Global Trade and Sustainability

Machines in the Earth's Garden

by C. Ford Runge

By the end of the American Civil War, knowledge of the vast natural resources of the American West and the continents of South America, Asia, and Africa had increased exponentially. Technological progress was equally rapid, entirely changing man's capacity to understand natural ecosystems and the scientific principles underlying them. Stephen Ambrose, describing the state of knowledge and technology at the time of Lewis and Clark, wrote:

> Americans of 1801 ... could not move goods or themselves or information by land or water any faster than the Greeks and Romans.... But only sixty years later, when Abraham Lincoln took the Oath of Office as the sixteenth President of the United States, Americans could move bulky items in great quantity farther in an hour than Americans of 1801 could do in a day, whether by land (twenty-five miles per hour on railroads) or water (ten miles an hour upstream in a steamboat). ...In Jefferson's day, it took six weeks to move information from the Mississippi River to Washington, D.C. In Lincoln's, information moved over the same route by telegraph almost instantaneously (pp. 53–54).

Thus in the nineteenth century was the conviction broken, as Henry Adams wrote, that "what had ever been must ever be." In the twentieth century, the capacity of technology to completely alter physical landscapes and change the order of natural systems and cycles has become more and more obvious. Total war in Europe and, at the nuclear level, in Japan, was one example. Extractive industry, such as strip mining or widespread clear-cutting of forests, is another. The most recent, and controversial, is global climate change. These manmade disruptions have forced many to ask whether technology can continue to act on natural systems without ultimately destroying them. Yet technology can also reduce some of the ecological impacts of modern production methods, by substituting information or biological processes (now including genetic information) for physical inputs. The current tension between global trade and sustainability is a new version of an old controversy over the impact of technology on the environment. Because of the growing importance of global trade and sustainability, it is a controversy we must strive to better understand.

Technology drives global trade. When stripped of jargon, sustainability concerns the well-being of future generations in the face of growing pressure on the natural environment to provide and maintain a variety of services, including extractable natural resources, waste absorption, and ecological systems. Technological optimists believe economic growth, driven by trade, can complement natural resources, or substitute for them outright. Thus, technological optimists embrace plant biotechnology as a way of substituting information (pest resistance, for example) for inputs such as pesticides, and "backstop technologies" such as renewable fuels as substitutes for fossil fuels. On the pessimistic side, critics of developments such as biotechnology emphasize its risks to natural biota and note the potential of such technologies to substitute for and ultimately drive out genetic diversity and resistance to various plant diseases or pests. The Union of Concerned Scientists, forged originally to combat

the negative impacts of nuclear fission and fusion, has recently turned its attention to agricultural biotechnology, suggesting that it is technological pessimism that unites its initiatives. In the final analysis, debates over sustainability and global trade involve deep issues of technological change and its impact on the natural environment, with optimists and pessimists likely to promote very different predictions and prescriptions.

Two hypotheses

I will offer two broad hypotheses describing the impacts of global trade on sustainability. The first is that trade is the cause of reduced sustainability of ecological systems and is, in fact, destroying them. While many have focused on physical environmental resources in this process, there are similar arguments made in respect to labor conditions and standards (including wage levels and worker safety, for example) and cultural issues such as the preservation of traditional heritage or language. In all cases, the hypothesis is that the transboundary flow of goods, services, bads, and disservices negatively affects environmental quality. Global trade is driven by a form of Raymond Vernon's "product cycle," in which demands for specific innovations first appear in a "lead market," then are diffused to other markets through direct foreign investment. If this cycle is enlarged to include not only goods but services, bads, and disservices, global trade diffuses all of the "products" of technological change across jurisdictional boundaries. Tests of this hypothesis suggest a complex picture, in which the hypothesis of trade as destroyer is by no means universally accepted.

The second, and in some ways more refined, hypothesis is that global trade, a largely market-driven phenomenon, carries with it effects that result from the failure of markets to account for environmental impacts (or, for that matter, labor conditions and cultural effects). Analyzing the second hypothesis is somewhat more difficult but, in my judgment, more rewarding, since it leads to a decomposition of both the market and nonmarket impacts of global trade as they relate to environmental quality. I shall argue that the first hypothesis, the "globalization as destroyer" hypothesis, is unduly pessimistic as a description of observable evidence. When used to describe the environmental impacts of global trade, it leads to a substantial number of false predictions and prescriptions. The second, the market failure hypothesis, is supportable and implies the need for more substantial institutional innovations in response to these failures. The world community and many nations have yet to show themselves capable of such innovations, with some small but significant exceptions.

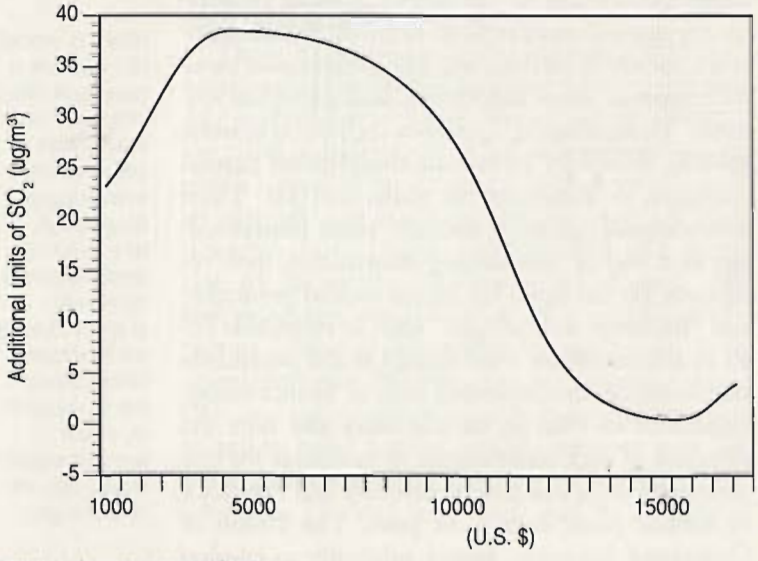

Figure 1. Income and pollution

Global trade as destroyer

The view that global trade is a dynamo of ecological destruction has a substantial following. The empirical evidence is more complicated. Basic findings suggest that trade and associated GDP growth do lead to increases in various indicators of environment damage but that in many cases these indicators then move positively at higher levels of income. A number of studies have examined this so-called "inverted U" or "Kuznets" function (analogous to the demographic transition hypothesis), in which pollution rises with increases in income at lower levels of GDP per capita, then begins to fall once a threshold is reached.

Figure 1 depicts the variation in sulphur dioxide pollution attributable to variation in per capita income across countries and time. Concentrations of SO_2 have risen with income at low levels of per capita GDP, fallen with income at higher levels of per capita GDP, and eventually leveled off in the most advanced economies. The estimated turning point comes at about $5,000 (1988 U.S. dollars). The conclusions for smoke pollution are much the same as those for SO_2 pollution.

Lucas has looked not only at the relation to GDP/capita but specifically at the relation between various environmental indicators and trade-openness measured by exports/GDP. He found that many pollutants are unassociated with export openness, and some indicators, such as wilderness area, are positively associated with openness. Deforestation, in contrast, is negatively associated with it. In a recent report for the World Resource Institute, we examined the relationship between changes in export shares in Latin America and the Caribbean for numerous sectors and found that the highest polluting sectors were basic metals, industrial chemicals, and nonmetal products, while the lowest were

textiles and apparel, metal products, and food products. When we examined export growth in these sectors, it was by no means clear that export share was growing more rapidly in the highly polluting sectors; if anything, the opposite trend seemed better supported (Runge et al.).

Based on the evidence to date, export expansion and increases in GDP per capita as a measure of trade expansion are therefore not unambiguously associated with reduced sustainability of ecological systems; rather, growth in income and exports appears to lead to increases in environmental damages at lower income levels, followed in some cases by reduction as incomes increase, implying that income growth is a precondition for environmental protection. But this evidence, which remains fragmentary, begs the key question: What are the *mechanisms* behind this process? This brings us to hypothesis number two.

The machine of trade in the earth's garden

Leo Marx concluded his study of technology and the pastoral ideal, *The Machine in the Garden*, with the remark that "The machine's sudden entrance into the garden presents a problem that ultimately belongs not to art but to politics" (p. 365). The *mechanisms* by which globalization and trade affect sustainability are not revealed by inverted U-shaped functions, which hide the political choices leading nations and individuals to respond to pollution as a public bad. These market failures demand attention to the incentives of individuals and nations to engage in collective actions to reduce these negative externalities over time (see Sandler). A decomposition of the impacts of trade on the environment allows us to discern if, how, and why certain trends in the data occur, such as the inverted "U." Let me sketch five such impacts of global trade on the physical environment (Runge).

The first, celebrated since Adam Smith, is *allocative efficiency*: the argument that specialization and comparative advantage more efficiently utilize natural resources than policies of national or local self-sufficiency, a view in direct contrast to advocates of "localism." The second effect of trade is on the *scale* of economic activity, generally measured in terms of GDP per capita, involving the question of whether economic activity creates more ecological "wear and tear." The nonlinearities reported in the data (specifically inverted-U-shaped functions) suggest that other forces are at work, above and beyond scale effects. The third effect is on the *sectoral composition* of output: Are more or less ecologically threatening sectors favored by trade? This was the focus of the Latin American exercise reported earlier. A fourth way in which trade may affect the environment is by inducing *technological innovation* and transfer—of both goods and bads. A final impact is on policy—and political institutions. Rising incomes may make environmental protection more affordable, but the ultimate question is not only whether countries are able to pay for such protection, but whether they are willing to pay and can reveal this preference through the political process in the form of institutional innovations that reduce negative externalities. Market failure is thus joined by the possibility of government failure in responding to the negative environmental impacts of economic growth.

We can think of trade and globalization as inducing some allocative efficiencies, leading to increased growth and GDP per capita, with some negative scale effects. If these effects lead to increases in demand for environmental protection, revealed in a political process, then induced technical changes and shifts in composition are more likely. But if negative scale effects are not overcome by allocative efficiencies and market-based technologies, and the political process does not respond to these environmental externalities, a disconnection is possible.

This question lies at the heart of the debate over sustainability and global trade. Obviously, the political process at both the national and the international levels is only beginning to respond to environmental problems—and grudgingly. Moreover, the data suggests that such responses are much less likely at lower levels of income, even in well-functioning democracies. In the United States and Western Europe, environmental responsibility and even corporate environmental activism are very much in favor with the public and a large part of the private

sector. But in most developing countries, environmental regulation is regarded at best as an affectation of the rich and at worst as an excuse to deny market access to Third World exporters as a form of green protection. The central conundrum facing global environmental policy is how to connect incentives for upward harmonization of environmental standards to the dynamic process of trade liberalization while avoiding the use of "environmental conditionality" as an excuse for closing off market access. Here, new institutions are required, including the possibility of a World Environment Organization (WEO), designed to function alongside the World Trade Organization in Geneva.

Synthesis or antithesis?

The reconciliation of global trade and sustainability is unlikely to occur without political commitments to redirect some of the economic benefits generated by growth and trade toward targeted environmental improvements. How and where to target these improvements requires data on environmental impacts and attention to the possibility that environmentalism can be hijacked for purely protectionist purposes. For these reasons, any real progress in sustainable development is unlikely until we have a clear empirical basis allowing interventions that maximize environmental benefits and discourage protectionism in green guise. Such detailed analysis and understanding requires investigators to temper a priori optimism or pessimism and to admit the possibility of both positive and negative ecological impacts of global trade. A policy acknowledging negative and positive effects when and where they occur, and encouraging political and policy decisions that promote positive and discourage negative impacts, is neither original nor new, and is similar to the prescriptions of Pigou's *Economics of Welfare*. But the scientific essence of this effort to synthesize the advantages of more open trade with those of a cleaner environment is an empirically accurate description, upon which prediction and prescription can then be built—an important future role for applied economists. ◘

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■ For more information

Ambrose, S.E. *Undaunted Courage: Meriwether Lewis, Thomas Jefferson and the Opening of the American West.* New York: Simon and Schuster, 1996.

General Agreement on Tariffs and Trade (GATT). *International Trade 90-91*, vol. 1. Geneva, 1992.

Grossman, G.M., and A.B. Krueger. *Environmental Impacts of a North American Free Trade Agreement.* Discussion Paper #158, Princeton University, Woodrow Wilson School of Public and International Affairs, 1991.

Inglehart, R., N. Nevitte, and M. Basanez. *The North American Trajectory: Cultural, Economic, and Political Ties among the United States, Canada, and Mexico.* New York: Aldine De Gruyter, 1996.

Lucas, R.E.B. "International Environmental Indicators: Trade, Income, and Endowments." *Agriculture, Trade and the Environment: Discovering and Measuring the Critical Linkages.* M.E. Bredahl, N. Ballenger, J.C. Dunmore, and T.L. Roe, eds., chap. 16. Boulder CO: Westview Press, 1996.

Marx, L. *The Machine in the Garden; Technology and the Pastoral Ideal in America.* New York: Oxford University Press, 1964.

Runge, C.F., E. Cap, P. Faeth, P. McGinnis, D. Papageorgiou, J. Tobey, and R. Housman. *Sustainable Trade Expansion in Latin America and the Caribbean: Analysis and Assessment.* Washington DC: World Resources Institute, August 1997.

Runge, C.F. "Trade, Pollution, and Environmental Protection." *The Handbook of Environmental Economics.* Daniel W. Bromley, ed., chap. 16, pp. 353–75. Oxford UK: Blackwell, 1995.

Sandler, T. *Global Challenges: An Approach to Environmental, Political, and Economic Problems.* Cambridge UK: Cambridge University Press, 1997.

Williamson, J.G. "Globalization, Convergence, and History." *J. Econ. History* 56(June 1996): 277–306.

This article is based in part on a paper prepared for the Summer Workshop of the Board of Sustainable Development, National Research Council, Woods Hole, Massachusetts, July 1997. The author thanks Vernon W. Ruttan and three reviewers for comments and suggestions.