

Fueling Injustice: Globalization, Ecologically Unequal Exchange and Climate Change

J. TIMMONS ROBERTS* & BRADLEY C. PARKS**

*The College of William and Mary, Williamsburg VA

** Millennium Challenge Corporation, Washington, DC Corporation

The globalization of economic production fundamentally reshapes how a 'fair' solution to the climate change problem must be forged. Emissions are increasing sharply in developing countries as wealthy nations 'offshore' the energy- and natural resource-intensive stages of production. We review a new and relatively under-utilized theory of 'ecologically unequal exchange' and apply it to the case of climate change. We describe four distinct principles that have been proposed to assign responsibility for carbon emissions, discuss their inadequacies, and briefly lay out some 'hybrid' proposals currently under consideration. We suggest combining hybrid proposals with environmental aid packages that help poorer nations transition from carbon-intensive pathways of development to more climate-friendly development trajectories, using remuneration from the so-called 'ecological debt'. In the context of deadlock over a completely inadequate Kyoto Protocol, we argue that fairness principles, climate science, and an understanding of globalization and development must be integrated.

La globalización de la producción económica cambia completamente la forma de cómo una "simple" solución al problema del cambio climatológico debe de ser alterado. Las emisiones han aumentado bruscamente en los países en desarrollo mientras que los países ricos operan en el extranjero las fases intensas de producción de energía y utilización de recursos naturales. Hemos revisado una teoría nueva y relativamente poco utilizada de 'intercambio ecológico desigual' y la hemos aplicado al caso del cambio del clima. Describimos cuatro principios distintos que se propusieron para asignar la responsabilidad a las emisiones de carbón, discutimos sus faltas de adecuación y planeamos brevemente unas propuestas 'híbridas' que se encuentran actualmente bajo consideración. Sugerimos combinar las propuestas híbridas con los paquetes de ayuda para el medio ambiente que ayuden a las naciones más pobres a hacer la transición de las vías intensivas de desarrollo de carbón a

trayectorias de desarrollo más adaptable al clima, usando renumeración de la llamada 'deuda ecológica'. En el contexto sobre un Protocolo de Kyoto estancado y completamente inadecuado, discutimos que la justicia, ciencia climatológica y el entendimiento de globalización y desarrollo deben integrarse.

Introduction: Pollutions of Poverty and Wealth

The globalization of economic production fundamentally reshapes how a 'fair' solution to the climate change problem must be forged. Emissions are increasing sharply in developing countries as wealthy nations 'offshore' the energy- and natural resource-intensive stages of production. Meanwhile, case study research and the systematic analysis of thousands of hydro-meteorological disasters over the past two decades show that the world's poorest nations are least able to prepare for, handle, and recover from the effects of global climate change (e.g. Roberts and Parks, 2007). In this article, we examine who is putting the world's climate at risk from greenhouse gases, asking four straightforward questions that lead to some very difficult issues: Who is responsible for climate change? What are the different ways of accounting for responsibility and who prefers each? What are the implications of addressing global inequality in responsibility for climate change? How can the globalization of economic production be incorporated into a just climate treaty?

We argue that global warming is all about inequality: in who will suffer its effects most, who is most responsible for the problem, and who is willing and able to address the problem. These compounding inequalities overlay an already polarized North–South debate and enmesh rich and poor countries in an adversarial negotiating environment. As such, it has become exceedingly difficult to broker a mutually acceptable international agreement that would stabilize the climate.

To a naïve observer, resolving the crisis of global climate change might be a matter of rational measurement of the atmosphere, giving equal shares of its capacity for absorbing greenhouse gases to all humans and assigning responsibility to individuals based on what they have put into it. It is, after all, a basic rule of civil justice, Superfund, and kindergarten ethics that those who created a mess should be responsible for cleaning up their share of the mess. Yet internationally, this simple question of who is to blame for the problem leads to a hornet's nest of contentious issues.

Resolving the climate change crisis depends fundamentally upon achieving a mutually acceptable understanding of 'what is fair'. Fairness principles can provide 'focal points' that reduce the costs of negotiating and bargaining, make agreements more palatable to domestic audiences (who frequently possess an indirect veto power over ratification and implementation), and realign the incentives of rich and poor nations to create fewer opportunities for shirking, defecation, and other types of opportunistic behavior (Roberts and Parks, 2007; Wiegandt, 2001).

However, norms of fairness are extremely elastic and subject to political manipulation, and fairness focal points rarely emerge spontaneously. In many cases, countries hold genuinely different perceptions of fairness because of their highly disparate positions in the international system. Some poor nations, for example, believe that they are unjustly suffering the consequences of the North's profligate consumption. Others believe that they are entitled to pursue 'cheap' economic growth using fossil fuels and other natural resources at hand, since now-wealthy countries did the same at their early stages of development. Several rich nations, by

contrast, argue that a climate agreement excluding developing countries is unfair and meaningless since 'non-Annex I' emissions will increase exponentially over the next few decades.¹ Other rich nations have suggested that if they continue to bear the weight of sustaining global economic growth and international financial stability, it would be both unfair and unrealistic to expect them to make sharp and immediate reductions in their carbon emissions.

Making matters more complicated, oil-exporters argue that in the absence of legal text that provides for their compensation and diversification into less carbon-intensive sectors, they cannot reasonably be expected to participate in any agreement. Small island states take an entirely different view; they believe that a 'fair agreement' would immediately stabilize the climate, forestall the complete destruction of island nations and cultures, and address their basic economic needs and extraordinary vulnerability to climate-related stress and hydro-meteorological disasters. Nations in cold locations, with higher heating bills, and countries with large land areas have also argued that their special 'national circumstances'—which predispose them towards higher emissions levels from transportation of goods and people—must be taken into consideration in crafting a fair deal for all nations. Still others argue that a distinction must be drawn between 'survival' and 'luxury' emissions (Agarwal and Narain, 1991; Parikh and Parikh, 2002). In short, we live in a morally ambiguous world where social understandings of fairness are 'configurational', depending on countries' position in the global hierarchy of economic and political structure.

In this article we review a new and relatively under-utilized theory of 'ecologically unequal exchange' and apply it to the case of climate change. We assess whether wealthy nations are 'dematerializing' or 'decarbonizing' by assessing how emissions are skyrocketing in developing nations. We describe four distinct principles that have been proposed to assign responsibility for carbon emissions, discuss their inadequacies, and briefly lay out some 'hybrid' proposals currently under consideration. We suggest combining hybrid proposals with environmental aid packages that help poorer nations transition from carbon-intensive pathways of development to more climate-friendly development trajectories, using remuneration from the so-called 'ecological debt'. In the context of deadlock over a completely inadequate Kyoto Protocol, we argue that fairness principles, climate science, and an understanding of globalization and development must be integrated.

Dematerialization, Ecologically Unequal Trade, and the Ecological Debt

Several authors and politicians have argued that wealthy countries are 'dematerializing' their economies as people become 'postconsumerist', or post-modern, in their consumption patterns. That is, citizens of the global North increasingly value consumption of services and experiences over material products (Adriaanse *et al.*, 1997; Inglehart, 1990; Ruth, 1998). As such, many have argued that economic growth is decoupling from resource consumption. Despite the fact that a declining material intensity of GDP does not necessarily translate into lower levels of *absolute* resource consumption, this 'dematerialization' trend is celebrated as a great environmental victory (Giljum and Eisenmenger, 2004).² This is tied to a second and related claim made by World Bank and WTO analysts—that exports from Third World nations are continually being upgraded and are increasing poor nations' prospects for positive economic growth and development (World Bank, 1992; Bhagwati, 2004).³

Both of these arguments have come under attack by a group of scholars forging a literature on 'ecologically unequal exchange' (Andersson and Lindroth, 2001; Cabeza-Gutés and Martinez-Alier, 2001; Damian and Graz, 2001; Giljum, 2003, 2004; Giljum and Eisenmenger, 2004;

Giljum and Hubacek, 2001; Heil and Selden, 2001; Hornborg, 1998a, 1998b, 2001; Machado *et al.*, 2001; Martinez-Alier, 2003; Muradian and Martinez-Alier, 2001a, 2001b; Muradian and O'Connor, 2001; Muradian *et al.*, 2002; Russi and Muradian, 2003; Sachs, 1999). These scholars suggest that while exports are indeed shifting, trade relations remain extremely unfair because poorer nations export large quantities of under-priced products whose value does not include the environmental (and social) costs of their extraction, processing, or shipping.⁴ Rich and poor nations are therefore said to possess different 'biophysical metabolisms' that shape the global distribution of environmental burdens and benefits (Fischer-Kowalski and Amann, 2001). This argument has found empirical support and led to the logical but radical claim that the wealthier nations owe some kind of remuneration (an 'ecological debt') to poorer nations for the environmental damage 'embodied' in their energy- and material-intensive products (Machado *et al.*, 2001; Muradian *et al.*, 2002; Princen *et al.*, 2002).

In late 2001, scholars and activists from the global South met in the African nation of Benin to articulate a position on the so-called 'ecological debt' (a close cousin of the 'ecologically unequal exchange' idea). The argument, as originally developed by Spanish economist Joan Martinez-Alier and the Ecuadorian environmental group Acción Ecológica, is that wealthy nations have been running up a huge debt over centuries of exploiting the raw materials and ecosystems of poor nations (Martinez-Alier, 2003; Simms *et al.*, 2004; Acción Ecológica, 2003). The debt encompasses the historical and modern exploitation of non-Western natural resources and the excessive use of 'environmental space' for dumping waste (e.g. expropriating global atmospheric resources). An extraordinary coalition of environmental, human rights, and development NGOs has lobbied for the ecological debt to either be paid or used as balance to forgive national economic debts (Simms *et al.*, 2004).⁵ This idea has traveled around the world very quickly, and garnered the support of the Chinese government and the G-77 at the 2000 South Summit in Havana, Cuba. Many developing countries have also articulated this position during climate negotiations (Roberts and Parks, 2007).

The intellectual heritage of the 'ecological debt' and 'ecologically unequal exchange' literature can be traced back to the 'structuralist school' of the 1940s, 1950s, and 1960s. At that time, Raul Prebisch and his colleagues at the UN's Economic Commission on Latin America (ECLA) found a striking empirical pattern: the export commodity prices of poor nations seemed to consistently fall relative to the prices of items exported by wealthy nations. ECLA argued that this was the result of weak income elasticity of demand for primary products, a massive oversupply of labor, and poor union organization in developing countries. Together these led to stagnant wages, inflation and lower export prices as opposed to rising wages and stable prices achieved in core nations. Structuralists therefore argued that the liberal emphasis on global GDP growth was a highly misleading indicator of international well-being. Some nations were growing, some were stagnating, and others were declining or falling into deep depression. Much of this variation, in their view, could be explained by countries' 'natural' comparative advantages—the value of their resource-based exports and labor oversupply.

The 'ecological debt' and 'ecologically unequal exchange' literature is also rooted in world-systems theory, which postulates that national development cannot be understood in isolation from the global system, where relatively few nations wield great economic and military power (Braudel, 1981; Frank, 1969; Wallerstein, 1972). World-systems theorists argue that nations can move up or down the global hierarchy, but must do so in a world where there are already powerful economic players with developed industrial bases and relatively overwhelming military might that can be used to manipulate political and economic relations. The international division of labor is said to function in the following way: core wealthy nations import raw

materials and export high value services and industrial manufactures while controlling powerful financial institutions; poor peripheral nations export their natural resources and supply cheap labor directly to manufacturers; and semi-peripheral middle-income nations lie somewhere in the middle, with some industry, higher-value services, and a partially diversified export structure. While a few nations move up the global hierarchy of wealth and power, the underlying relations of extraction, production and consumption between core and (semi-)peripheral nations remain intact.

The emphasis of world-systems theory on historicism and structuralism helps to explain why many peripheral and semi-peripheral nations are locked into ecologically unsustainable patterns (Roberts and Grimes, 2002; Roberts *et al.*, 2003). World-systems theorists argue that the volatility and periodic collapse of export commodity prices lead poor nations to ramp up the extraction and sale of material goods that they are already selling at a near loss. Giljum (2004, p. 17), for example, argues that:

[L]ow prices for primary commodities allow industrialized countries of the capitalist core to appropriate high amounts of biophysical resources from the peripheral economies in the South, while maintaining external trade relations balanced in monetary terms. ... [W]hat within the system of prices appears as reciprocal and fair exchange masks a biophysical inequality of exchange in which one of the partners has little choice but to exploit and possibly exhaust his natural resources and utilize his environment as a waste dump, while the other partner may maintain high environmental quality within its own borders.

In his path-breaking 1985 book *Underdeveloping the Amazon*, sociologist Stephen Bunker also theorized extensively on the issue of ecologically unequal exchange. Based on case study research in Brazil, he argued that every time an economy exports its natural resources, an energy and material loss takes place, 'decelerating' the extractive economy and 'accelerating' the productive economy. He also suggested that 'regions whose economic ties to the world system are based almost exclusively on the exchange of extracted commodities, can be characterized as extreme peripheries because of the low proportions of capital and labor incorporated in the total value of their exports and because of the low level of linkages to other economic activities and social organization in the same region' (Bunker, 1985, p. 24). Furthermore, 'accelerated energy flow to the world industrial core permits social complexity which generates political and economic power there and permits the rapid technological changes which transform world market demands. It thus creates the conditions of the core's economic and political dominance over the world system to which the dominant classes of peripheral economies respond with their own accumulation strategies' (Bunker, 1985, p. 24). Therefore, in Bunker's model, the core's productive economy consumes commodities directly and indirectly through manufactures, but also effectively consumes the extractive economy, draining it of its energy and matter and damaging the local ecology, social organization, and infrastructure.⁶ In effect, the core relies on the periphery as both a source and sink (for high entropic by-products and waste).⁷

A number of scholars have recently exposed Bunker's thesis to empirical testing. One particular hypothesis has attracted much more attention than any other: that when nations exchange goods, the market prices of primary products are often undervalued, and in the course of extracting, moving, and processing products for export there is a massive transfer and degradation of materials and energy that goes unrecognized. Using a 'materials flow' accounting methodology, a number of economists have argued that physical numeraires can be used to bring these flows of material and energy back into the equation. The easiest way to do this is to measure the physical weight of import and export flows. However, more sophisticated methodologies are being

developed to account for indirect material flows used in the production process, as well as waste and emission flows (Giljum, 2004; Machado *et al.*, 2001; Muradian *et al.*, 2002).

Empirical work using materials flow analysis has led to an important finding: many developing countries traditionally seen as successful, export-oriented economies are suffering huge, unrecorded (economic and ecological) losses (Giljum, 2004; Machado *et al.*, 2001; Muradian *et al.*, 2002). Using time series data on consumption of natural resources, Giljum (2004) finds that Chile's natural resource exports have increased threefold and its use of material inputs has increased by a factor of six over the period 1973–2000. Giljum identifies a clear link between this pattern and huge export drives in the forestry, fishing, mining, and fruit-growing sectors (also see Quiroga, 1994). In a similar study, Muradian and Martinez-Alier (2001b) document the responses of developing countries to declining terms of trade. They find that falling prices correlate with large export drives for primary products. Of the 18 natural resource exports from developing countries they examine, all but two saw their prices fall between the 1970s and 1990s, yet 14 of the 18 exports increased dramatically in volume over the same period in physical terms.

Tracking material and energy flows from extraction to production to final disposal is illuminating not only from an export perspective, but also from an 'import' perspective. The most systematic and comprehensive empirical study employing this latter approach examines the EU-15 region and concludes that, while the EU maintains balanced external trade relations in monetary terms with all other major regions of the world, it runs an enormous trade deficit in physical terms (Bringezu and Schütz, 2001a). Primarily due to the import of fossil fuels, semi-manufactured products, and abiotic raw materials, the EU imports—in physical terms—more than four times what it exports. Yet, 'EU-15 exports have a *money value* of 4 times that of imports. With regard to trade relations with Southern regions such as Africa and Latin America, one ton of EU exports embodies a money value 10 times higher than one ton of EU imports' (Giljum and Eisenmenger, 2004, p. 84, emphasis added). Thus, from both an import and export perspective, materials flow analysis suggests that core economies are draining ecological capacity from extractive regions by importing resource-intensive products and have shifted environmental burdens to the South through the export of waste (Andersson and Lindroth, 2001).

In this regard, materials flows analysis appears to have debunked earlier claims that we have entered an era of dematerialization. In reality, what appears to be happening is that some core economies are being 'relatively dematerialized' as they export to poor countries, or 'peripheralize', the material-intensive stages of the production process. Domestic production has no doubt become more efficient—where efficiency is defined as the material intensity of one's own production—in the core zones of the world economy. However, nations that increasingly import the material-intensive goods required by their lifestyles are clearly no less materialist and no more sustainable than they were when they bore their own environmental burdens (Fisher-Kowalski and Amman, 2001).⁸

Cutting the Carbon Cake: Four Ways to Share the Burden

Global climate change is a key area in which ecologically unequal exchange appears to be in effect. Statistical research suggests that trading more products increases emissions by poorer nations, while lowering them for wealthier nations (Heil and Selden, 2001; Roberts and Parks, 2007). As such, devising a mutually acceptable agreement to stabilize the climate raises the difficult issue of how to determine who is most responsible for the problem. Four different methods of 'differentiation' have been proposed during the fifteen or so years of

climate negotiations, each with crucial assumptions and implications for climate stabilization, social justice, political expediency, and who will bear the greatest burden of change if accepted as the basis for a climate treaty. These are: grandfathering, carbon intensity, contraction and convergence to a global per capita norm, and historical responsibility.

The Kyoto Protocol, as it was negotiated in 1997, was based on grandfathering—that nations should reduce their emissions incrementally from a baseline year. Large emitters, therefore, had their high discharges of greenhouse gasses ‘grandfathered’ in, with relatively minor adjustments averaging 5.2%, for the foreseeable future. The carbon intensity approach, introduced by the World Resources Institute and favored by the second Bush administration starting in 2002, calls for voluntary changes in efficiency to drive reduction of emissions. In this approach, the goal is to have strong economic growth with as few carbon emissions as possible. Both of these proposals have the effect of departing incrementally from the current status quo without placing radical demands on powerful nations.

On the other side of the spectrum are two proposals that strongly favor developing countries: historical responsibility and per capita contraction and convergence. India, China, and much of the developing world favor a per capita approach in which each person on Earth is given an equal right to the ability of the atmosphere to absorb carbon. Under the per capita proposal, nations whose per capita consumption of fossil fuels is significantly lower than the world average would be given significant room to grow and emit. Most per capita plans would allow them to trade their extra carbon emission credits for the capital they need for development. By comparison, nations with highly fossil energy-intensive economies would face sharp requirements to cut their consumption of fuels.

Brazil also introduced a proposal in 1997 that would take into account the amount of damage done by nations in the past to the atmosphere’s ability to absorb more greenhouse gases. This historical responsibility approach puts the onus on nations that put greenhouse gases in the atmosphere in past decades to reduce their emissions quickly, most notably Britain and the United States. Some developing countries have supported this approach and demanded that some indemnification be paid for the so-called ‘carbon debt’. We take up each alternative approach here, examining its roots and implications, the principles upon which it is based, and how each has been approached or ignored in global climate negotiations over the past dozen years.

Grandfathering

The treaty that emerged from back-room bargaining at Kyoto in 1997 was based on the concept of grandfathering—that the world’s wealthier nations would make efforts to reduce their carbon emissions relative to a baseline year; in this case, 1990.⁹ After a series of drawn-out negotiations, individual reductions targets were agreed upon among rich nations, mostly 6–7% below the 1990 baseline by 2010.¹⁰ The approach was decided upon for Kyoto because of its political expediency.

For more than a decade of climate negotiations, similar arguments have been made in response to calls for sharp and immediate cuts in emission levels. Many countries contend that ‘national circumstances’ and economic hardships affect their ability to make deep and immediate reductions. At Kyoto and the many meetings since, the United States, Russia, and several other high-emissions nations bargained hard for minor changes to the status quo. The US Senate and current US administration have underscored that even a Kyoto-type treaty would unfairly damage the nation’s economy and send jobs overseas. On the Senate floor in

November 2003, dozens of senators argued the McCain–Lieberman Climate Stewardship Act would place painful limits on US economic growth and create terrible suffering among different groups of Americans.

The principle of grandfathering has not been applied to developing countries. However, were it to resurface (as focal points often do, see Goldstein and Keohane, 1993), most experts agree it would have the effect of punishing ‘late-developers’. As Aslam (2002, p. 176) explains, ‘current emissions of developing countries ... are very low compared with those of industrialized countries, but are rising rapidly. This places developing countries at a severe disadvantage when it comes to negotiating emission control targets that are based on a grandfathering system’.

The extent of inequality in total emissions is startling to contemplate. With the latest figures at the time of writing, the United States emitted the largest proportion of carbon of any nation. Since the 1990 baseline, emissions have in fact increased in most nations, and in some nations substantially. Besides the ex-Soviet Union republics, whose economies largely collapsed after the transition to capitalism, only a few countries in the developed world are on track to meet even their modest Kyoto goals.

While many argue that the grandfathering approach is amoral and baldly based on political power in the international system, it does represent at least three understandings of justice. Entitlement theories of justice, both in their libertarian and Marxist forms, hold that individuals are entitled to what they have produced (Albin, 2003; Müller, 2001). As such, every nation possesses a common law (inherent) right to emit carbon dioxide. Grandfathering also exemplifies the justice principle of proportional equality—that nations are unequal and should therefore be treated unequally. While developing countries were not required to commit to scheduled reductions of emissions in the first round of negotiations, the decision to use 1990 as a baseline year is an implicit recognition of these two principles. Finally, grandfathering represents the pragmatic principle that if we can solve the problem we are closer to justice than if we insist upon a utopian plan which makes no progress. Cecilia Albin (2001, 2003) argues that in spite of the fact that international environmental agreements regularly institutionalize fairness norms—for example, the ‘polluter pays’, ‘no harm’, and ‘shared, but differentiated responsibility’ principles—their success is first and foremost dependent upon their ability to yield joint gains for all parties. She offers the example of Sweden and Finland, which, despite being victimized by the air pollution of neighboring Baltic countries, did not insist that the ‘polluter pays’ principle be strictly enforced. Quite the opposite. They financed a large foreign aid initiative to help the less developed countries responsible for the air pollution adopt more environmentally friendly technologies.

Carbon Intensity

Faced with pressure to sign the Kyoto treaty, President George W. Bush promised during his 2000 campaign to do so. However, after entering office, his position shifted and he withdrew the US from the treaty entirely. US National Security Advisor Condoleezza Rice told EU members in the spring of 2001 that the Kyoto Protocol was ‘dead’ without US participation, since the treaty requires that countries responsible for 55% of the total amount of emissions from the world’s wealthy nations ratify it. A firestorm of reaction from Europe and environmentalists in the USA forced the Bush administration to provide an alternative plan to address the problem.

At the science center of the National Oceanic and Atmospheric Administration in Maryland, President G.W. Bush on 14 February 2002 announced that ‘As president of the United States,

charged with safeguarding the welfare of the American people and American workers, I will not commit our nation to an unsound international treaty that will throw millions of our citizens out of work'. Rather, he proposed a 'New Approach on Global Climate Change' plan in response to the treaty, and provided a new benchmark by which the US government would measure its own progress on the issue. He 'committed America to an aggressive new strategy to cut greenhouse gas intensity by 18% over the next 10 years' (White House, 2002a). The simple measure they proposed was emissions per dollar of GDP. The White House press releases argued that: 'The President's Yardstick—Greenhouse Gas Intensity—is a Better Way to Measure Progress Without Hurting Growth'. It continued, 'A goal expressed in terms of declining greenhouse gas intensity, measuring greenhouse gas emissions relative to economic activity, quantifies our effort to reduce emissions through conservation, adoption of cleaner, more efficient, and emission-reducing technologies, and sequestration. At the same time, an intensity goal accommodates economic growth' (White House, 2002b).

The carbon intensity approach is an outgrowth of Bentham's utilitarian theory of justice, which states that mutual advantageous and cost-effective solutions are also just solutions. Since everyone is worse off in the absence of aggregate net benefits, utilitarians argue that inefficient solutions are also unjust (Gauthier, 1986). The fair solution, with respect to greenhouse gas emission reductions, would therefore be to stabilize the climate as cost-effectively as possible, while maximizing global economic growth. Since developing nations currently offer the most cost-effective opportunities to reduce greenhouse gas emissions, the international effort to stabilize greenhouse gas emissions would predominantly focus on the developing world (Stavins, 2004, p. 8).

On the positive side, the carbon intensity approach forces the international community to think about designing solutions that will allow growth to occur while minimizing impact on the global climate. A number of analysts have also suggested that the carbon intensity approach creates greater opportunities for developing country buy-in, since it does not impose a 'hard cap' on their total emissions (Kim and Baumert, 2002).¹¹ An added advantage to this approach is that industrialized nations tend to do better in intensity terms, since their infrastructure is typically much better than that of poorer nations (Roberts and Grimes, 1997; Roberts *et al.*, 2003). So, a carbon intensity approach could promote 'early action', which, according to Baumert *et al.* (2003, p. 6), is important because 'many developing countries believe that the industrialized countries lack credibility on the issue of international cooperation to curb greenhouse gas emissions, having done little to address a problem largely of their own making'.

On the downside, the proposals made by the Bush administration place no real restrictions on the future emissions of the US (since most analysts see the nation's efficiency as improving on its own by at least 18%) and are widely perceived as a repudiation of earlier commitments. The Bush administration's plan also does nothing about the existing stock of emissions and makes no effort to include 'exported emissions' caused by the offshoring of US industries to poorer nations. In addition, the carbon intensity approach has become a tool of political manipulation. The United States used this approach strategically at COP-8 and COP-9 in an effort to torpedo the Kyoto Protocol and delay post-2012 talks. US negotiator Harlan Watson urged Western nations at the New Delhi negotiations to 'recognize that it would be unfair—indeed, counterproductive—to condemn developing nations to slow growth or no growth by insisting that they take on impractical and unrealistic greenhouse gas targets'.¹² The following year at the Milan negotiations, US Undersecretary of State Paula Dobriansky tried to forge an unusual coalition with China and the G-77 by rejecting the need for developing countries to undertake scheduled commitments to reduce emissions (Dobriansky, 2003).

Per Capita

India, China, and the Group of 77 (actually a group of about 133 nations) have developed and advocated a series of proposals that account for carbon dioxide and other greenhouse gases on the basis of a simple, egalitarian principle. The idea is that every human on Earth has equal rights to the global atmosphere, and therefore allocations of how much each can pollute should be done on a per capita basis.¹³ France, Switzerland, and the European Union have all endorsed this proposal.¹⁴ Cambridge University economist Michael Grubb (1999, p. 270) calls it ‘the most politically prominent contender for any specific global formula for long-term allocations with increasing numbers of adherents in both developed and developing countries’.¹⁵

Per capita proposals place rich nations at a sharp disadvantage, since most of them already far exceed the stabilization target (roughly 1 metric ton of carbon equivalent per capita). Poor nations, by comparison, stand to gain considerably from a per capita allocation of carbon entitlements because their existing levels of income and industrialization place them well below the 1 metric ton threshold.

Environmentally sustainable per capita proposals typically require that a global ‘emissions budget’ first be specified. The scientific consensus is that to avoid the worst effects of climate change, we need to stabilize the concentrations of carbon dioxide around or below 450 parts per million. However, others suggest that 350 and 550 parts per million are more appropriate targets. In any case, these proposals suggest drastic reductions for the world’s richest nations, and commitments very soon for the poorer ones to reduce growth rates of their emissions and eventually stop and reverse them.

Under most per capita proposals, including the Contraction and Convergence model proposed by the Global Commons Institute, once the size of the emissions budget is specified, every global citizen is allocated an equal entitlement to the atmosphere. Rich countries, whose relatively small populations have already used a disproportionate amount of their atmospheric space, must ‘contract’ their annual carbon budget to a level of roughly 1 metric ton of carbon equivalent per person over the next century. Poor nations, whose citizens have thus far occupied very little atmospheric space, are allowed to increase their emissions for some time and eventually ‘converge’ with rich nations. Developing countries willing to restrict their emissions growth below their allowance have the opportunity to trade those allowances in exchange for funding or technical assistance through the Clean Development Mechanism, Joint Implementation, and other emissions trading mechanisms.

The key question surrounding the per capita approach is its political feasibility. Egalitarian principles played a prominent role in UN Convention on Law of the Sea negotiations (Baumert, 2002). However, many analysts consider the application of egalitarian principles to climate policy politically explosive and economically inefficient. Grubb and his colleagues (1999) describe one very telling interaction between rich and poor nations at the Kyoto negotiations that lasted late into the evening. At 3 o’clock in the morning, amidst heated debate over global emissions trading, China, India, and the Africa Group of Nations expressed their strong support for a per capita allocation of global atmospheric property rights. Chairman Raul Estrada and a representative of the US delegation responded that the ‘Contraction and Convergence’ proposal was a political non-starter and negotiations were immediately brought to a close.

It is important for readers to understand just how far apart the people of the world are in per capita terms. Twenty percent of the world’s population in the high-income countries is responsible for 63% of the emissions, while the bottom 20% of the world’s people is only releasing 3% (Roberts and Parks, 2007). According to our calculations, the average US citizen dumps as much

greenhouse gas into the atmosphere as nine Chinese citizens, 18 citizens of India, and 90 Bangladeshis (from 2000 figures). Even more startling is that each US citizen on average pollutes as much as over 500 citizens of Ethiopia, Chad, Zaire, Afghanistan, Mali, Cambodia, and Burundi (Roberts and Parks, 2007). In 183 nations, people emit on average less than half as much as the Americans do. In 130 nations, it would take at least five citizens to generate as much carbon dioxide from burning fossil fuels as one US citizen does. In 90 nations, it would take over ten citizens to generate as much as one American. And in 30 of those nations, it would take over 100.¹⁶

Historical Responsibility

The polluter pays principle has been central to domestic and international environmental law for more than 30 years.¹⁷ Brazilian scientists and government experts have developed a sophisticated proposal to address climate change based on this principle. They argue that a country's greenhouse gas reductions should depend on its relative contribution to the global temperature rise (La Rovere *et al.*, 2002, p. 158).¹⁸ The reasoning behind the historical responsibility proposal is that carbon dioxide burned now stays in the atmosphere for 100–120 years. Therefore, it is important to account not only for future emissions, but all of the damage done in earlier years (Neumayer, 2000). The political implications are obvious: since virtually all the carbon emitted since 1945 is still in the atmosphere and 'early industrializers' are almost exclusively responsible for that damage, rich nations would be required to make deep and immediate cuts. Early estimates suggest that by 2010 Britain would have to reduce emissions by 66%, the United States by 23%, and Japan 8% (La Rovere *et al.*, 2002).

Given their tiny contribution to the existing stock of carbon emissions, it is not surprising that developing countries have been strong advocates of the historical responsibility approach. At their 2000 South Summit in Havana, the G-77 submitted the following statement as part of a larger manifesto:

We believe that the prevailing modes of production and consumption in the industrialized world are unsustainable and should be changed for they threaten the very survival of the planet. . . . We advocate a solution for the serious global, regional, and local environmental problems facing humanity, *based on the recognition of the North's ecological debt* and the principle of common but differentiated responsibilities of the developed and developing countries. (G-77, 2000, emphasis added)

However, the historical responsibility proposal has failed to gain much traction in the policy community. To be broadly acceptable to people around the world, proposals for addressing climate change need to be relatively easy to understand, and making the historical responsibility principle operational requires fairly complex methods of calculation (Baumert, 2002). Nonetheless, the 2000 Special Report on Emissions Scenario' of the IPCC found that summed emissions 'supply a reasonable "proxy" for the relative contribution to global warming' of different nations, if 'limited to a few decades' (La Rovere *et al.*, 2002, p. 168). The summed emissions from the high-income nations amount to nearly twice the tons of carbon of the middle income nations, and four times the cumulative emissions of the majority of the world, that live in the poorest nations. This is a highly contentious issue, but one which we believe must be considered if we are to address inequality and climate change. The polluter pays argument is that high-emitting nations, even if they did not know the danger of their behavior, still benefited from it and should be held responsible

for its impacts. This logic holds in many national laws, including Superfund and other pollution laws in the United States.

A Way Forward: Hybrid Justice, Pathway Switching, and the Ecological Debt

Elsewhere, we have argued that poor nations and rich nations hold diametrically opposed views of ‘climate justice’ because of the highly asymmetric global distribution of environmental ‘goods’ and ‘bads’ (Parks and Roberts, 2005, 2006). Such inequality unfortunately makes it very unlikely that a North–South fairness consensus will spontaneously emerge on the basis of one of these four principles described above. The globalization of economic production and the transfer of industrial emissions to the global South has worsened this problem. Therefore, what is needed is moral compromise, or a negotiated ‘justice settlement’ (Aldy *et al.*, 2003; Baumert *et al.*, 2003; Blanchard *et al.*, 2003; Stavins, 2004).

A number of proposals representing moral compromise have emerged in recent years. Bartsch and Müller (2000) propose a ‘preference score’ method, which combines the grandfathering and per capita approach through a voting system. Their proposal allows each nation, weighted by its population, to choose the methodology that it prefers. Each global citizen’s ‘vote’ is then used to calculate national carbon emission allowances. Under this proposal, roughly three-quarters of the global emissions budget would be based on the per capita approach and one-quarter on grandfathering. Others have focused on more politically feasible per capita proposals that provide for ‘national circumstances’, or allowance factors, like geography, climate, energy supply, and domestic economic structure, as well as ‘soft landing scenarios’ (e.g. Baumert *et al.*, 2003; Blanchard *et al.*, 2003; Gupta and Bhandari, 1999; TERI, 1997; Torvanger *et al.*, 2004).

The Pew Center for Global Climate Change has developed a hybrid proposal that assigns responsibility based on past and present emissions, carbon intensity, and countries’ ability to pay (i.e. its per capita GDP). It separates the world into three groups: those that ‘must act now’, those that ‘could act now’, and those that ‘should act now, but differently’ (Claussen and McNeilly, 1998). The ‘Triptych’ proposal, designed by scholars at the University of Utrecht (and already used to differentiate commitments among EU countries), ‘accounts for differences in national circumstances such as population size and growth, standard of living, economic structure and fuel mix in power generation’ (Groenenberg *et al.*, 2001). Its novel contribution is that it divides each country’s economy into three sectors: energy-intensive industry, power generation, and the so-called domestic sector (transport, light industry, agriculture, and commercial sector) (Groenenberg *et al.*, 2001; Evans, 2002). It applies the carbon intensity approach to the energy-intensive sector, ‘decarbonization targets’ to the power generation sector, and a per capita approach to the ‘domestic’ sectors. Similarly, the Multi-sector Convergence approach, developed by two research institutes in Northern Europe, treats sectors differentially and integrates per capita, carbon intensity, and ‘ability to pay’ (GDP per capita) approaches (Sijm *et al.*, 2000; Ybema *et al.*, 2000). Many other proposals exist.

We believe these hybrid proposals are among the most promising solutions to break the North–South stalemate. However, simply asserting that a ‘negotiated justice’ settlement is necessary avoids the more central question of whether and to what extent an agreement must favor rich or poor nations. As we have argued elsewhere, the greatest barriers to meaningful North–South cooperation are not differences in principled understandings of what is fair. Rather, divergent principled beliefs are a consequence of more fundamental root causes: incongruent worldviews and causal beliefs, persistent global inequality, and an enduring deficit in North–South trust (Roberts and Parks, 2007).¹⁹ Therefore, along with developing a workable

and fair 'hybrid justice' proposal, policy makers must redouble their efforts to allay the fears and suspicions of developing countries; rebuild conditions of generalized trust, forge long-term, constructive partnerships with developing countries across multiple issue areas; and create greater 'policy space' for governments to pursue their own development strategies (Roberts and Parks, 2007).

Attention is finally beginning to be paid to sectors and pathways of development. Several South Asian authors working on the Fourth Assessment Report of the IPCC have recently argued that 'development pathways . . . societies choose today may be as important, possibly even more important, as the climate measures they take' (Najam *et al.*, 2003). Initial discussions of this issue also began at the COP-10 in Buenos Aires in 2004. Our own research suggests that some development pathways insulate countries from economic volatility more than others, cause less local environmental damage, and give more options to planners; others are much more difficult to change (Roberts and Parks, 2007).

More in-depth analysis of development pathways under globalization is needed, but one can imagine a sophisticated hybrid proposal for assigning national carbon-dioxide emission quotas based initially on economic profiling of the consumption and production of nations. This would require that a future treaty be developed from the physical science of what the atmosphere can likely handle, principled decisions about which approach is fairest, and the practical social science of how different types of nations will meet their allowed emissions. This picture of national responsibilities for the world's emissions requires more than a static accounting of tons of carbon emitted in each nation. Rather, the rapid shifting of the energy- and natural resource-intensive stages of production to developing nations requires responsibility to be tied to the total carbon 'footprint' of products where they are consumed. Climate justice will require complex physical and social science calculations and many normative decisions about how to assess responsibility. 'Ecologically unequal exchange' must be considered in these calculations. Simply put, brute bargaining strength will never lead us to a workable climate treaty, in neither the sense of atmospheric stability nor the political or social sense.

Acknowledgments

The views expressed in this article are the authors' own and do not necessarily represent the views of the Millennium Challenge Corporation.

Notes

- 1 Wealthier nations that accepted Kyoto targets were listed in 'Annex I' of the treaty, and the rest, which were expected to take up limits only in future rounds of the treaty, were classified as 'non-Annex I'.
- 2 Rich nations indeed continue to consume more natural resources than ever before by almost any measure. In 1998, the richest 20% of the world's population consumed 46% of all meat and fish, 65% of all electricity, 58% of all energy, 74% of all telephones, 84% of all paper and 87% of all cars. The poorest 20%, by contrast, consumed less than 10% of all these products (UNDP, 1998). There is a strong body of evidence that suggests that many of these resources originate in poor and middle-income nations. Arden-Clarke (1992) reports that two-thirds of all primary commodity exports come from the Third World. However, dollar-dependent export measures mask even deeper inequalities. Measuring national export-import ratios in terms of *physical weight*, the developed world becomes a much greater net importer of environmentally intensive products (Andersson and Lindroth, 2001; Fischer-Kowalski and Amman, 2001).
- 3 Arrighi *et al.* (1999) provide a damaging critique of these claims on development grounds, arguing that poorer nations receive sharply diminishing returns for industrialization.

- 4 Röpke (1999) argues that 'prices are distorted not only because of the present [environmental] externalities, but also because such externalities have existed for nearly two centuries and have been built into the social and physical structures of society as accumulated externalities'.
- 5 This coalition includes the New Economics Foundation, Jubilee Research, Oxfam, World Wildlife Fund, World Vision, Friends of the Earth, Greenpeace, Christian Aid, Action Aid, the Heinrich Böll Foundation, the International Institute for Environment and Development, Corporate Watch, Centre for Science and the Environment, and EcoEquity.
- 6 Bunker (1985) tried to extend thermodynamic law to global political economy. He argued that energy and matter are 'withdrawn from the natural environment of the extractive economies and flow toward and are concentrated in the social and physical environments of the productive economies, where they fuel the linked and mutually accelerating processes of production and consumption'. His argument, then, could be characterized as one of social entropy. Industrial capitalism, with all of its high energy outputs requires a constant flow of low-entropy inputs from other areas, in particular, the periphery and semi-periphery which houses the majority of low-entropy stocks.
- 7 Some would argue that this is nowhere more evident than in the climate change arena, where core nations undercompensate peripheral nations for their critical energy sources, and then, at the same time insist that they sequester their 'luxury emissions' by planting reforestation projects, potentially creating 'green deserts' which provide limited job creation and economic progress in the short-term.
- 8 Giljum and Eisenmenger (2004) rightly point out '[t]he implementation of a strategy of *absolute dematerialization* would lead to radical changes of economic structures in both North and South and to price changes on international commodity markets'.
- 9 1990 was chosen because climate science became well known then, with the first assessment report of the Intergovernmental Panel on Climate Change.
- 10 Because national emissions can vary greatly depending on economic conditions in any year, the target date of 2010 was expanded into a five year average of 2008–12.
- 11 Southern nations view pressure for scheduled emission reduction commitments as part of a larger Northern crusade to rein in their economic development. Former UNFCCC Secretariat staff member Joanna Depledge writes that '[a]bsolute caps on emissions are generally viewed, especially by developing countries themselves, as caps on development' (Depledge *et al.*, 2003, p. 56).
- 12 Harlan L. Watson, Senior Climate Negotiator and Special Representative and Head of the US Delegation Remarks to the Eighth Session of the Conference of Parties (COP-8) to the UN Framework Convention on Climate Change New Delhi, India, 25 October 2002.
- 13 Two groups have been promoting the idea of a per capita framework for years. The Global Commons Institute, led by Aubrey Meyer, has been promoting a 'contraction and convergence' approach which makes tough demands for reductions on the global North, but allows a transition period and lots of tradable permits to emit greenhouse gases in the short term transition period. The other group, with perhaps more clout because of its location in New Delhi, India, is the Centre for Science and the Environment, led by Anil Agarwal and Sunita Narain.
- 14 Other rich countries (e.g. Japan, Norway, Iceland, Poland) would reportedly accept the per capita principle if it were integrated into a larger approach (i.e. multi-sectoral, menu approach, etc.) (Baumert, 2002).
- 15 The European Parliament has advocated a 'progressive convergence towards an equitable distribution of emission rights on a per capita basis by an agreed date in the next century' (Cited in Baumert *et al.*, 2003, p. 182).
- 16 This article and nearly all the analysis and discussion of emissions inequality focuses on inequality *between* nations. However it is important to acknowledge and suggest future research on inequality of emissions *within* nations. We currently lack much data on intra-country variation in carbon emissions, especially in the poor nations, but Loren Lutzenheizer's 1996 analysis shows how US citizens with incomes over \$75,000 emitted nearly four times the amount of carbon as those whose income is under \$10,000 (Lutzenheizer, 1996).
- 17 The 'polluter pays' principle was endorsed by all OECD countries in 1974 (OECD, 1974).
- 18 Since the late 1990s, the Brazilian proposal has been significantly revised with improved understanding of how carbon is absorbed and released by the oceans, land and plants.
- 19 There are several widespread perceptions in the global South that reinforce a sense of mistrust of the North on climate change. First, there is a gaping divide between rich and poor nations in terms of how they define the issue of climate change. Rich nations tend to see climate instability as a 'global public bad' that affects all nations and requires the efforts of all nations. Poor nations tend to see climate change as a problem of Northern consumption. Second, poor nations typically prioritize developmental and local environmental issues over issues of international concern. Third, many Southern governments are deeply suspicious that 'Northern' environmental issues are but another way for the world's most powerful nations to limit their economic development. Fourth, there is a widely held perception among poor nations that their position in the world

economy constrains their ability to make large strides in the area of environmental protection, particularly as exporters of commodities facing highly volatile prices and deteriorating terms-of-trade. Fifth, many developing countries believe that a distinction should be made between 'survival' and 'luxury' emissions. Parikh and Parikh (2002, p. 5), for example, argue that one might distinguish between the 'gas-guzzling, air-polluting automobiles in Europe and North America' and those emanating from the methane created by 'fermenting rice fields of subsistence farmers in West Bengal' (Parikh and Parikh, 2002, p. 5). Finally, the North–South debate over how to account for carbon responsibility is plagued by conditions of *generalized* mistrust, due to the US repudiation of the Kyoto Treaty and industrialized countries overall not taking active enough steps to address the problem (Roberts and Parks, 2007).

References

- Acción Ecológica (2003) Que es la Deuda Ecológica? Web document: <http://www.accionecologica.org>. Accessed 14 July 2003.
- Adriaanse, A., Bringezu, S., Hamond, A., Moriguchi, Y., Rodenburg, E. & Rogich, D. *et al.* (1997) *Resource Flows: The Material Base of Industrial Economies* (Washington, DC: World Resource Institute).
- Agarwal, A. & Narain, S. (1991) *Global Warming: A Case of Environmental Colonialism* (New Delhi: Centre for Science and Environment).
- Albin, C. (2001) *Justice and Fairness in International Negotiation* (Cambridge: Cambridge University Press).
- Albin, C. (2003) Negotiating international cooperation: global public goods and fairness, *Review of International Studies*, 29(3), pp. 365–385.
- Aldy, J. E., Barrett, S. & Stavins, R. N. (2003) Thirteen plus one: a comparison of global climate policy architectures, *Climate Policy*, 3, pp. 373–397.
- Andersson, J. O. & Lindroth, M. (2001) Ecologically unsustainable trade, *Ecological Economics*, 37, pp. 13–122.
- Arden-Clarke, C. (1992) South–North terms of trade: environmental protection and sustainable development, *International Environmental Affairs*, 4(2), pp. 122–139.
- Arrighi, G., Silver, B. J. & Brewer, B. D. (1999) Industrial convergence, globalization, and the persistence of the north–south divide. Reprinted in Roberts, J. T. & Hite, A. (eds) (2007) *The Globalization and Development Reader* (Oxford: Blackwell).
- Aslam, M. A. (2002) Equal per capita entitlements: a key to global participation on climate change?, in Baumert, K. A. (ed.), *Building on the Kyoto Protocol: Options for Protecting the Climate* (Washington, DC: World Resources Institute), pp. 175–202.
- Bartsch, U. & Müller, B. (2000) *Fossil Fuels in a Changing Climate: Impacts of the Kyoto Protocol and Developing Country Participation* (Oxford: Oxford University Press).
- Baumert, K. A. (ed.) (2002) *Building on the Kyoto Protocol: Options for Protecting the Climate* (Washington, DC: World Resources Institute).
- Baumert K. v. A., Perkaus, J. F. & Kete, N. (2003) Great expectations: can international emissions trading deliver an equitable climate regime? *Climate Policy*, 3(2), pp. 137–148.
- Bhagwati, J. (2004) *In Defense of Globalization* (New York: Oxford University Press).
- Blanchard, O., Criqui, P., Kitous, A. & Viguiet, L. (2003) Combining efficiency with equity: a pragmatic approach, in Kaul, I., Conceicao, P., Le Goulven, K. and Mendoza, R. U. (eds) *Providing Global Public Goods: Managing Globalization* (New York: nOxford University Press).
- Braudel, F. (1981) *The Structures of Everyday Life*. Vol. 1 of *Civilization and Capitalism, 15th–18th Century* (New York: Harper & Row).
- Bringezu, S. & Schütz, H. (2001a) Material use indicators for the European Union, 1980–1997. Economy-wide material flow accounts and balances and derived indicators of resource use. EUROSTAT Working Paper, No. 2/2001/B/2, Wuppertal Institute, Wuppertal.
- Bunker, S. (1985) *Underdeveloping the Amazon: Extraction, Unequal Exchange and the Failure of the Modern State* (Urbana, IL: University of Illinois Press).
- Cabeza-Gutés, M. & Martinez-Alier, J. (2001) L'échange écologiquement inégal, in Damian, M. & Graz, J. C. (eds) *Commerce international et développement soutenable* (Paris: Economica).
- Claussen, E. and McNeilly, L. (1998) *Equity and Global Climate Change: The Complex Elements of Fairness* (Arlington, VA: Pew Center on Climate Change).
- Damian, M. & Graz, J. C. (eds) (2001) *Commerce international et développement soutenable* (Paris: Economica).

- Depledge, J. 2002. Continuing Kyoto: extending absolute emission caps to developing countries, in Baumert, K. A. (ed.), *Building on the Kyoto Protocol: Options for Protecting the Climate* (Washington, DC: World Resources Institute), pp. 31–60.
- Dobriansky, P. (2003) Only new technology can halt climate change, *Financial Times*, 1 December.
- Evans, A. (2002) *Fresh Air? Options for the Future Architecture of International Climate Change Policy* (London: NEF).
- Fischer-Kowalski, M. & Amman, C. (2001) Beyond IPAT and Kuznets Curves: globalization as a vital factor in analyzing the environmental impact of socio-economic metabolism, *Population and Environment*, 23(1), pp. 7–47.
- Frank, A. G. (1969) *Latin America: Underdevelopment or Revolution* (New York: Monthly Review Press).
- Gauthier, D. (1986) *Morals by Agreement* (Oxford: Clarendon Press).
- Giljum, S. (2003) Biophysical dimensions of North–South trade: material flows and land use (Ph.D. thesis, University of Vienna).
- Giljum, S. (2004) Trade, material flows and economic development in the South: the example of Chile, *Journal of Industrial Ecology*, 8(1–2), pp. 241–261.
- Giljum, S. & Eisenmenger, N. (2004) North–South trade and the distribution of environmental goods and burdens. A biophysical perspective, *Journal of Environment and Development*, 13(1), pp. 73–100.
- Giljum, S. & Hubacek, K. (2001) International trade, material flows and land use: developing a physical trade balance for the European Union, Interim Report, International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria.
- Goldstein, J. & Keohane, R. (eds) (1993) *Ideas and Foreign Policy: Beliefs, Institutions, and Political Change* (Ithaca, NY: Cornell University Press).
- Groenenberg, H., Phylipsen, D. & Blok, K. (2001) Differentiating commitments world wide: global differentiation of GHG emissions reductions based on the Triptych approach—a preliminary assessment, *Energy Policy*, 29, pp. 1007–1030.
- Group of 77 (G-77). (2000) Declaration of the South Summit, Meeting held in Havana, Cuba, 10–14 April.
- Grubb, M., Vrolijk, C. & Brack, D. (1999) *The Kyoto Protocol: A Guide and Assessment* (London: Royal Institute of International Affairs).
- Gupta, S. & Bhandari, P. (1999) An effective allocation criterion for CO₂ emissions, *Energy Policy*, 27, pp. 727–736.
- Heil, M. T. & Selden, T. M. (2001) International trade intensity and carbon emissions: a cross-country econometric analysis, *Journal of Environment and Development*, 10, pp. 35–49.
- Hornborg, A. (1998a) Towards an ecological theory of unequal exchange: articulating world system theory and ecological economics, *Ecological Economics*, 25, pp. 127–136.
- Hornborg, A. (1998b) Ecosystems and world systems: accumulation as an ecological process, *Journal of World-Systems Research*, 4, pp. 169–177.
- Hornborg, A. (2001) *The Power of the Machine: Global Inequalities of Economy, Technology, and Environment* (Walnut Creek, CA: Alta Mira Press).
- Inglehart, R. (1990) *Culture Shift in Advanced Industrial Society* (Princeton, NJ: Princeton University Press).
- Kim, Y.-G. & Baumert, K. A. (2002) Reducing uncertainty through dual-intensity targets, in Baumert, K. A. (ed.), *Building on the Kyoto Protocol: Options for Protecting the Climate*, (Washington, DC: World Resources Institute), pp. 109–135.
- La Rovere, E. L., Valente de Macedo, L. & Baumert, K. A. (2002) The Brazilian proposal on relative responsibility for global warming, in Baumert, K. A. (ed.), *Building on the Kyoto Protocol: Options for Protecting the Climate*, Washington, DC: World Resources Institute), pp. 157–173.
- Lutzenheiser, L. (1996) Riding in style. Presentation at the American Sociological Association Annual Meeting, New York, 16 August.
- Machado, G., Schaeffer, R. & Worrell, E. (2001) Energy and carbon embodied in the international trade of Brazil: an input-output approach, *Ecological Economics*, 39(3), pp. 409–424.
- Martinez-Alier, J. (2003) *The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation* (Cheltenham: Edward Elgar).
- Müller, B. (2001) Varieties of distributive justice in climate change: an editorial comment, *Climatic Change*, 48, pp. 273–288.
- Muradian, R. & Martinez-Alier, J. (2001a) Trade and the environment: from a ‘Southern’ perspective, *Ecological Economics*, 36, pp. 281–297.
- Muradian, R. & Martinez-Alier, J. (2001b) South–North materials flow: history and environmental repercussions, *Innovation: The European Journal of Social Science Research*, 14(2), pp. 171–187.

- Muradian, R. & O'Connor, M. (2001) Inter-country environmental load displacement and adjusted national sustainability indicators: concepts and their policy applications, *International Journal of Sustainable Development*, 4(3), pp. 321–347.
- Muradian, R., O'Connor, M. & Martinez-Alier, J. (2002) Embodied pollution in trade: estimating the 'environmental load displacement' of industrialized countries, *Ecological Economics*, 41, pp. 51–67.
- Najam, A., Rahman, A., Huq, S. & Sokona, Y. (2003) Integrating sustainable development into the fourth assessment report of the Intergovernmental Panel on Climate Change, *Climate Policy*, 3(1)(Suppl.), pp. S9–S17.
- Neumayer, E. (2000) In defence of historical accountability for greenhouse gas emissions, *Ecological Economics*, 33, pp. 185–192.
- Organization for Economic Co-operation and Development (OECD) (1974) Recommendation on the Implementation of the Polluter Pays Principle, C(74)223 (Paris: OECD).
- Parikh, J. (1992). *Consumption Patterns: the Driving Force of Environmental Stress* (New Delhi: Indira Gandhi Institute of Development Research).
- Parikh, J. K. & Parikh, K. (2002) *Climate Change: India's Perceptions, Positions, Policies and Possibilities* (Paris: OECD).
- Parks, B. C. & Roberts, J. T. (2005) *Environmental and Ecological Justice*, Palgrave Advances in International Environmental Politics (Basingstoke: Palgrave Macmillan).
- Parks, B. C. & Roberts, J. T. (2006) Globalization, vulnerability to climate change, and perceived injustice, *Society and Natural Resources*, 19(4), pp. 337–355.
- Princen, T., Maniates, M. & Conca, K. (eds) (2002) *Confronting Consumption* (Cambridge, MA: MIT Press).
- Quiroga, R. (ed.) (1994) *El Tigre sin Selva. Consecuencias Ambientales de la Transformación Económica de Chile: 1974–93* (Santiago: Instituto de Ecología Política).
- Roberts, J. T. & Grimes, P. E. (1997) Carbon intensity and economic development 1962–1991: a brief exploration of the environmental Kuznets Curve, *World Development*, 25(2), pp. 181–187.
- Roberts, J. T. & Grimes, P. E. (2002) World-system theory and the environment: toward a new synthesis, in Dunlap, R. E., Buttell, F. H., Dickens, P. & Gijswijt, A. (eds) *Sociological Theory and the Environment: Classical Foundations, Contemporary Insights* (Lanham, MD: Roman and Littlefield Publishers).
- Roberts, J. T. & Parks, B. C. (2007) *A Climate of Injustice: Global Inequality, North–South Politics, and Climate Change* (Cambridge, MA: MIT Press).
- Roberts, J. T., Grimes, P. E. & Manale, J. (2003) Social roots of global environmental change: a world systems analysis of carbon dioxide emissions, *Journal of World-System Research*, IX(2).
- Røpke, I. (1999) Prices are not worth that much, *Ecological Economics*, 29(1), pp. 45–46.
- Russi, D. & Muradian, R. (2003) Gobernanza global y responsabilidad ambiental, *Ecología Política*, 24, pp. 95–105.
- Ruth, M. (1998) Dematerialization in five US metals sectors: implications for energy use and CO₂ emissions, *Resources Policy*, 24(1), pp. 1–18.
- Sachs, W. (1999) *Planet Dialectics: Explorations in Environment and Development* (London: Zed Books).
- Sijm, J. P. M., Jansen, J. C., Battjes, J. J., Volkers, C. H. & Ybema, J. R. (2000) *The Multi-Sector Convergence Approach of Burden Sharing: An Analysis of its Cost Implications* (Oslo: CICERO).
- Simms, A., McGrath, J. & Reid, H. (2004) Up in smoke?, *Threats from, and Response to, the Impact of Global Warming on Human Development* (London: NEF).
- Stavins, R. (2004) Can an effective global climate treaty be based upon sound science, rational economics, and pragmatic politics? KSG Faculty Research Working Paper Series RWP04-020.
- TERI (Tata Energy Research Institute) (1997) *Long Term Carbon Emission Targets Aiming Towards Convergence* (New Delhi: TERI).
- Torvanger, A. & Godal, O. (2004) An evaluation of pre-Kyoto differentiation proposals for national greenhouse gas abatement targets, *International Environmental Agreements: Politics, Law and Economics*, 4, pp. 65–91.
- United Nations Development Programme (UNDP) (1998) *Human Development Report 1998* (New York: United Nations).
- Wallerstein, I. (1972) Three paths to national development in 16th century Europe, *Studies in Comparative International Development*, 8, pp. 95–101.
- White House (2002a) Fact Sheet: President Bush announces clear skies & global climate change initiative. Available online at: <http://www.whitehouse.gov/news/releases/2002/02/20020214.html> (accessed 14 February 2002).
- White House (2002b) Global Climate Change Policy Book. Available online at: <http://www.whitehouse.gov/news/releases/2002/02/climatechange.html> (accessed 14 February 2002).
- Wiegandt, E. (2001) Climate change, equity, and international negotiations, in Luterbacher, U. & Sprinz, D. (eds) *International Relations and Global Climate Change* (Cambridge, MA: MIT Press), pp. 127–150.

World Bank (1992) *World Development Report 1992: Development and the Environment* (Washington, DC: World Bank).

Ybema, J., Battjes, J. J., Jansen, J. C. & Ormel, F. (2000) *Burden Differentiation: GHG Emissions, Undercurrents and Mitigation Costs* (Oslo, Norway: CICERO).

J. Timmons Roberts is Professor of Sociology at the College of William and Mary, Williamsburg, VA, USA.

Bradley C. Parks is Development Policy Officer in the Department of Policy and International Relations at the Millennium Challenge Corporation.

Copyright of Globalizations is the property of Routledge and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.