BOSTON UNIVERSITY
Global Development Policy Center
Economics in Context Initiative

Trade and the Environment

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An ECI Teaching Module on Social and Environmental Issues in Economics

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NOTE – terms denoted in **bold face** are defined in the **KEY TERMS AND CONCEPTS** section at the end of the module.

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1. ENVIRONMENTAL IMPACTS OF TRADE

About thirty percent of global economic production is traded across national boundaries.[1] Recent policy changes in the United States, primarily the expanded tariffs put in place by the Trump administration, along with responses by other countries, have focused attention on the positive and negative impacts of international trade. Among these impacts is the relationship between trade and the environment. Economic theory can help us to understand the social and environmental implications of trade policy, addressing such questions as:

- Is trade good or bad for the environment? (See Box 1 for a discussion of how higher tariffs may impact action on global climate change.)
- How does trade affect exporting countries, importing countries, and the world as a whole?
- What policies and institutions address the environmental impacts associated with trade?

In this module we seek to answer these questions, ultimately considering how trade objective can become better aligned with sustainability goals.

International attention first focused on the relationship between trade and the environment in 1991, when the Mexican government challenged a U.S. law banning tuna imports from Mexico. The U.S. Marine Mammal Protection Act prohibited tuna-fishing methods that killed large numbers of dolphins and banned tuna imports from countries, including Mexico, that used such fishing methods. The Mexican government argued that the U.S. prohibition on Mexican tuna imports violated the rules of the **General Agreement on Tariffs and Trade (GATT)**.

Created in the 1940s, the GATT was an international agreement to reduce tariffs and other barriers to trade. The GATT was replaced in 1995 by the **World Trade Organization (WTO)**, which we will discuss in more detail later in the module. According to the free-trade principles listed in the GATT, and later in the WTO, countries could not restrict imports for environmental reasons except in limited cases such as protecting the health and safety of their own citizens. A GATT dispute panel ruled that the United States could not use domestic legislation to protect dolphins outside its own territorial limits, and thus could not prohibit imports of tuna from Mexico. Although Mexico did not press for enforcement of this decision, the tuna/dolphin decision opened a long-running controversy over issues of trade and environment.

General Agreement on Tariffs and Trade (GATT) a multilateral trade agreement providing a framework for the gradual elimination of tariffs and other barriers to trade; the predecessor to the World Trade Organization.
World Trade Organization (WTO) an international organization dedicated to the expansion of trade through lowering or eliminating tariffs and nontariff barriers to trade.

This debate has expanded to cover many international environmental issues, including forest protection, ozone depletion, hazardous wastes, plastics pollution, and global climate change. If individual countries are prohibited from using trade measures to protect the environment, as in the tuna/dolphin case, then international trade law seems to favor expansion of trade over

[1] Trade in goods and services, based on 2023 data from the World Bank's World Development Indicators database.

environmental quality. On the other hand, international agreements on trade can also be structured to promote environmental goals.

BOX 1: TARIFFS AND GLOBAL CLIMATE CHANGE

In April 2025 the Trump administration announced dramatically higher tariffs on nearly all trading partners, with many nations responding by raising tariffs on imports from the U.S. While the specific tariffs charged on various countries by the United States are in constant flux as of mid-2025, higher overall tariffs are likely to be a feature of international trade for a considerable time. What are the implications of higher tariffs for the environmental impacts of trade, specifically global climate change?

There are a couple of ways that higher tariffs may be beneficial for the climate.[2] First, tariffs are expected to reduce global economic growth, and reduced economic activity is generally associated with lower carbon emissions. Second, a reduction in merchandise trade volumes reduces the carbon emissions associated with transportation. However, most experts believe these effects are likely to be short-term and eventually offset by negative factors.

One issue is that a global transition to renewable energy and electric vehicles is highly dependent upon trade, particularly low-cost goods produced in China.[3] As tariffs raise the cost of Chinese exports, it is expected to slow the development of a low-carbon global economy. A global economic slowdown initiated by higher tariffs could also slow investment in low-carbon infrastructure and technologies. Another concern is that higher tariffs may pressure some countries to relax environmental standards in order to remain competitive.[4]

But as U.S. progress in reducing carbon emissions is expected to slow due to higher tariffs and a policy shift in favor of fossil fuels, most other countries remain committed to their climate goals. A retreat from climate action in the U.S. will create opportunities for other nations. According to Kingsmill Bond, an energy consultant. “The more the U.S. cuts itself off from the rest of the world, the more the rest of the world will get on with things and the U.S. will be left behind. This is a tragedy for the clean energy industry in the U.S., but for everyone else there are opportunities.”[5] Ultimately, Trump’s trade war will not prevent action on climate change and will primarily harm the U.S. Andreas Sieber, an associate director at 350.org, notes:

Trump’s tariffs won’t slow the global energy transition – they’ll only hurt ordinary people, particularly Americans. The transition to renewables is unstoppable, with or without him. His latest move does little to impact the booming clean energy market but will isolate the U.S. and drive up costs for American consumers.[6]

At the national level, the standard economic policy response to environmental impacts is to implement policies that internalize externalities. At the international level, however, the picture is more confusing. The burden of environmental externalities associated with trade may be

[2] McDermott, 2025.
[3] Ambrose, 2025.
[4] Gabbatiss, 2025.
[5] Ambrose, 2025.
[6] *Ibid.*

borne in both the importing and exporting countries, as well as other countries. The authority to formulate and enforce environmental policies often exists only at the national level. This can create significant problems when environmental impacts are transnational, because provisions for environmental protection in international trade agreements are often weak or nonexistent, as we'll discuss later in the module. To address these issues, we first turn to an examination of the basic economic theory relevant to the trade/environment nexus.

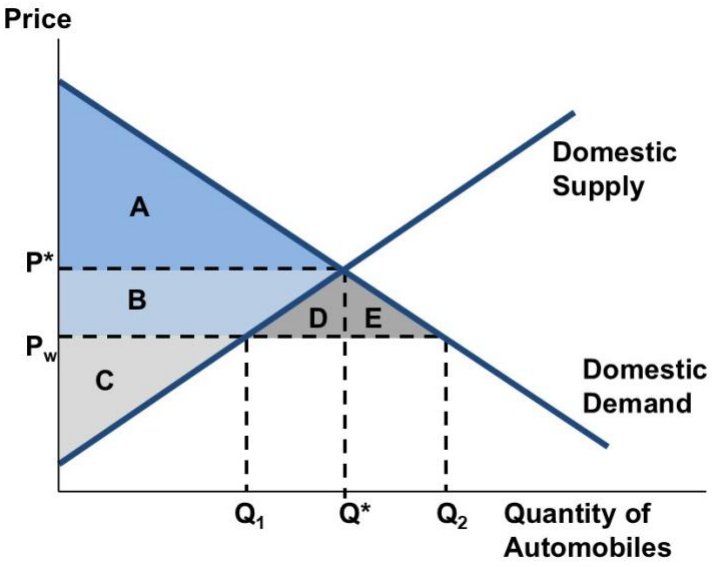
1.1 Comparative Advantage and Environmental Externalities

A basic principle of standard economic theory is that expanded trade is generally beneficial, promoting increased efficiency and greater wealth among trading countries. Known as the theory of **comparative advantage**, this analysis demonstrates that two trading countries will both gain by specializing in producing those goods and services that they can produce most efficiently and then trading with each other. The theory demonstrates that both countries will be able to achieve a consumption level that is unattainable without trade. But what if expanded trade causes environmental damage? How will this affect the analysis of costs and benefits from trade?

We can use economic **welfare analysis** to analyze the gains and losses associated with the environmental effects of trade. We start by introducing a graphical welfare analysis of trade without considering the environmental externalities created by producing and consuming goods and services. Consider Figure 1, which uses automobiles as an example of an imported good's welfare effects on consumers and producers.

comparative advantage the theory that trade benefits both parties by allowing each to specialize in the goods that it can produce with relative efficiency.
welfare analysis an economic tool that analyzes the total costs and benefits of alternative situations to different groups, such as producers and consumers

Figure 1. *Welfare Gains and Losses from Importing Automobiles*



In the absence of trade, domestic supply and demand would be in equilibrium at a quantity of Q^* and with a domestic price of P^*. We can obtain the total market welfare in this automobile market as the sum of the net benefits to consumers (i.e., **consumer surplus**) and the net benefits to producers (i.e., **producer surplus**). Consumer surplus would be area A and producer surplus would be areas (B + C); thus, total welfare without trade is (A + B + C).

consumer surplus the net benefit to a consumer from a purchase; equal to their maximum willingness to pay minus price.
producer surplus the net benefits of a market transaction to producers, equal to the selling price minus production costs (i.e., profits).

Now let's assume this country can trade and becomes an importer of some automobiles. With trade, both production and consumption of automobiles will change in this importing country. If there are no barriers to trade, automobiles can be imported at the world price P_w, which in this example is lower than the domestic market price for the good. (We assume that the country's demand is not large enough to affect the world price.[7]) With prices driven down to P_w by competition from relatively cheap imports, domestic producers are only willing to produce Q_1 automobiles. But at this lower price, the quantity of domestic demand increases to Q_2. The difference between Q_2 (demand) and Q_1 (domestic supply) indicates the quantity of imported automobiles. The resulting equilibrium is at a price of P_w and a quantity of Q_2.

How does trade affect domestic economic welfare? With a lower price and a higher quantity consumed, consumer surplus increases from area A without trade to (A + B + D + E). But domestic producer surplus decreases to area C, as domestic producers sell only Q_1 automobiles at a price of P_w. Total social welfare with trade is (A + B + C + D + E), larger than the previous social welfare without trade of (A + B + C). The net gain as a result of trade is the triangular area (D + E).

This example demonstrates the basic theory of comparative advantage, showing clear gains from trade. Note that these are overall gains to the country; some groups can lose from trade, such as domestic auto workers who may lose their jobs when the industry contracts. The theory of comparative advantage says only that overall gains are larger than losses.

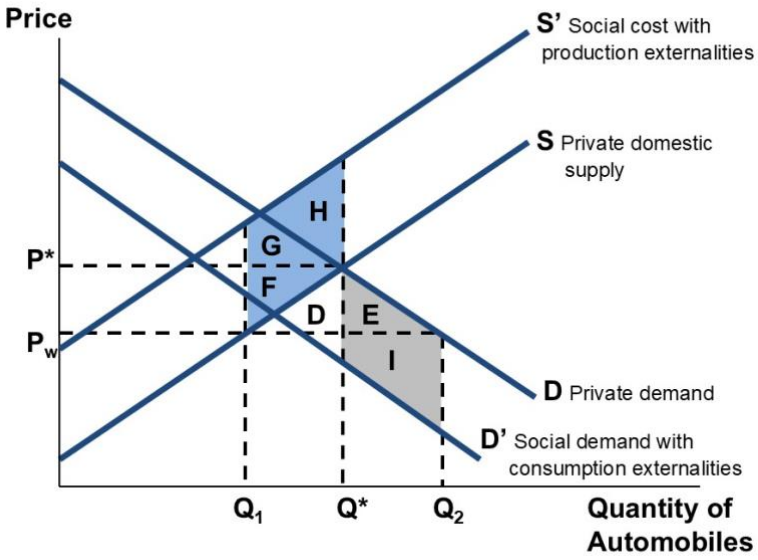
But this basic theory leaves out any **negative externalities** associated with trade. We can differentiate between **production externalities**, caused by automobile production, and **consumption externalities**, resulting from automobile use (e.g., burning gasoline) and eventual disposal.

negative externalities effects of a market transaction that have negative impacts on parties outside the transaction.
production externalities externalities associated with the production of a good or service, such as emissions of pollutants from a factory.
consumption externalities externalities associated with consumption of a good, such as pollutant emissions from vehicles.

[7] This example shows trade in a relatively small country whose demand has no significant effect on world price, so world price is shown as constant (technically, an infinitely elastic supply curve at *Pw*). For a country large enough to affect world price, the world supply curve would be shown as upward sloping.

Production externalities can be represented as an additional cost to the private supply curve. This is shown in Figure 2, with the social cost of supply given by *S'*. Note that the externalities associated with the production of the *imported* automobiles are not shown in this graph, as we are considering only welfare impacts in the importing country for now. (We will consider the environmental impacts associated with exporting in another example.)

Figure 2. *Welfare Impacts of Importing Automobiles with Externalities*



The welfare effects of a negative production externality can be represented by a parallelogram between *S* and *S'* up to the quantity of automobiles produced domestically. Prior to trade, this parallelogram would have extended up to *Q**. But with trade, and the resulting lower level of domestic production, the negative production externality only extends up to Q_1. Trade thus results in lower production externalities shown by areas (F + G + H)—the blue-shaded region in Figure 2. Thus, in addition to the gains from trade accruing to market participants, areas (D + E), the reduction in production externalities also provides a welfare gain.

But we also need to consider consumption externalities. The total quantity of automobiles sold increases from *Q** to Q_2 with trade. So, we will have more air pollution from burning gasoline, more oil runoff into streets, more highway congestion, increased carbon emissions, and more vehicles entering the waste flow once their useful life is over. These additional consumption externalities will, at least to some extent, offset the welfare gains from lower domestic production externalities.

To present consumption externalities in our graph, we first note that a demand curve represents the marginal benefits of consumers by showing how much they are willing to pay for different quantities of something. But with the presence of consumption externalities, the social benefits associated with automobile consumption are lessened. Just as we added production externalities as an additional social cost to the private supply curve, we can subtract consumption externalities from the private benefits to obtain the true social benefits of automobiles.

In Figure 2 we can subtract the consumption externalities from private demand to obtain curve *D'*—the social marginal benefits of automobile consumption, showing lower benefits than the unadjusted demand curve *D*. Consumption externalities would be represented by the parallelogram between *D* and *D'*, up to the quantity of automobiles consumed. Prior to trade, this parallelogram would have extended to Q^*. But after trade it extends further, to Q_2. The increase in consumption externalities as a result of trade is areas (E + I) in the graph—the gray-shaded region.

We can then assess the overall welfare effects of trade in this country, based on all three factors: the change in market benefits, the reduction in production externalities, and the increase in consumption externalities. The net welfare effects are:

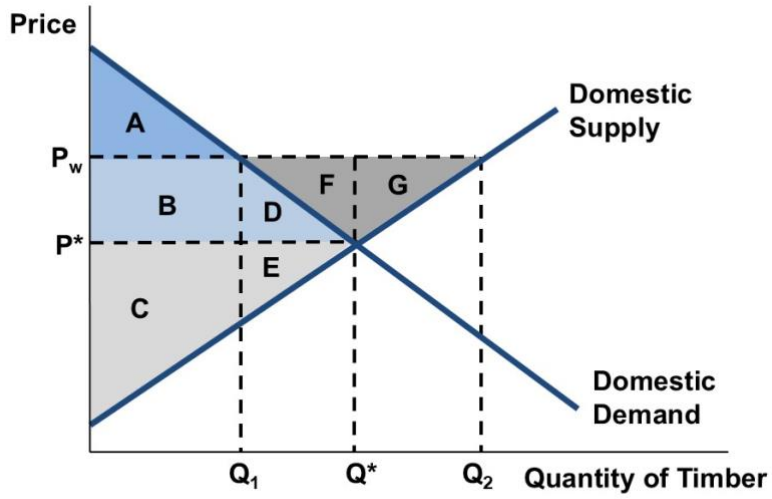
$$\begin{aligned} \textit{Net change in welfare} &= (D + E) + (F + G + H) - (E + I) \\ &= (D + F + G + H) - I \end{aligned}$$

Before we considered environmental externalities, welfare theory indicated that trade unambiguously provided overall net welfare gains in an importing country. Now, whether trade actually increases net welfare or not depends on whether (D + F + G + H) is greater than area I. The way we have drawn Figure 2, it appears that (D + F + G + H) is significantly greater than I, and trade results in net benefits even considering externalities. But this need not always be the case. In the case of automobiles, we might find that the consumption externalities per vehicle far exceed the production externalities. This would increase the size of area I relative to areas (F + G + H) and possibly result in trade lowering overall social welfare in the importing country.

1.2 Exports and Environmental Externalities

We now turn our attention to the welfare effects of trade on an exporting country. Again, we will start with a welfare analysis of trade in the absence of externalities and then consider how inclusion of environmental impacts changes social welfare. Here, we use timber exports as our example, as shown in Figure 3.

Figure 3. *Gains and Losses from Exporting Timber*

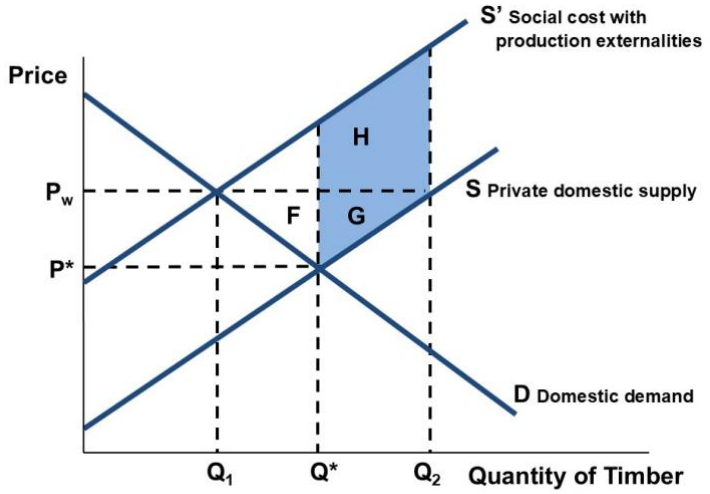


In the absence of trade, the domestic price of timber is P^* and the quantity of timber sold is Q^*. Consumer surplus is (A + B + D) and producer surplus is (C + E). Now suppose the country can export timber, and that the country can get a higher price for its timber on the world market. Given access to world markets and a higher price of P_w, timber suppliers in the country will raise their domestic price to P_w as well. In other words, suppliers will no longer be willing to sell to domestic consumers at the former domestic price of P^*, because they can export their timber at a price of P_w.[8]

Faced with a higher price, domestic consumers reduce their timber purchases to Q_1; consumer surplus thus declines to area A. At a price of P_w, suppliers are willing to sell a quantity of Q_2. The difference between Q_1 and Q_2 represents the amount of timber that is exported. As a result of greater sales at a higher price, producer surplus increases from (C + E) to (B + C + D + E + F + G). The gain in producer surplus (B + D + F + G) more than offsets the loss of domestic consumer surplus (B + D), for a net social gain of areas (F + G). Once again, the theory demonstrates overall gains from trade without considering environmental externalities. (And once again, there can be some losers from trade—in this case, domestic consumers).

As you might guess, the situation is not so unambiguous when we introduce the externalities of timber production—which could include land and watershed degradation as well as reductions in other use and nonuse values. These production externalities are shown in Figure 4, represented by the difference between the private supply curve and the social cost curve *S'*, which shows the production costs plus environmental externalities. Prior to trade, the production externalities of timber would have been a parallelogram between these two curves extending up to a quantity of Q^*. With trade and expanded production, these externalities extend further, up to Q_2. The increase in production externalities is area (G + H). There could also be changes in consumption externalities associated with lower domestic consumption of timber, but since these are probably much less significant than in the case of automobiles, we omit them from Figure 4.

Figure 4. *Welfare Impacts of Exporting Timber with Externalities*



[8] Similar to our analysis of an importing country, here we assume that the exporting country can sell all the timber they want at the prevailing world price.

Taking into account these environmental externalities, we cannot say unambiguously that there are net benefits from trade to this exporting country. Market benefits have increased by (F + G) but externalities have increased by (G + H). The net change in welfare is (F − H). If area F is greater than area H, then there will be a net social gain from trade; but if area H is greater than area F, there will be a net loss. As we've drawn Figure 4, there appears to be a net loss of welfare, implying that in this case the environmental damages from timber production outweigh the net market gains from trade. As with the earlier example of imports, whether there is a net benefit or loss for any specific export will depend on the size of the different market and external effects.

Our examples, of course, represent a very simple model of trade, but the conclusion that environmental costs may seriously affect net gains from trade is far-reaching. In the real world, countries trade trillions of dollars' worth of products. Where there are significant environmental externalities, trade will reallocate these externalities among countries and may increase externalities overall due to expanded production.

One implication of this analysis is that it may be possible to **export pollution** by importing goods whose production creates heavy environmental impacts, effectively shifting these emissions to other countries. It is often the case that pollution is exported from high-income to low-income countries, as we'll discuss later in the module. Trade also requires energy use for transportation, with resulting air pollution and other environmental consequences such as introduction of alien invasive species.[9]

exported emissions/pollution shifting the impacts of pollution to other countries by importing goods whose production involves large environmental impacts

Indirect effects of trade might also occur, for example when large-scale export agriculture displaces peasant farmers onto marginal lands such as hillsides and forest margins, leading to deforestation and soil erosion. Specific kinds of trade, such as trade in toxic wastes or endangered species, can have obvious negative environmental impacts.

Trade can also have some environmentally beneficial effects. Freer trade may help spread environmentally friendly technology. Trade tends to promote more efficient production, which reduces materials and energy use per unit of output. In addition, trading countries may come under pressure to improve environmental standards when product quality or trans-boundary impacts are at issue, such as pesticide residues on food or water pollution in rivers that cross national boundaries.

We sometimes hear trade debated as a conflict between those who are "pro-trade" and those who are "anti-trade." But international trade is an established part of modern economic life. The important question for our purposes is how we can balance the economic gains from trade against the reality that trade shifts environmental impacts, sometimes increasing and sometimes decreasing total external costs. (There is a similar debate about the social impacts of trade; we will not explore this in depth here, but the issues often overlap with those of environmental impacts.) To help us answer this question, we need to delve further into the current policy context of trade issues.

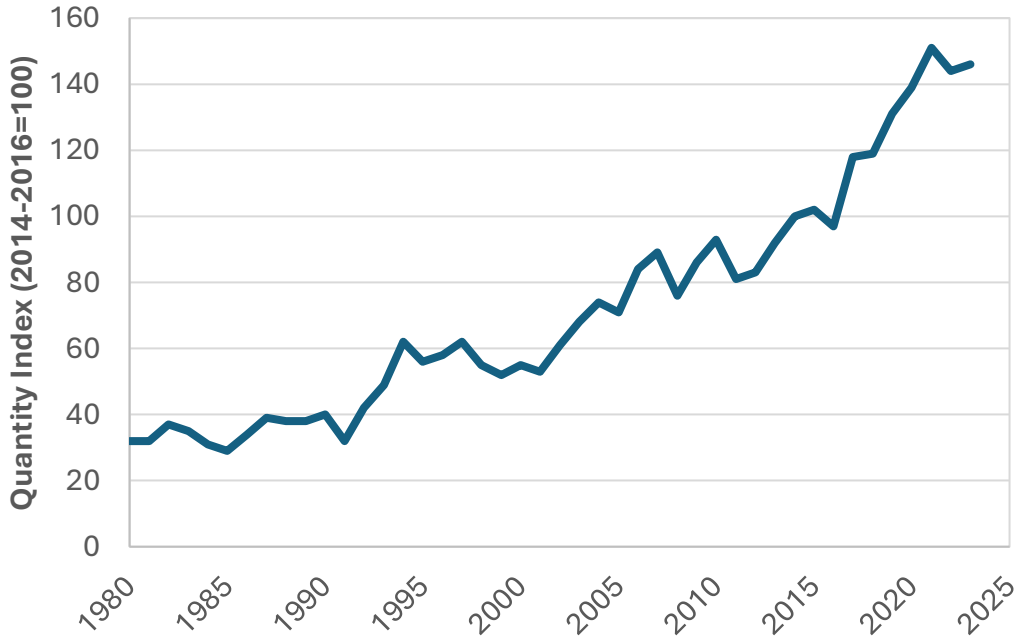
[9] See Hulme, 2021.

2. TRADE AND ENVIRONMENT: POLICY AND PRACTICE

Let us consider some practical examples of the environmental impacts of trade. Many lower-income countries grow agricultural crops for domestic sale as well as for export. As global trade has increased, such countries have devoted more land to growing export crops. We see in Figure 5 that the quantity of agricultural exports among countries classified as low-income food-deficit[10] by the Food and Agriculture Organization increased slightly from 1970 to 2000. These countries face widespread food insecurity and are also vulnerable to food supply shocks, such as price changes or natural disasters, that can put vulnerable populations at high nutritional risk. Despite these risks, we see that since 2000 the quantity of their food exports have increased by about a factor of about three.

In many cases, low-income countries increase agricultural exports due to structural adjustment policies required by international agencies such as the International Monetary Fund (IMF) and the World Bank. The goal of expanding exports is to bring more revenue and economic growth to the country. There is conflicting evidence regarding whether expanded agricultural exports promote economic growth in lower-income countries.[11] Even if agricultural exports increase economic growth, we need to consider the social and environmental costs to determine if such trade is actually beneficial for an exporting country.

Figure 5. *Agricultural Exports, Low-Income Food-Deficit Countries, 1980–2023*



Source: Food and Agriculture Organization, FAOSTAT database.

[10] Most low-income food-deficit countries are in Africa, as well as some in Asia and other regions. As of 2023 there were 44 such countries.
[11] See, for example: El Weriemmi and Bakari, 2024.

What are some of the environmental impacts of expanded agricultural exports? The expansion of export agriculture can lead to deforestation as tropical forests are cleared to grow crops such as coffee, palm oil trees, and soybeans, as well as create pasture to raise livestock for meat exports. This deforestation contributes to global climate change. A 2019 analysis found that the expansion of agriculture and tree plantations for exports is responsible for about 30–40% of all deforestation-related carbon emissions.[12] In addition to the loss of biodiversity and ecosystem services associated with deforestation, expansion of export crops often places greater demands on a country's water resources, as many export crops require intensive irrigation.[13]

Expansion of agricultural exports is also likely to increase a country's use of agricultural chemicals. A 2008 study found a significant positive relationship between a country's export-focused agricultural production and its use of fertilizers and pesticides. The paper concludes:

> [Traditional economic models] assume that free trade will allow market mechanisms to diminish environmentally degrading production practices and create a more resource efficient system of trade. Our results do not give compelling indications that this process is occurring in relation to trade in agricultural products and the use of fertilizer and pesticides … Our results at least suggest that the claim of international organizations, such as the WTO, that increasing export agriculture will benefit the welfare of national populations and the environment, should receive further scrutiny.[14]

A 2020 paper reviewed 43 studies of the relationship between agricultural trade and the environment, including local pollution and carbon emissions.[15] The authors found that 21 of those studies concluded that agricultural trade has a negative impact on the environment, 10 studies indicated that trade has a positive impact on the environment, and the other 12 studies suggested that the relationship was ambiguous or insignificant. Negative environmental impacts were most likely to occur in developing countries, while any positive impacts tended to benefit developed countries.

A 2022 article based on an analysis of 43 developing countries over 2002-2020 concluded that expanded agricultural exports increased environmental impacts, primarily emissions of carbon dioxide, methane, and nitrogen oxides.[16] The authors suggest that "policymakers, especially in developing countries, should consider the effects of agricultural products export, especially raw agricultural exports, on environmental conditions."

Importing countries can also experience negative environmental impacts. For example, a 2018 article found that countries that increase their reliance on imported soybeans tend to shift to crops that are more environmentally damaging, such as corn and rice that require more water and cause more water pollution.[17]

Social and environmental impacts often depend not on trade alone but on domestic political conditions. **Dualistic land ownership**, with large landowners wielding considerable political power and small farmers being displaced by export-oriented agriculture, can be doubly

[12] Pendrill *et al*., 2019.
[13] Schaeffer, 2009.
[14] Longo and York, 2008, p. 101.
[15] Balogh and Jámbor, 2020.
[16] Saghaian *et al*., 2022.
[17] Sun *et al*., 2018.

damaging to the environment. In Central America, for example, improved transportation and trade infrastructure led to:

> a technical shift to higher-profit, input-dependent farming. Maize and beans gave way to cotton, tomatoes, strawberries, and bananas. The value of farmland naturally increased, which benefited privileged landowning elites but led many poor farmers to be promptly evicted. These farmers had no choice but to move on to drier lands, forests, hillsides, or lands with shallow and less fertile soils. … [Affluent farmers] use their influence to demand environmentally damaging input subsidies, which in turn lead them to over-mechanize, over-irrigate, and overspray.[18]

dualistic land ownership an ownership pattern, common in developing countries, in which large landowners wield considerable power and small landowners tend to be displaced or forced onto inferior land.

Health and safety issues that arise from trade are not always easily resolved at either the domestic or international level. For example, domestic regulations that prohibit the sale of toxic pesticides may not apply internationally.

Goods that are restricted in domestic markets, on the grounds that they present a danger to human, animal or plant life or health, or to the environment, may often be legally exported. This may cause a problem for the importing country, where information is lacking on whether and why the product is banned: exporters may make false declarations, customs authorities (particularly in developing countries) may lack adequate product testing facilities.[19]

According to the **WTO's Article XX**, countries may restrict trade to "conserve exhaustible natural resources" or to protect "human, animal or plant life or health." Differing interpretations of this special exception to free trade rules have led to disputes among countries.

WTO's Article XX a World Trade Organization rule allowing countries to restrict trade in order to conserve exhaustible natural resources or to protect human, animal, or plant life or health.

For example, starting in the 1990s, European countries refused to allow imports of U.S. and Canadian beef produced with hormone supplements. The United States and Canada argued that since there is no proven harm to human health from beef hormones, this ban constituted an illegal barrier to trade. The Europeans, however, cited the **precautionary principle**: Because their consumers are concerned about the possible effects of hormones, shouldn't they have the prerogative to decide what they will allow for domestic consumption? The long-standing trade dispute was eventually settled in 2012, with an agreement that allowed the European Union to maintain its ban on imports of hormone-treated beef, in return for increasing its quota for imports of high-quality beef from the United States and Canada.[20]

[18] Paarlberg, 2000, p. 177.
[19] Brack, 1998, p. 7.
[20] European Parliament, 2012.

precautionary principle the view that policies should account for uncertainty by taking steps to avoid low-probability but catastrophic events.

2.1 Product and Process Issues

Trade disputes have also arisen over the use of genetically engineered crops. Although genetically engineered foods are allowed in the United States, they are widely opposed in Europe. Should European countries be able to ban the importation of genetically engineered foods? The issue has enormous implications both for agribusinesses that see great profit potential in genetic engineering and for many consumers who strongly oppose it.

The issue is further complicated because the opposition to genetic engineering is based in part not on human health effects (which, if proved, would be a valid reason for trade restrictions under Article XX) but on the likely environmental impacts of genetically engineered crops. Pollen from such crops can spread into the environment, disrupting fragile ecosystems, endangering neighboring organic farms, and possibly creating "superweeds" resistant to herbicides. But under WTO rules, the process by which a product is produced is not an acceptable cause for trade restrictions. Only if the product itself is harmful can a country impose controls. This is known as the **process and production methods (PPM)** rule.

For example, if dangerous pesticide residues are detected on fruit or vegetables, imports of those products can be banned. But if the overuse of pesticides is causing environmental damage in the producing areas, the importing country has no right to act, according to WTO rules. Similarly, if rainforests are being destroyed by unrestricted logging, it is not permissible for countries to impose a ban on the importation of unsustainably produced timber.

The PPM rule removes an important potential weapon for international environmental protection. If a country fails to act to protect its own environment, other countries have no trade leverage to promote better environmental practices. Only if a specific **multilateral environmental agreement (MEA)** is in place, such as the Convention on International Trade in Endangered Species (CITES), are import restrictions permissible.

This principle was at issue in the tuna/dolphin decision, in which trade authorities ruled that countries had no jurisdiction over extraterritorial environmental issues. But such issues are more and more common in an increasingly globalized world. Further, concerns have arisen of a **"race to the bottom"** in which countries reduce environmental and social standards in order to gain competitive advantage.

> Producers located in member states enforcing strict process standards will suffer a competitive disadvantage compared with producers located in member states enforcing less strict standards… [F]aced with the prospect of their industries suffering a competitive disadvantage when compared with companies located in low-standard jurisdictions, member states may choose not to elevate environmental standards or may even relax current standards.[21]

[21] Brack, 1998, p. 113.

process and production methods (PPMs) international trade rules stating that an importing country cannot use trade barriers or penalties against another country for failure to meet environmental or social standards related to the process of production.
multilateral environmental agreements (MEAs) international treaties between countries on environmental issues, such as the Convention on Trade in Endangered Species.
"race to the bottom" the tendency for countries to weaken national environmental standards to attract foreign businesses or to keep existing businesses from moving to other countries.

Based on a review of economic studies, a 2009 analysis concludes that there is little empirical evidence of a widespread environmental "race to the bottom" among competing nations.[22] But a 2023 paper studying Chinese corporations' international investments found evidence of "a race-to-the-bottom by privileging locations with looser green practices."[23] Even if countries don't specifically lower environmental standards to gain a competitive trade advantage, multinational companies may seek to produce their goods in countries with relatively lax environmental regulations to produce at lower cost. This can result in a **pollution haven** effect, where foreign investment and pollution shifts to countries with lower environmental standards.

pollution haven a country or region that attracts high-polluting industries due to low levels of environmental regulation.

Most empirical tests of the pollution haven hypothesis dating from the 1990s and early 2000s found little evidence that international trade levels in a country were related to the stringency of environmental regulations.[24] But more recent studies using more sophisticated statistical techniques provide supporting evidence, at least in some instances. For example, a 2015 paper found that stricter environmental regulations in surrounding countries will cause more foreign investment to flow into a particular country, as its environmental regulations appear comparatively weak.[25]

A 2020 article found that foreign investment in developing Asian countries "may lead to an increase in dirty investments in these countries," which should be prevented by appropriate environmental regulations.[26] A 2021 analysis of 40 countries considered where each step of a production process occurs, finding that "high-income countries offshore their emissions to low-income countries by outsourcing only the dirty production stages instead of the entire production process."[27]

Another concern is that competitive pressures may exert a "chilling" effect on countries considering strict environmental laws. The North American Free Trade Agreement (replaced by the United States–Mexico–Canada Agreement in 2020) produced cases in which corporations challenged environmental regulations as barriers to trade. In one case, Dow chemical corporation sued the province of Quebec to overturn a ban on certain pesticides produced by Dow. While Quebec was able to maintain the ban, the province had to acknowledge that the pesticides pose no significant risks when used properly. In another case, Ethyl Corporation (based in the United States) successfully overturned a Canadian ban on the importation and sale of the gasoline additive MMT, a chemical suspected of causing nerve

[22] Frankel, 2009.
[23] Ascani *et al.,* 2023.
[24] Kellog, 2006.
[25] Tang, 2015.
[26] Guzel and Okumus, 2020.
[27] Duan, *et al*., 2021.

damage. Canada was required not only to eliminate the ban but also to pay $13 million to compensate Ethyl Corporation for legal costs and lost sales.[28]

Trade agreements can provide fossil-fuel companies with a powerful tool to prevent action on climate change, as they can argue that overly strict environmental regulations unfairly reduce their profits. A potential solution to this problem is to clarify that international environmental agreements, such as the 2015 Paris Climate Agreement, take precedence over existing trade agreements.[29]

2.2 Environmentally Beneficial Effects of Trade

Trade expansion may also have beneficial effects on the environment. According to comparative advantage theory, trade causes countries to become more efficient in their use of resources, thereby conserving resources and avoiding waste. Trade liberalization may also remove **distortionary subsidies**, improving the efficiency of resource allocation. For example, widespread subsidies on chemical fertilizers and pesticides promote environmentally harmful farming methods, but trade agreements often prohibit such subsidies to domestic producers. Eliminating these subsidies would promote both economic efficiency and environmental sustainability.

distortionary subsidies subsidies that alter the market equilibrium in ways that are harmful to economic efficiency.

Trade may also encourage the spread of environmentally friendly technology. In energy production, for example, many lower-income depend heavily on older highly-polluting power plants. Trade can facilitate the replacement of these plants with modern efficient facilities and renewable energy. Multinational companies, often seen as exploiting the natural resources of lower-income countries, can also introduce efficient technologies in industrial sectors. Multinationals may respond to domestic political pressures to develop cleaner industrial processes and then disseminate those processes throughout their worldwide operations.[30] Foreign investment in the manufacturing sector is particularly likely to result in the replacement of older technologies and equipment with newer production methods that are less resource- and pollution-intensive.[31]

2.3 Trade and Global Climate Change

Trade has important effects on emissions of carbon dioxide and other gases that contribute to global climate change. Increased transportation resulting from expanded trade results in higher transport-related emissions. Trade also shifts the pattern of carbon emissions, with a significant amount of exported pollution—carbon emissions associated with consumption of imported goods.

Until recently, increased economic activity in a country was generally associated with higher environmental impacts, such as higher CO_2 emissions. **Decoupling** refers to breaking this linkage between economic activity and environmental impacts. We see evidence of decoupling

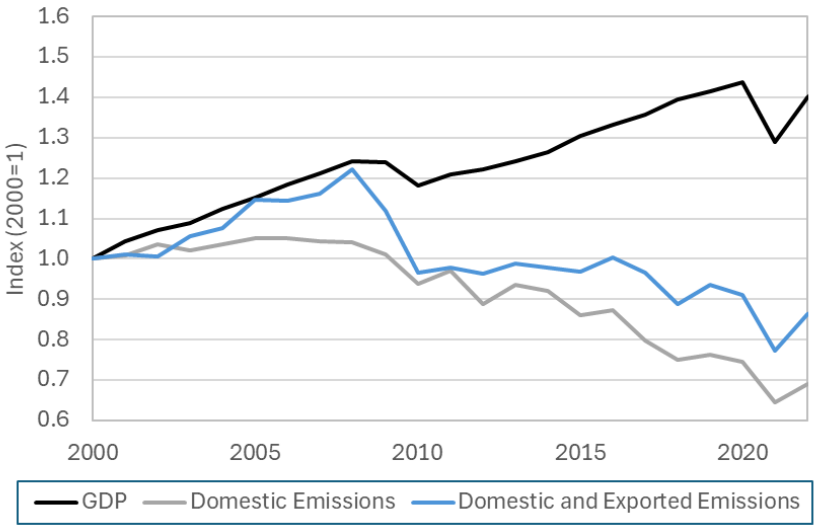
[28]Global Affairs Canada, "NAFTA – Chapter 11– Investment." https://www.international.gc.ca/trade-agreements-accords-commerciaux/topics-domaines/disp-diff/ethyl.aspx?lang=eng.
[29] Tienhaara, 2017.
[30] Zarsky, 2004.
[31] Neumayer, 2001.

in the United Kingdom in Figure 6. Through most of the 2000s GDP in the UK increased while domestic carbon emissions, considering only carbon emissions emitted within the UK, remained relatively steady. But while GDP continued to increase after 2010, domestic carbon emissions fell significantly. Between 2000 and 2022, GDP in the UK increased by 47% while domestic emissions fell by 32%—indicating the country had clearly decoupled economic growth from its carbon emissions.

decoupling breaking the correlation between increased economic activity and similar increases in environmental impacts.

But we also need to account for the UK's exported emissions—those emissions "embedded" in goods imported into the UK. If we include the UK's exported CO_2 emissions, we see in Figure 6 that the UK's decoupling is not nearly as dramatic. From 2000 to 2008, the UK's GDP and total CO_2 emissions (including domestic and exported emissions) grew at similar rates. While domestic emissions fell by 32% between 2000 and 2022, total emissions only fell by about 10%—still indicating decoupling but only slightly. In 2022 over 60% of the emissions associated with consumption in the UK were a result of emissions embedded in the UK's imports. Estimates of where the UK's exported emissions are generated show that they originate all over the world, with 17% originating in other European countries, 21% originating in China, and 6% in the United States.

Figure 6. *United Kingdom GDP and Domestic and Exported Carbon Emissions, 2000-2022*



Sources: GDP from World Bank, World Development Indicators database; emissions from UK Department for Environment, Food, and Rural Affairs, "Carbon Footprint for the UK and England to 2022."

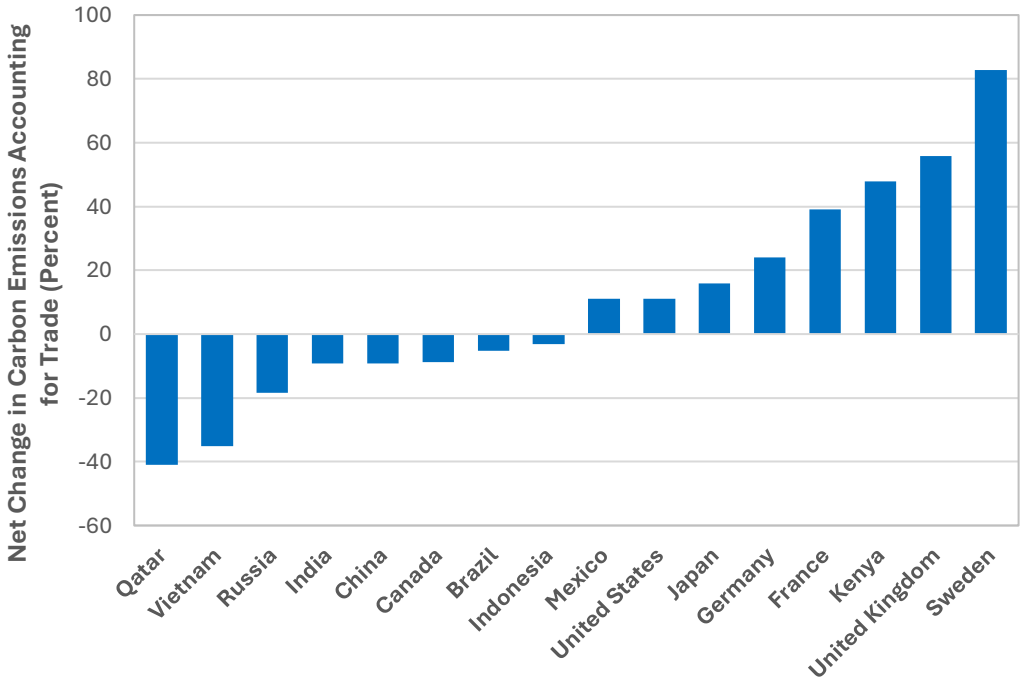
Some countries, such as the UK, are net exporters of carbon emissions, meaning that when both exported and imported goods are considered, the country is responsible for more emissions than its domestic statistics indicate. Other countries, such as China, are net importers of carbon emissions, meaning that demand in those countries is not responsible for as much emissions as official statistics indicate—a significant portion of emissions result from production for export.

Figure 7 shows the results of carbon emissions embedded in trade for select countries for 2022. For example, Qatar's emissions would decline by over 40% because a large part of its emissions are the result of demand for exported goods (mainly oil and gas) by other countries. In addition to Qatar, we see that Vietnam, Russia, India, China, Canada, Brazil, Indonesia are net importers of carbon emissions (those countries with negative values). In addition to the UK, countries that are net exporters of carbon emissions include Mexico, the United States, Japan, Germany, France, Kenya, and Sweden. Carbon emissions in Sweden—a country often praised for its environmental record—would increase by 83 percent if we accounted for its exported emissions.

These results have important implications for international negotiations on global climate change. A reasonable point is that those who consume goods, not those who produce them, have the responsibility to reduce emissions.[32] The 2015 Paris Climate Agreement, however, adopted the traditional approach to measuring emissions, considering only where the emissions are generated. An alternative would be to hold net carbon exporters responsible for emissions linked to their consumption of goods produced elsewhere. This could be done by measuring the **carbon footprint** of a country, taking into account emissions associated with both domestically produced and imported goods.

carbon footprint total carbon emissions, direct and indirect, resulting from the consumption of a nation, institution, or individual.

Figure 7. *Accounting for Carbon Emissions Embedded in Trade, 2022*



Source: Our World in Data, "Share of CO_2 Emissions Embedded in Trade," with data from the Global Carbon Budget.

[32] Davis and Caldeira, 2010.

3. TRADE AGREEMENTS AND THE ENVIRONMENT

A variety of institutional and policy approaches have been suggested to balance the goals of trade benefits and environmental protection, some similar to the standard free-trade model and others significantly different. We examine several of them.

3.1 The World Trade Organization Approach

The overarching policy goal of free or "liberalized" trade has been pursued for more than seven decades through "rounds" of trade agreements under the GATT and its successor, the WTO. The WTO, whose membership now comprises 166 countries responsible for over 98% of world trade, has generally worked to lower tariffs (taxes imposed on traded goods) and nontariff barriers to trade, as well as reduce subsidies for export industries.

Although the WTO recognizes a special exception to trade rules under Article XX for resource conservation and environmental protection, its rulings have interpreted this fairly narrowly. WTO authorities tend to be suspicious of "**green protectionism**"—the use of trade barriers to protect domestic industry from competition under the guise of environmental regulation. They have also been unsympathetic to countries' efforts to affect environmental policy outside their borders through trade measures.

green protectionism the use of trade barriers to protect domestic industry from competition under the guise of environmental regulation

The WTO has established a Committee on Trade and the Environment, which has addressed some environmental concerns but in rather general terms. While the committee "was created to make sure that trade and environmental policies are mutually supportive,"[33] critics contend that it has produced only "weak policy outcomes" and will continue to do so until environmental concerns become fully integrated into the WTO's mission.[34]

From the WTO perspective, environmental policy responsibility should remain primarily at the national level. Their position is that "while there is no specific agreement dealing with the environment, under WTO rules members can adopt trade-related measures aimed at protecting the environment provided a number of conditions to avoid the misuse of such measures for protectionist ends are fulfilled."[35] This is consistent with an economic principle known as the **specificity rule**: policy solutions should directly target the source of the problem. In this view, using trade measures to accomplish environmental policy goals may not be the most direct approach and can cause unintended effects such as economic losses from trade restriction.

specificity rule the view that policy solutions should be targeted directly at the source of a problem.

This argument, which places the responsibility for environmental policies on national governments, has been criticized on several grounds. It fails to consider the competitive

[33] World Trade Organization, 2020, p. 14.
[34] Gabler, 2010.
[35] World Trade Organization, "Trade and Environment." https://www.wto.org/english/tratop_e/envir_e/envir_e.htm

pressures that may encourage trading countries to reduce environmental protections, as well as the weak regulatory institutions in many countries. It is also inadequate for dealing with global environmental issues, such as climate change and biodiversity, that transcend national boundaries. We discuss potential WTO reforms at the end of the module.

3.2 The NAFTA/USMCA Approach

The North American Free Trade Agreement (NAFTA) of 1993 lowered trade barriers across North America. During negotiations, environmental groups argued strongly that freer trade could have negative environmental consequences, pointing to the severe environmental problems already affecting the maquiladoras, which are industrial zones along the Mexican border in which materials and equipment can be imported duty-free for assembly and re-export. As a result, the treaty included the creation of the Commission for Environmental Cooperation (CEC) to "strengthen cooperation between the Parties to conserve, protect, and enhance the environment and address environmental challenges and priorities," and strengthen environmental regulation,[36]

Although this specific recognition of environmental issues persuaded some environmental groups in the United States to support the agreement, the CEC has had few enforcement powers. It may respond to a country's failure to enforce existing environmental regulations, but its role is generally limited to producing a fact-finding report and offering recommendations to the government involved.

The United States–Mexico–Canada Agreement (USMCA), which was signed in 2018 and went into effect in 2020, replaced NAFTA. The USMCA includes a chapter (Chapter 24) addressing environmental issues, and it maintained the CEC. In some ways the USMCA strengthens the environmental provisions of NAFTA, addressing 30 additional environmental issues such as plastic pollution, wildlife trafficking, genetic resources, and contaminated lands.[37] The USMCA also added a prohibition of fishery subsidies that encourage overfishing and a recognition of the importance of biodiversity for indigenous peoples.[38] Another important change is that the USMCA makes it more difficult for foreign corporations to challenge national environmental laws under a revised investor-state dispute settlement clause.[39] While the USMCA affirms each country's commitment to several international environmental agreements, it specifically leaves out any mention of climate change and the Paris Climate Agreement. Another significant omission is that it fails to address fossil-fuel subsidies.

3.3 The European Union Approach

The European Union (EU) is unusual in being a free-trade area with its own legislative and administrative institutions. Unlike the North American CEC, the EU has the power to make environmental regulations binding on its member countries. This is known as **harmonization of environmental standards**. Note, however, that this policy solution involves more than free trade; it entails a supranational authority with the power to set environmental standards.

harmonization of environmental standards the standardization of environmental standards across countries, as in the European Union.

[36] www.cec.org/about/agreement-on-environmental-cooperation/.
[37] Laurens *et al*., 2019.
[38] Vaughn, 2018; Simeu, 2020.
[39] Bernasconi, 2018.

Regional trade area policies also raise the issue of "harmonizing up" versus "harmonizing down." Some countries are forced to tighten their environmental policies to meet EU standards. But others find their environmental standards weakened. The EU overturned a law requiring returnable bottles in Denmark as a barrier to trade, and Norway chose not to join the EU in part out of fear that it would be compelled to modify strict domestic environmental regulations.

It is relatively rare for trade agreements to include the kind of enforceable supranational environmental regulations that exist in the EU. Although the Standards Code adopted after the Uruguay Round of GATT trade negotiations in 1992 calls for international harmonization of environmental standards, no basis exists for this process to be other than voluntary.

Following Britain's exit from the European Union in 2020 ("Brexit"), UK and EU researchers have identified a risk of "environmental regression in the UK: there are around 500 separate items of EU environmental law and policy which risk not being retained after Brexit, producing a gap in environmental protection."[40]

3.4 Multilateral Environmental Agreements (MEAs)

Some environmental problems linked to trade require international solutions. The first international treaty dealing with trade and the environment was the Phylloxera agreement of 1878 among several European countries, restricting trade in grapevines to prevent the spread of pests that damage vineyards. In 1906 an international convention was adopted banning the use of phosphorus in matches. Phosphorous was responsible for serious disease among match workers, but it was the cheapest ingredient for matches. An international convention was required to prevent any exporting country from gaining a competitive advantage by using phosphorus in match production.[41]

Since then, numerous international treaties have responded to specific environmental issues, such as conventions protecting fur seals, migratory birds, polar bears, whales, and endangered species. Transboundary and global environmental issues have been addressed in treaties such as the Convention on International Trade in Endangered Species (1975), the Montreal Protocol on Substances that Deplete the Ozone Layer (1987), the Basel Convention on Hazardous Wastes (1989), the Antarctica Treaty (1991), the Convention on Biological Diversity (1993), the Convention on Straddling and Highly Migratory Fish Stocks (1995), the Minamata Convention on Mercury (2013), and the Paris Climate Agreement (2015).

Questions remain, however, about the compatibility of MEAs with WTO rules. Which set of international agreements should take precedence in case of a conflict? For example, the Paris Climate Agreement encourages the transfer of energy-efficient technology to low-income countries—but this provision could violate the WTO's prohibition of export subsidies. (For more on potential conflicts between the Paris Climate Agreement and trade deals, see Box 2.) While national laws such as the U.S. Marine Mammal Protection Act have been found incompatible with WTO rules, so far no major test case has addressed a conflict between an MEA and a trade agreement. But some analysts have argued that the possibility of a conflict with WTO rules has a "chilling" effect on the ability of MEAs to achieve their objectives.[42]

[40] Olivieri, 2020.
[41] Charnovitz, 1996.
[42] Gallagher, 2009.

4. STRATEGIES FOR SUSTAINABLE TRADE

Global trade has increased over the last several decades, from about 12% of global economic production in 1960 to 20% in 1990 and 30% in 2023.[43] Global trade volumes are expected to continue increasing in the future, although at a slower rate than in the past due to recent tariff increases.[44] Expanded global trade can bring benefits in terms of increased efficiency, technology transfer, and the import and export of sustainably produced products. But we must also evaluate the effects of trade in terms of social and ecological impacts, which can lead to conflicts between economic and environmental policy objectives.

BOX 2: THE PARIS CLIMATE AGREEMENT AND THE TRADE IN SERVICES AGREEMENT

Most of the public debates about trade focus on trade in goods, including agricultural products, fuels, manufactured products, and raw materials. But according to the WTO, about 22% of global trade is exports of commercial services, and this percentage has been increasing in recent years.[45] Major categories of services traded internationally include transportation, financial services, communication, and business services.

In 2013 negotiations started between 23 parties, including the European Union, Mexico, and the United States, to draft a treaty known as the Trade in Services Agreement (TISA).[46] The negotiation process for TISA has been criticized for its high degree of secrecy, though a leaked draft of an "Energy Services Proposal" indicated that the TISA signatories would need to agree to "energy neutrality." This means that the member parties would not be allowed to create "market distortions" favoring renewable energy over fossil fuels.[47]

The 2015 Paris Climate Agreement calls for policies that make "finance flows consistent with a pathway to low greenhouse gas emissions," implying the need for economic policies such as subsidies that would favor renewable energy. Susan Cohen Jehoram, a spokeswoman for Greenpeace, responded to the release of the Energy Services Proposal by noting that:

> If we want to reach [the Paris Climate target], governments will need a toolbox of measures that can give incentives to cleaner energy. TISA … would increase the power of multinationals to prevent governments taking desperately needed measures to decrease CO_2 levels.[48]

As of 2025, TISA had still not been agreed on or signed, and its prospects seemed poor, with negotiations stalled.

[43] Data from World Bank, World Development Indicators database.
[44] WTO, 2025.
[45] WTO, 2023.
[46] Office of the United States Trade Representative. https://ustr.gov/TiSA
[47] Neslen, 2016.
[48] *Ibid.*

The complexity of the international policy framework governing trade and environmental issues means that confusion often arises over which laws take precedence, or which organization has authority. These conflicts can be reduced if future trade agreements take environmental sustainability more explicitly into account. Introducing sustainability into trade policy will require institutional changes at global, regional, and local levels.

4.1 Proposals for a World Environmental Organization

At the global level, advocates of institutional reform have proposed setting up a **World Environmental Organization (WEO)** that would counterbalance the WTO much as national environmental protection agencies balance departments of finance and commerce.[49]As a 2018 article explains:

> It is time that leadership emerges in the form of a global governance mechanism to assure a healthy global environment now and into the future. A well-structured and empowered World Environment Organization can provide such governance. The tragedy of the global environmental commons is happening, but it is not inevitable. It will take resolve, effort, and sacrifice to avert the full tragedy by heeding the clear scientific and moral callings to protect the environment through establishing a WEO to govern the Earth's resources and environmental commons.[50]

World Environmental Organization (WEO) a proposed international organization that would have oversight of global environmental issues.

A WEO could, for example, play a role in negotiating trade agreements on agricultural subsidies, seeking to redirect farm subsidies to soil conservation and development of low-input agricultural techniques. It could also provide greater leverage to phase out fossil-fuel subsidies. As a response to global climate change, energy sector trade may need to accommodate a carbon tax or tradable permit scheme. Global agreements on forest and biodiversity preservation are also likely to involve specific trade restrictions, tariff preferences, or labeling systems. In all these areas, a powerful institutional advocate for environmental interests would have a major impact on the shaping of trade treaties and regulations.

4.2 "Greening" Existing Institutions

Given that the creation of a WEO is currently unlikely, another approach would be to "green" existing institutions. With appropriate reforms, the WTO could emerge as "our best bet for building a global green economy."[51] These potential reforms include:

- Establishing a framework for equitably phasing out fossil fuels, considering the different contexts of richer and poorer countries.
- Establishing standards for accounting for carbon emissions embedded in trade.
- Boosting trade in goods and services essential for low-carbon production.

[49] Biermann and Bauer, 2005.
[50] Rabb and Ogorzalek, 2018, p. 34.
[51] Botwright, 2024.

- Developing standard environmental protection provisions for bilateral and multilateral trade treaties.
- Expanding the environmental and social provisions of WTO Article XX.

Other international organizations, such as the World Bank and IMF, could also be reformed to emphasize sustainable trade objectives. With these institutional reforms, trade agreements could become a powerful tool for harmonizing environmental standards upward. It is also important that national and local governments have the capacity to institute environmental regulations that go beyond international standards. While clearly protectionist policies could still be prohibited, such flexibility would address concerns about downward harmonization.

It is evident that there are many different approaches to reconciling the goals of trade and environment policy. An article reviewing the debate on trade and environment concludes that:

> there is no real choice about whether to address the trade and environment linkage; this linkage is a matter of fact … Building environmental sensitivity into the trade regime in a thoughtful and systematic fashion should therefore be of interest to the trade community as well as environmental advocates.[52]

Achieving this goal will be a major challenge for trade negotiators at both the regional and global levels for the foreseeable future.

5. SUMMARY

International trade has environmental implications. While the theory of comparative advantage indicates that trade provides economic benefits to trading partners, trade may not make a country better off once environmental impacts are considered.

Trade has both positive and negative impacts on the environment. Expanded agricultural trade has increased deforestation and the use of chemical fertilizers and pesticides. Foreign investment motivated by trade can expand polluting industries. Transportation associated with trade increases greenhouse gas emissions. Positive impacts of trade on the environment can include increased access to environmentally friendly technologies and the phaseout of distortionary subsidies in trade agreements.

International trade agreements make provisions for resource conservation and environmental protection, but these are usually limited exceptions to a general principle of free trade. In the World Trade Organization (WTO), countries may consider the environmental impact of a product's consumption but not of its production processes. This has led to numerous trade disputes over whether specific measures are justified on the grounds of protection of life and health or are simply disguised protectionism.

Policy responses to trade and environment issues can occur at the national, regional, or global level. The European Union is an example of a free-trade area that includes institutions for transnational environmental standards enforcement. The United States–Mexico–Canada Agreement (USMCA) incorporates several beneficial environmental provisions but omits any

[52] Esty, 2001, pp. 114, 126–127.

discussion of climate change. In addition to ideas for greening existing international trade organizations, proposals have been made for a World Environmental Organization to oversee global environmental policy and to advocate for environmental interests in the world trade system.

6. DISCUSSION QUESTIONS

1. What are the welfare implications of trade in toxic wastes? Should such trade be banned, or can it serve a useful function? Who should have the power to regulate trade in toxic wastes: individual countries, local communities, or a global authority?
2. Can harmonization of environmental standards solve the problem of environmental externalities in trade? How would the issues of harmonization differ in the USMCA, the EU, and the WTO? Would harmonization promote economic efficiency as well as environmental improvement, or might it lead to lower environmental standards?
3. What should be done if the provisions of a Multilateral Environmental Agreement conflict with the principles of the WTO? Which should take precedence, and who should have the authority to decide? Which economic, social, and ecological principles should be used to decide such issues? What specific issues regarding trade are associated with international climate agreements?

7. KEY TERMS AND CONCEPTS

carbon footprint
comparative advantage
consumer surplus
consumption externalities
decoupling
distortionary subsidies
dualistic land ownership
exported emissions/pollution
General Agreement on Tariffs and Trade (GATT)
green protectionism
harmonization of environmental standards
multilateral environmental agreements (MEAs)
negative externalities
pollution haven
precautionary principle
process and production methods (PPMs)
production externalities
“race to the bottom”
specificity rule
welfare analysis
World Environmental Organization (WEO)
World Trade Organization (WTO)
WTO’s Article XX

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1. **https://www.wto.org/english/tratop_e/envir_e/envir_e.htm.** The World Trade Organization's website devoted to the relationship between international trade issues and environmental quality. The site includes links to many research reports and other information.

2. **https://www.cec.org.** Homepage for the Commission on Environmental Cooperation, which operates under the United States–Mexico–Canada Agreement "to address regional environmental concerns, help prevent potential trade and environmental conflicts, and to promote the effective enforcement of environmental law." The site includes numerous publications on issues of trade and the environment in North America.

3. **https://www.oecd.org/en/topics/trade-and-environmental-sustainability.html.** The website for the trade and environment division of the Organization for Economic Cooperation and Development, including many publications dealing with trade and environmental policy.

4. **https://www.iisd.org/articles/trade-and-environment.** The International Institute for Sustainable Development's webpage on "Trade and the Environment: The Search for Sustainable Solutions"

5. **https://www.fairtradefederation.org**. Homepage for the Fair Trade Federation, an organization dedicated to promoting socially and ecologically sustainable trade.