Symposium:
International Trade and the Environment

Does Trade Help or Hinder the Conservation of Natural Resources?

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Introduction

The effects of trade and trade-related measures on the use and conservation of natural resources are both determined and complicated by the context in which these resources are exploited. Renewable resources often suffer from ill-defined property rights, transboundary migration, and a host of management challenges posed by the complex biological processes that determine "renewability." As a result, the interdependence of trade and resource use has a long history in international dialogue and law, as countries have sought help from partners in meeting their conservation goals. This dialogue stands in some contrast to the debate over the "offshoring" of pollution-intensive industries, where few (if any) of the presumed recipients of greater pollution have sought international assistance in preventing such shifts in production (see Levinson 2010 in this symposium). Furthermore, the complexity of renewable resource management in a global context adds another dimension to the issue of why countries might want to negotiate environmental and trade policies together (see Ederington 2010 in this symposium).

This article surveys the literature on trade and renewable resource management and finds interactions that are complex and often ambiguous: in some situations trade can facilitate conservation, but in others it can encourage overexploitation and even extinction. Depending on the resource and the circumstances, even trade-restrictive measures aimed at protecting natural resources may have unintended consequences.

The next section presents some historical background on international policy responses to unsustainable resource practices, highlighting the role of trade and trade measures. This is followed by a discussion of the economics of renewable resources and trade, including the roles of relative prices, the opportunity cost of habitat, other factors of

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production and the economy at large, and threats to domestic ecosystems. The article concludes with a discussion of the lessons and implications for trade-related resource policies, including trade bans and ecolabeling, and future research on trade and renewable resource management.

History of Trade and International Cooperation on Resource Conservation

The history of international environmental agreements began with efforts to conserve natural resources. The earliest treaties focused on transboundary resources, but trade and trade measures have played an important role throughout the evolution of international agreements on resource conservation.

Early Wildlife Conservation Agreements

Perhaps the first international environmental agreement related to wildlife conservation was the Convention for the Protection of Birds Related to Agriculture, signed by eleven European nations in 1902 to prohibit the capture, killing, or sale of certain species during breeding and migration seasons. Trade-restrictive measures were explicit in the Migratory Bird Treaty, negotiated between the United States and Great Britain in 1916 to protect birds migrating between the United States and Canada. This treaty prohibited or regulated trade in many bird species at a time of active commerce in birds and their feathers. Similar conventions with other countries followed. Another early example of international cooperation on conservation is the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere, adopted in 1940 and entered into force in 1942, which included controls on international trade in protected fauna and flora.

Commercial Fisheries Agreements

International cooperation on the management of commercial fisheries began more than a century ago, with some bilateral agreements dating to the 1800s (Barrett 2003). The first multilateral agreement to manage commercial fisheries was the North Pacific Fur Seal Treaty of 1911, under which the United States, Russia, Japan, and Great Britain agreed to measures to manage commercial seal hunting, including banning offshore hunting, assigning jurisdictions for regulating onshore hunting, and establishing formulas for sharing the catch. Since whale hunting is by nature offshore, the International Agreement for the Regulation of Whaling, first signed in 1937, and its successor convention, which entered into force in 1948, established an International Whaling Commission to monitor and regulate whaling. The commission's moratorium on commercial whaling has continued since the mid-1980s, although certain countries objected and are not bound by it. Despite some early successes,[1] historical harvesting pressures, ecological pressures, bycatch, and ship strikes have reduced both seal and whale populations today.

[1]Fifty years after the signing of the Fur Seal Treaty, seal herds had increased tenfold (see U.S. Fish and Wildlife Service press release, "International Fur Seal Treaty Negotiated 50 Years Ago," July 2, 1961).

International Trade Agreements and Resource Conservation

In 1947, not long after the establishment of the early environmental agreements, negotiations began on the General Agreement on Tariffs and Trade (GATT), which evolved into the World Trade Organization (WTO). The primary goal of the GATT was more open trade, through the lowering of tariffs and the elimination of nontariff barriers to trade. Two kinds of concerns have been raised about the environmental impacts of the multilateral trading system. First is the concern that trade liberalization itself can place untenable pressures on resource stocks, especially in countries without the means to manage and protect them; this has been the focus of much of the economics research examined in this review. Second is the concern that trade policy obligations can hamstring governments' resource management efforts by prohibiting trade-restrictive measures. This issue has been evolving as WTO law is interpreted through the dispute settlement mechanism.

Since the beginning of the GATT, exceptions have been allowed in order to conserve natural resources. Most notably, Article XX(g) provides that WTO member states may engage in trade-restrictive policies "relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption." Although this exception states "exhaustible" resources, it has generally been interpreted to include renewable resources that may be depleted, and in the past it has been invoked to support policies aimed at the conservation of tuna, salmon, herring, dolphins, and turtles, and also clean air.[2] Article XX(b) allows trade measures to be undertaken "to protect human, animal or plant life or health." This exception has been used to justify restrictions on developing country imports of timber and other renewable resource products, and more recently to justify trade restrictions on the basis of the "threat" of a potential biological invasion. Despite these exceptions, Article XX also requires "that such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade."

The applicability of these exceptions has been tested in the WTO dispute settlement mechanism. Perhaps the most famous dispute regarding renewable resource conservation is *India etc. vs. U.S.: "Shrimp–Turtle."* The U.S. Endangered Species Act of 1973 listed five species of sea turtles that exist in U.S. waters as endangered or threatened, and required that U.S. shrimp trawlers use "turtle excluder devices" (TEDs) in their nets when fishing in sea turtle areas. In 1989, Congress extended the requirements to ban imports of shrimp originating in areas where sea turtles might be threatened unless the harvesting nation was certified to have comparable regulations and outcomes.[3] In the "Shrimp–Turtle" dispute, the WTO appellate panel ultimately ruled against the United States. The reasoning behind the decision was that the U.S. policy was applied in an arbitrary manner, providing transitional assistance to some WTO members in the Caribbean but not to the complaining members in Asia.

Perhaps more important is what the panel did *not* find: "We have *not* decided that the sovereign nations that are Members of the WTO cannot adopt effective measures to protect endangered species, such as sea turtles. Clearly, they can and should." This statement indicates

[2]For more information, see http://www.wto.org/english/tratop_e/envir_e/envt_rules_exceptions_e.htm.
[3]Section 609 of U.S. Public Law 101–2.

a clear departure from an earlier ruling of a GATT dispute panel that was less deferential to the general exceptions contained in Article XX.[4] However, an additional statement by the appellate panel in the shrimp–turtle case indicates a preference against unilateral trade measures: "And we have *not* decided that sovereign states should not act together bilaterally, plurilaterally or multilaterally, either within the WTO or in other international fora, to protect endangered species or to otherwise protect the environment. Clearly, they should and do."

Trade-Related Treaties Concerning Resource Conservation

Indeed, the several international treaties related to resource conservation explicitly recognize the role of international trade in achieving their goals. That trade may be a threat to species conservation is at the core of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In force since 1975, CITES places certain controls on international trade in specimens of selected species, according to their endangered status as listed in the CITES appendixes. As indicated in Appendix I of CITES, international trade involving species threatened with extinction (e.g., African elephant ivory, sea turtles, Brazilian mahogany) is banned altogether except in exceptional circumstances. Other species, though not threatened with extinction, are sufficiently endangered by trade to mandate controls. In some cases, a country with threatened species may enlist the help of CITES partners in controlling trade (see CITES Appendix III). For all of the species listed in the CITES appendixes, CITES requires that their import, export, re-export, and introduction from the sea be authorized through a licensing system that is developed and managed in each member country. However, the primary policy tool of CITES remains the trade ban.

A more subtle indication of the role of trade in conservation may be evident in other agreements. In the late 1970s and early 1980s, alarm at the rate of deforestation in many tropical countries, tempered with recognition of the tropical timber trade's role in these countries' economic development, led to the first International Tropical Timber Agreement (ITTA) in 1983. In this and subsequent ITTA agreements the aim is "to promote the expansion and diversification of international trade in tropical timber from sustainably managed and legally harvested forests and to promote the sustainable management of tropical timber producing forests."[5] Signatories to the ITTA comprise both producer and consumer countries, and the measures for implementing the agreements include collecting and sharing information, building capacity for monitoring and enforcement, developing guidelines for sustainable practices and certification, promoting technology transfer, and fostering international cooperation through the International Tropical Timber Organization. Although ITTO members face certain obligations, most measures are voluntary, and do not include the kind of trade-restrictive measures contained in CITES.

Thus, over time, there has been an evolution from trade-restricting to trade-promoting measures to encourage sustainable harvesting practices. This trend continues with the

[4]In *Mexico etc. vs. U.S.*: *"Tuna–Dolphin,"* the GATT panel rejected the validity of the exception, saying it did not allow for the regulation of production processes (as opposed to product qualities) used in imported products.

[5]Fourth Session of the United Nations Conference for the Negotiation of a Successor Agreement to the International Tropical Timber Agreement, 1994, Geneva, Switzerland, January 16–27, 2006.

Convention on Biological Diversity (CBD), a product of the 1992 Earth Summit at Rio de Janeiro. The CBD's goals are biodiversity conservation, sustainable use of the components of biodiversity, and equitable sharing of the benefits of commercial uses of genetic resources, including pharmaceutical products derived from indigenous biological organisms. As a framework convention, it is less prescriptive than most of the conservation-oriented agreements that have preceded it, but it goes beyond them in some important ways: it recognizes that not only species but also ecosystems must be conserved, and that not only resource property rights but also intellectual property rights to genetic resources must be institutionalized. The CBD also recognizes the complex relationship between trade and conservation, with CBD activities including both trade promotion for products using biodiversity resources in a sustainable way, and analysis and mitigation of the effects of trade liberalization on biodiversity.[6]

Common Themes

Two competing ideas simultaneously underlie the array of intergovernmental conservation efforts discussed above: that trade can be a boon to conservation goals, and that trade can be a threat to biodiversity. Given the long history of international trade and conservation policies, it is somewhat surprising that the resource economics literature has only fairly recently made a concerted effort to understand the complex interplay between trade and resource conservation. Yet, we see these same competing ideas highlighted in the emerging literature, which we discuss in more detail in the next section.

The Economics of Renewable Resources and Trade

Renewable resources—such as fisheries, forests, wildlife, and the benefits provided by ecosystems and biodiversity—pose challenges that are different from those posed by pollution. Therefore, a separate and distinct literature has emerged on the economics of trade and renewable resources (for a more technical review of this literature, see Bulte and Barbier 2005).

Two factors distinguish the management of renewable resources from other environmental problems. First, these resources are indeed renewable. That is, although they may be depleted by harvesting activities, they do replenish over time according to biological processes. Second, because most renewable resources rely on habitat that is itself depletable and subject to economic and ecological forces, the management of renewable resources is more complex and intertemporal (and often more spatial) than other environmental issues. Thus the static models that are commonly used in trade and environment analysis may miss these and other important factors that arise from the dynamics of renewable resources.

These dynamics are determined by interactions between economic, ecological, and institutional variables. Of course, weak institutions and lax regulation are important underlying issues for trade and pollution, because unregulated polluters do not take into account the

[6]Policies used in the implementation of the CBD include individual transferable fishing quotas and other property-right-based mechanisms, biodiversity prospecting for new products from natural sources, and the commercialization of medicinal plants or other biodiversity-based products, possibly including the use of certification or ecolabeling (http://www.cbd.int/incentives/indirect.shtml, accessed September 20, 2008).

environmental costs of their activities. However, in the case of renewable resources, weak institutions also lead to an "open-access" problem, in which harvesters extract the resource or convert the habitat without considering the effects of the smaller stock on other harvesters and future extraction opportunities—a problem sometimes called the tragedy of the commons.

Trade can influence these dynamics in several ways. First, trade liberalization changes relative prices and thus the incentives to exploit natural resource commodities. Second, trade can have broader effects on the economy, including the opportunity cost of land (which affects the supply of habitat), incomes (which may affect demand for resource-intensive products—or for ecosystem services), and labor, capital, and other factors of production. Third, trade interacts with and can influence the institutions governing the management of natural resources. Finally, trade can directly introduce threats to ecosystems, in the form of invasive species. The role of these factors is examined in more detail below.

Role of Relative Prices

The primary effect of trade liberalization is to change the prices of resource-intensive goods relative to the prices of other goods. At the same time, for a small, open economy, which has been the focus of most of the literature, trade liberalization also means that the domestic resource price is no longer self-regulating. In a self-sufficient, closed economy, prices adjust with the harvest size, with large harvests relative to demand driving down prices and thereby incentives to extract the resource, and relatively small harvests having the opposite effect. But with trade, prices are set in world markets and they become insensitive to any overexploitation of the resource. Thus, the long-run effects depend on whether trade raises or lowers prices for the resource. The typical case for analysis is a small developing economy, relatively abundant in a particular natural resource. In this case, the domestic equilibrium price—the price when supply equals demand—is lower than on global markets, so open trade raises prices for the resource commodity. This situation can have several effects.

The main effect of higher prices is to encourage intensified exploitation, causing resource stocks to decline (at least initially). If stocks are managed optimally (that is, to maximize discounted welfare over time), trade will increase welfare in present value terms, although in the long run, steady-state welfare and stocks may ultimately be lower (Bulte and Barbier 2005). However, if stocks are poorly managed, higher prices can exacerbate a preexisting open-access problem. The country may experience temporary gains from trade, but these new profits attract new entrants until all the rents are again dissipated—or until a capacity limit is reached. Brander and Taylor (1997a) define that capacity limit as the available supply of labor in a country, and show that if the country can fully specialize and still receive enough rents from the resource sector, then it can benefit from more open trade in the long run. However, if all the rents are dissipated, then the country will be worse off under trade. This problem may be exacerbated for a large resource exporter, as world resource prices may continue to rise as overharvesting drives up costs, causing real wages to fall (Brander and Taylor 1998).

On the other hand, if international resource prices are actually lower—as when a country has already dangerously overused its resource for its own consumption—then opening to trade allows domestic demand to be satisfied by imports, relaxing pressure on the resource

and allowing it to recover. In this way, trade can be beneficial to countries with severe open-access problems. Clearly, however, the combination of trade and open-access harvesting does have the potential to cause the collapse of a species. Taylor (2006) presents the case of the North American bison, where the innovation of new tanning techniques made the hides desirable, and the ensuing European demand fueled a slaughter that brought the Great Plains population of bison from 10 million or perhaps even 15 million down to 100 in a little more than 10 years.

Role of Habitat and other Factors

Changing relative prices can also have important secondary effects on welfare and resource stocks as other factors of production adjust. Some kinds of factor adjustments are of greater concern for resource commodities that are harvested on commercial scales and represent significant employment, such as timber or fisheries. Other resource production may be too small in scale to influence the wider economy, while many natural resources that we value (e.g., biodiversity, ecosystem services) are not traded at all. Therefore, it is useful to distinguish among these different types of resources when assessing the likely effects of trade.

Land

For almost all renewable resources, the most important factor of production is land—or habitat more generally. Since land is immobile, its value is most closely tied to local opportunities, in which resource rents may play a more prominent role than in the economy as a whole. Still, that land (or water) typically has other uses, and those opportunity costs are also affected by trade.

When land can either serve as habitat for the resource or be converted for other uses, such as agricultural cultivation, resource price changes can have counterbalancing effects. This means that while higher resource prices increase exploitation, they also increase the value of maintaining habitat and expanding the resource base (Barbier and Schulz 1997; Jinji 2006). Which of these two effects dominates will depend on the specific circumstances. However, several studies caution that trade restrictions (e.g., trade bans, import restrictions, or even certification schemes) that reduce the value of resources such as ivory or tropical timber may have the counterproductive effect of hastening habitat conversion, which weakens the support system for the resource in the long run (Barbier et al. 1990, 1994; Barbier 2001; Smulders et al. 2004; Jinji 2006).

Other Sectors

Although most studies have focused on changes in resource prices, trade liberalization may also affect the prices in other sectors. Some of these sectors may compete for the land or habitat that the natural resource relies on. For example, increasing relative returns to agriculture can lead to greater rates of deforestation and soil depletion, while a shift to less land-intensive sectors would allow resources to recover (López 2000). Other sectors might complement the resource or its habitat, as, for example, higher prices for shade-grown coffee can help the conservation of forest cover (Blackman et al. 2007). Or tariff reductions might affect sectors that require a supply of resource products. Indeed, given the tendency toward tariff

escalation—that is, higher tariffs for more highly processed goods than for raw materials—tariff liberalization is likely to have larger effects on resource-using products (like furniture) than on many of the resources themselves (like timber). In addition, the increased availability of imported goods may have its own cross-cutting effects: on the one hand, imports may displace goods produced from converted habitat, while on the other hand, imports may also be substitutes for domestic consumption of the resource commodity (Barbier and Schulz 1997).

Trade-induced changes in a major resource-producing sector may also have broader impacts on an economy. For example, the reallocation of effort to resource exploitation can have additional implications if other sectors in the economy might be better (or poorer) engines of growth in the long run than natural resource commodities. Shifting production toward the resource-intensive sector implies reducing employment in other sectors, like manufacturing. If manufacturing has spillover benefits for growth, or increasing returns to scale more generally, this diversion of labor can lead to lower welfare (Matsuyama 1992).[7] But if non-resource-intensive sectors exhibit diminishing returns to scale (say, as more fishers and foresters attempt to shift to manufacturing, where they are unskilled), the diversion of labor to the higher-earning resource sectors can improve overall productivity and welfare—even if the resource suffers from open-access problems (Hannesson 2000). In the long run, when the accumulation of capital or labor enhances productivity, sustainable growth and resource use requires that the labor supplied for harvesting the open-access resource shrink over time and shift to other sectors; in some cases this process may be more likely to occur with than without open trade (McAusland 2005; López et al. forthcoming).

Changes in Incomes

Demand for resource-related goods may also be affected indirectly by trade through changes in real incomes and economic growth over time. Higher incomes at home and abroad can increase demand for resource (or resource-using) products, possibly intensifying price pressures. Conversely, using the proceeds from resource exports to finance investments in human and industrial capital can ultimately decrease reliance on extraction (Sarraf and Jiwanji 2001). Income growth can perhaps increase demand for ecological services and the capacity for resource protection (as alleged in the extensive literature on the environmental Kuznets curve).

Role of Institutions

Much of the research on institutions reflects the concern that trade may prove costly for natural-resource-exporting developing countries (the "South"), where governance is generally weaker and open-access regimes are more likely to prevail than in developed countries (the "North"). This concern was voiced by Chichilinsky (1994), who asserts that open access—in which the costs of additional exploitation on other and future harvesters is ignored—confers

[7]That manufacturing is ultimately a more productive driver of growth is one of the assumptions underlying the concept of "Dutch disease" (Corden and Neary 1982), whereby a massive influx of foreign currency from resource exports causes the home currency to appreciate, manufacturing to shrink, government budgets to expand, and institutional quality and oversight to deteriorate.

an "apparent" competitive advantage against regimes with perfect property rights, where these costs are internalized. This apparent cost advantage induces trade that would not otherwise occur, possibly resulting in lower welfare in the South. Brander and Taylor (1997b) confirm some of this intuition using a dynamic resource framework. They consider trade between a "consumer" country, with open access to its resource pool, and a "conservationist" country, which actively manages its resource. If, despite open access, resources remain relatively abundant in the consumer country before trade, then trade liberalization will cause this country to export the resource, which will further deplete the open-access stock and lead to welfare losses. However, if the resource in the consumer country is severely depleted before trade, opening to imports from the well-managed country will serve to protect the open-access stock, and both countries will experience gains from trade.

When neither country has perfect property rights or management strategies, additional scenarios are possible. Overexploitation in the South may eventually lead to a reversal in the direction of trade, as the North becomes an exporter. With sufficient recovery rates, long-run gains from trade could be realized. However, since, in this scenario, the North is also unable to manage its resources optimally, it is possible that stocks in the North could ultimately be driven to collapse as well (Karp et al. 2001).

Asymmetry of Institutions

Part of the reason trade may not make all parties better off stems from the asymmetry of renewable resource management institutions. When only certain portions of global resources are "enclosed" with property rights regimes that limit access, although owners of these enclosed resources are made better off, there is a side effect that puts more pressure on the remaining unenclosed resources (de Meza and Gould 1992; Emami and Johnston 2000; Fischer and Laxminarayan forthcoming). In this case, trade may result in more overharvesting of the unenclosed resources, and the global resource system overall, than if all resources were governed by open access. The pressures on unenclosed resources can be further exacerbated by trade in the capital equipment used for harvesting. For example, after the Newfoundland cod stocks collapsed, a Canadian policy paid vessel owners to withdraw capacity, and those vessels were sold to other parts of the world—mainly to developing countries (Eggert and Greaker 2009). In essence, overcapitalization of fishing fleets was exported, contributing to degradation of fish biomass in other open-access regimes (they cite Argentina as an example).

Enforcement of Property Rights

Of course, there is no particular reason to believe that management regimes will stay fixed if there are significant changes in resource rents as a result of trade. In fact, higher resource values increase the return to better management and make more funds available for the enforcement of property rights. For example, trade liberalization in Argentina in the 1990s resulted in a vast expansion of fisheries exports, and the parallel decline in now-valuable fish stocks led Argentina to adopt an individual transferable quota system in 1997 (Eggert and Greaker 2009).

In general, greater enforcement of resource property rights leads to improvements in resource conservation; however, society as a whole may not necessarily benefit because of the costs associated with enforcement (Hotte et al. 2000). When enclosure of resources

occurs incrementally and incompletely, such as when private landowners monitor their own parcels, there are likely to be ranges of relative prices that may make society better or worse off from trade (Margolis and Shogren 2002). One challenge is that higher resource prices not only increase the gains to enforcement but also increase the return to evading enforcement.

Copeland and Taylor (2009) identify three additional factors that help determine whether improved incentives to manage resources will be sufficient to protect the resource and allow society to benefit from trade. One is the power of the regulator, which is necessary to effectively deter illegal harvesting at sufficiently low costs. A second is the ability of the resource to generate competitive returns without being extinguished, a precondition for sustainable management. A third concerns the magnitude of the open-access problem, and how much labor in the economy is available for harvesting, relative to what is sustainable. For economies with favorable conditions in these three areas, sufficiently high resource prices can facilitate good management regimes and gains from trade. However, for economies with serious challenges to enforcement, particularly those facing resources with slow replenishment rates, trade can do more harm than good.

Greater enforcement, however, may not be the only outcome of higher resource prices. Larger rents can also increase the return to special-interest lobbying and corruption, and more funds in government coffers can be used by officials to effectively buy political support through patronage and relieve pressure for better governance. For example, higher resource prices may result in increased lobbying for greater access and larger quotas, to the detriment of welfare and stock conservation (Bulte and Barbier 2005; Barbier et al. 2005). Rent-seeking as a result of trade-related windfalls in resource sectors can also have macroeconomic effects, since these nonproductive activities slow growth (Lane and Tornell 1999).

Quality of Institutions

Institutional quality—and its potential deterioration with trade—has been a major focus of the recent literature on the "resource curse," which posits that being endowed with abundant natural resources puts many countries on a poorer growth path. Most of these studies focus on exhaustible extractive resources such as oil and minerals (see Fischer 2007). The resource curse idea was initially substantiated empirically by Sachs and Warner (1995). However, recent evidence finds that the pathway for resources to become either a curse or a blessing is clearly associated with the quality of the institutions that interact with resource abundance, rather than with the resources themselves (e.g., Mehlum et al. 2006).

Nevertheless, the empirical question remains: how much does resource abundance actually weaken institutions? Some evidence has been found for a link between natural resource abundance and increased corruption (Leite and Weidmann 1999) or the risk of armed conflict (Collier and Hoeffler 2004). Some scholars make a distinction between dispersed resources and "point-source" resources—those that generate concentrated resource rents, like most nonrenewable resources and plantation farming. Revenues derived from point-source resources can be more easily collected and controlled. This reduces the need for taxes, which in turn gives civil society less incentive to demand accountability from government and provides government the means to mollify dissent, either by favors or by force. There is some econometric evidence for the theory that export concentration in

point-source resources (Isham et al. forthcoming) or in nonrenewable resources (Sala-i-Martin and Subramanian 2003) has a negative influence on institutional quality.

Of course, weak institutions could also make a country more dependent on such resources, so the direction of causality is not completely clear. Noting that institutional differences across countries precede resource discoveries, Boschini et al. (2004) find a low correlation between natural resources and institutional quality. Brunnschweiler and Bulte (2008) make the important point that the measure of resource abundance used in most studies—the share of resource exports in GDP—is actually a better measure of resource dependence, whereas resource abundance is better measured by resource stock values. They apply this distinction and find that resource dependence is determined in part by resource abundance, as well as constitutions and institutions. However, they also find that dependence does not seem to affect growth, while resource abundance positively affects growth and institutional quality.

Looking at timber resources in tropical countries, Ferreira (2004) finds that trade, as measured by relative resource abundance, has little direct effect on deforestation rates, but that trade does have strong effects in interaction with measures of institutional quality. In particular, trade openness increases deforestation when the provision of government services and bureaucratic quality is inefficient, indicating poor abilities to manage the resources. On the other hand, as contract observance and enforcement by government becomes more efficient, deforestation also increases with more trade. Thus, when there is only partial improvement in institutional quality, some institutional components may speed the exploitation of resources, while others may slow it down.

Success Stories

Thus, there appears to be a growing consensus that resources are a blessing after all, and that even dependence on resource exports need not be a curse if institutions are strong. Botswana, which has enjoyed rents from diamond mining, is often held up as a case in point, where prudent fiscal practices stabilized government spending and prioritized development (Barbier 2005; Fischer 2007). However, most of the literature addresses the higher-value mineral (nonrenewable) resources. For renewable resources, an important question is not only whether trade in resources confers economic benefits, but also how it affects the long-term sustainability of the stock. Malaysia is one success story in resource-based growth: it directed deforestation of tropical timber toward sustainable plantation-based timber and rubber, and it used resource rents to develop other industries through investments in capital and education (Barbier 2005).

Role of Ecology

For renewable resources, stock depletion is a function of not only economic and institutional variables, but also ecological variables. The biological growth rate, in particular, is an important factor, with low-growth species more likely to suffer unsustainable pressures from trade. The growth rate, in turn, is affected by the availability of habitat and ecological services, which, as we have seen, can also be affected by trade pressures. However, other characteristics of a species may create additional challenges for resource management under trade.

Migratory Species and Shared Resources

One such challenge is that whereas some resources (timber, for example) are largely stationary, others roam and migrate across jurisdictional borders. Fish is the main commercial example, but noncommodity wildlife such as birds, butterflies, and sea turtles also migrate. For migratory wildlife, the main challenge is the preservation of habitat across jurisdictions. However, for migratory commodities, multijurisdictional harvesting becomes an issue because when two countries share a common resource pool, they have incomplete incentives to manage their own harvest practices. This is a national version of the open-access problem, although countries harvesting large shares of a common resource are likely to want to engage in at least some regulation. Bulte and Damania (2005) show that without trade, the policies of two countries sharing a common resource pool tend to be "strategic substitutes." That is, if one country has lax controls and allows overfishing, the other country's harvests will decline and domestic prices will rise; but higher prices deter fishermen from exiting the industry, so the second country will respond with tighter controls on fishing to shift labor toward more productive activities. However, if trade liberalization leaves prices to be determined instead in foreign markets, the two countries' regulatory policies become "strategic complements," which means a loosening of regulations in one country could lead to a "race to the bottom," as other countries follow suit. However, a "race to the top" is also possible if one country leads by improving conservation, and Bulte and Damania (2005) identify a role for international agencies to facilitate such an outcome among small, open economies. In an example of coordination, Barrett (2003) emphasizes the role of side payments among countries to ensure participation in the Fur Seal Treaty. But Barbier (2000) cautions that reaching an agreement is likely to be more difficult when the resource threat is not merely overexploitation but rather habitat loss due to other economic forces.

Pest Species

Other characteristics of species may pose other types of challenges. Some species may be pests; for example, elephants are notorious for raiding and trampling crops and occasionally harming humans. Other resources, like forests, may provide complementary benefits, such as biodiversity. Private resource-harvesting decisions typically ignore these spillover costs and benefits. In these cases, the distortion from open-access regimes may improve matters, such as when overharvesting reduces the damages from pest species, or exacerbate the problem of insufficient biodiversity provision. Thus, spillovers add further ambiguity to the effects of trade on resource conservation (Horan and Bulte 2004).

Some pests are invasive alien species that actually arrive due to trade, which raises a controversial trade policy issue: that the optimal policy response to invasive pests will differ in stringency according to the country of origin, since organisms from similar climates are more likely to invade and spread (Costello et al. 2007). However, such a trade policy response would go against the "national treatment" mandate of the GATT, and although differential treatment might qualify under an exception, distinguishing between legitimate discrimination and protectionism can be rather difficult (Margolis et al. 2005). A less controversial issue is the fact that invasive species can substantially reduce the ecological productivity of native resources, at potentially great cost to the economy. In addition to undertaking control efforts, domestic resource managers must adjust harvesting activities to respond to infestations and also maintain habitat resilience against invaders by avoiding overharvesting. The appropriate

portfolio of trade inspections, control, restoration, and resource management in response to invasive species is a complex spatial and dynamic problem (Sanchirico et al. 2008). Although trade liberalization may result in increased volumes of trade that bring invaders, if trade induces changes in production away from the resource-dependent sectors, it may also reduce a country's susceptibility to damage from invasions (Costello and McAusland 2003).

Local versus Global Stocks

A final important ecological issue is whether we are concerned with resource stocks at a local or at a global level. Trade raises the relative prices of resources for some countries and lowers them for others. As a result, some countries will want to intensify resource exploitation, while others will want to decrease harvesting. If the resources and their associated benefits are similar, then the net effect on global stocks will be smaller than the country-specific effects. Although increases in incomes may increase harvesting overall, much of the effect of trade is to simply shift the location of harvesting activities (and their consequences) across countries. However, if the benefits associated with natural resources are quite different across countries, this shift in the location of harvesting activities can have more pronounced ecological consequences at the global level. For example, if the land types that serve as host for commodity production also serve as habitat for biodiversity, and there is a high degree of endemism (i.e., low overlap of species across countries), then trade-induced specialization that reduces the diversity of land uses in each country will cause a decline in global species conserved (Polasky et al. 2004).

Implications for Policy

The literature on trade and renewable resources is evolving rapidly. The discussion of the literature in the preceding section reveals that the impacts of trade liberalization on renewable resources can be many, complicated, and competing.

The presence of so many ambiguities makes it difficult to draw clear policy prescriptions for promoting trade and the conservation of natural resources since the optimal policies are highly situation (and resource) dependent. Perhaps the clearest recommendation that emerges from the literature review here is to support the improvement of resource management institutions and property rights in the resource-dependent countries that lack them, since these institutions are (in most cases) essential for those countries to truly benefit from trade. Management regimes that are global in scope also help reduce the pressures on certain stocks that arise from asymmetries in regulation.

However, until the ultimate goal of global management is reached, can we use trade-related measures to support conservation goals? The next two subsections discuss the role and effectiveness of two such trade-related measures: trade bans and trade certification (or "ecolabeling").

Trade Bans

The literature on trade bans is voluminous and mostly concerns the ivory trade. It begins in large part with Barbier et al. (1990). The following discussion attempts to identify a few points in this vast literature that are of particular relevance to trade in renewable resources.

One would expect international trade bans to have the opposite effect of trade liberalization. However, the preceding discussion has shown that the impacts of trade liberalization are highly ambiguous. An additional complicating factor is that even when there is a trade ban, trade usually continues, either in domestic or illegal markets. Thus, when evaluating trade bans, it is also important to capture the demand-side effects and the effects of the enforcement regime.

The goal of trade bans is usually to reduce harvesting pressures by lowering prices for the threatened wildlife products and thereby the return to poaching. As noted earlier, lower values can also reduce the return for communities or private property owners to protect the resource or its habitat (e.g., Barbier and Schulz 1997). However, even without the habitat concerns, the combination of illegal demand and enforcement policies can undo the planned effects of trade bans. For example, if illegal harvests are confiscated and removed from markets, the result of stricter enforcement is to simultaneously raise both the price (by restricting the supply) and the number of species poached for a given supply to reach the market. The possible net result of increased poaching has led some economists to recommend reselling confiscated products to satisfy demand and drive down prices (Bergstrom 1990; Heltberg 2001). Alternatively, in the case of storable goods like ivory or rhino horn, some economists have suggested stockpiling the confiscated goods with a threat to dump them on the market if prices get too high (Kremer and Morcom 2000; Brown and Layton 2001). There is the risk, however, that governments with such stockpiles—or for that matter, cartels—could see an incentive to hasten extinction, which would raise the value of their now-exhaustible resource (Bulte et al. 2003).

A well-publicized trade ban splits demand, removing the demand of law-abiding consumers and leaving only illegal demand. To achieve success on the demand side, then, requires encouraging law-abiding behavior, through measures such as ensuring the availability of substitutes to absorb the previous demand and ensuring the effectiveness of the social stigma against consuming products that may have been obtained illegally. A common fear expressed by environmental groups opposed to the sales of confiscated ivory is that the appearance of legal ivory on the markets will undo the stigma effect and unleash new demand that will raise the return to poaching. Fischer (2004) considers the effect of certified ivory sales when the two kinds of consumer demand are distinct—that is, some consumers are law-abiding while others are not. If the price of certified ivory is higher than illegal ivory, sales of certified ivory will satisfy legal markets and have no effect on the illegal market, which operates with the same price and incentives as before. If the price of certified ivory is not higher, then sales of certified ivory will help satisfy illegal markets, which should help drive down prices and poaching. However, if the two markets are linked, such as through smuggling and laundering operations, then the effect of legal sales on the social stigma of consuming ivory affects both markets. If legal sales raise the willingness to pay by law-abiding consumers, but it is difficult to distinguish legal products from illegally harvested ones, then large sales can exacerbate the poaching problem. However, sufficiently small sales can still have a primary effect of satisfying illegal demand while keeping law-abiding demand low.

A variant of the argument to offer limited legal sales is the proposal to legitimize captive breeding as a way to divert demand from illegal sources. In this case, supply-side issues may become a concern, because as long as customers remain, trade bans have the effect of creating black markets, in which the trade is usually concentrated in the hands of a

few criminal organizations. Damania and Bulte (2007) argue that the effectiveness of wildlife farming in deterring poaching depends on how the illegal traders respond to the competition. If they see reduced demand after captive-bred products become available, they might choose to maintain prices by restricting supply and limiting poaching; however, if they decide to compete aggressively, thereby reducing prices, then the effect will be to increase poaching levels.

Trade Certification

Certifying sales of sustainably harvested products (also known as ecolabeling) is more often used in lieu of a trade ban than as a complementary policy. Ecolabeling is growing in popularity, particularly for renewable resources, and has been applied to timber, fish, coffee, and other agricultural products and practices associated with biodiversity conservation. The goal of such programs is to offer market-based incentives for better resource management by leveraging consumer demand for products harvested from well-managed stocks. Case studies indicate that ecolabels can be successful at generating price premiums in many niche markets,[8] but few careful studies have been able to establish environmental or welfare benefits.[9] Thus skepticism remains about the effectiveness of such voluntary programs for resource management on a large scale.

Wood products may be the most commonly certified, with labels indicating compliance with standards for environmental or ecological purposes. Sedjo and Swallow (2002) caution that the overall market may not generate as large a price differential between labeled and unlabeled wood as is indicated by surveys of consumer demand alone.[10] That is because both supply and demand are diverted by the creation of a choice; as more suppliers choose to certify to pursue higher prices, fewer remain to supply the uncertified market, driving those prices up, while certified prices fall with expanding supplies. Furthermore, if a price differential does remain in the market—which must occur if there are any costs to certification and which provides an incentive to producers to incur them—it is quite possible that the introduction of voluntary labeling will leave noncertifying producers worse off. Fischer and Lyon (2009) show that multiple environmental labels—as exist for wood products, as well as coffee and other commodities—can benefit suppliers by offering them more choice, but can also undercut environmental objectives, as those meeting the stricter standard lose market share to competitors meeting a more lenient standard. Swallow and Sedjo (2000) consider market feedback effects, finding that as consumers respond to price changes, it is theoretically possible for certification to lead to a reallocation of land toward less ecologically sustainable uses, perhaps enough to diminish global biodiversity or sustainability of forest products.

A more fundamental limitation of certification programs involves the additional transaction costs (Barbier et al. 1994). For example, in the case of wood products, not only must

[8]Many studies use surveys of willingness to pay, but one example of a study based on empirical evidence is Nimon and Beghin (1999), who investigate the price premium for "organic cotton" and other environmental attributes of apparel.

[9]Gallastegui (2002) reviews the earlier literature. A more recent study is Hicks and Schnier (2008), who examine the impact of dolphin-safe ecolabeling on the spatial distribution of fishing effort.

[10]See Mattoo and Singh (1994) for a general analysis, Gudmundsson and Wessells (2000) for an application to fisheries labeling, and Larson (2003) for an analysis of a shade-grown coffee label.

sustainable management practices be monitored and certified, but those sources must be tracked throughout the international supply chain, from harvest to processing to the final end-use sale of complex products (e.g., furniture, particle board, doors) in consumer markets. These supply costs are often prohibitive, which limits the speed and extent to which global forest products can be certified. Siry et al. (2005) find that progress on global forest certification is encouraging but mixed: more than 40 percent of the world's forest area has management plans, although it is unlikely that all of these plans fulfill the consensus criteria for sustainable forest management. Although 12 percent of the world's forests are legislatively protected from harvest or exploitation, only 3 percent are certified by one of the major forest certification programs, and just 5 percent of the certified forests are in developing countries (van Kooten et al. 2005).

Ferraro et al. (2005) compare the use of price premiumsthrough ecolabeling with the use of payments to landowners that are tied directly to ecosystem protection. They find that payments for ecosystem services are likely to be more efficient as a conservation policy instrument because they target the goals much more directly. In terms of achieving rural welfare objectives, however, which policy is more efficient depends in part on how the funds available for direct payments to landowners compare to the magnitude of the price premiums. Ferraro et al. (2005) find that the price-premium approach is still likely to be more effective at achieving both conservation and development objectives than some alternatives, including the popular policy of subsidizing the cost of capital for ecofriendly commercial activities.

Conclusion

We have seen from the discussions here that trade liberalization can be a boon to resource-rich countries, but not always; that trade can lead to the depletion of natural resources, but not always; and that trade bans can be appropriate, and certified trade can be helpful—but not always. Although clear-cut answers to the question of whether trade helps or hinders the conservation of natural resources are few and far between, the growing trade and renewable resources literature has added economic rigor to the debate.

One clear lesson from the literature is that it is important to understand the full economic, ecological, and institutional context of the resource, or policies can indeed backfire. To aid policymakers, future research will need to expand efforts to model and empirically evaluate specific resource issues in their particular economic and ecological contexts, including the relevant forces influencing the provision of habitat.

Despite the ambiguities about the effects of trade on natural resource conservation, one common theme does emerge from the literature and from recent real-world experience: unless underlying secondary problems—particularly the lack of secure property rights and good governance—are addressed, trade is much less likely to be beneficial. Toward that end, the existing conservation-oriented international agreements, regardless of their approach to trade promotion or restriction, are all promoting capacity development for the management of resources, as well as improving monitoring and the collection and exchange of information. Even the WTO is recognizing a need to address the interactions between counterproductive trade policies and resource depletion, as evidenced by the current Doha round's attempt to tackle fisheries subsidies, which both distort trade and encourage overfishing. However, the

scale of these activities remains modest relative to the size of the global problems of resource depletion and species loss. Thus, the role of economic and interdisciplinary analysis of second-best resource management in the context of trade policies is likely to continue and expand.

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