize a portion of the environmental costs associated with their consumption to less-powerful developing countries; consequently, developed countries are able to maintain both high levels of domestic consumption and good environmental conditions, while developing countries suffer from environmental harms, low levels of human well-being, and overall under-development (Hornborg, 2009; Jorgenson, 2006, 2012; Jorgenson and Clark, 2009; Rice, 2007). The vertical flow of

¹ Consumption-based emissions include emissions embedded in imports but exclude emissions embedded in exports.

² Unless otherwise specified, the terms "carbon dioxide emissions" and "carbon emissions" in this article refer to production-based emissions (also called territorial emissions) that include emissions embedded in exports but exclude emissions embedded in imports.

³ Trade dependence theory posits that less developed countries with high level of trade dependence are vulnerable to world market forces and are likely to be subjected to unfavorable terms of trade imposed by powerful, developed countries (Galtung, 1971). Previous studies show that trade dependence is negatively correlated with a country's GDP per capita and human well-being, and are positively correlated with income inequality (e.g., Kentor and Boswell, 2003).

⁴ Productive potential, also known as *exergy*, refers to the part of energy in certain substances that is available for mechanical work (Hornborg, 1998; Wall, 1986). When raw materials are converted into products, their productive potential decreases and economic value increases (Georgescu-Roegen, 1971).

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