RESEARCH HIGHLIGHTS

Optimal Unilateral Carbon Policy

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What is the optimal regional carbon policy when other regions have different or no carbon policy?

Context

With climate change, it doesn't matter where carbon emissions originate, the harm is global. As such, the ideal policy is a globally-harmonized carbon price. Global negotiations, however, have given up trying to achieve a uniform approach. Without harmonization, different carbon policies distort economic activity, potentially causing energy-intensive industries—and their emissions—to shift to countries with low or no emissions policies, an effect known as leakage. Leakage threatens to make carbon policies ineffective and makes it difficult to enact stringent policies because of fears of runaway industries. Unless concerns about leakage are addressed, it may be difficult to achieve significant reductions in global emissions.

The most common response to leakage is the carbon border adjustment: a tariff on the energy-content of imports and a corresponding rebate of prior carbon taxes paid on exports. The European Union is considering a carbon border adjustment to reduce leakage caused by its Emissions Trading System, and every major proposed carbon price in the United States includes a similar mechanism. Studies of carbon border adjustments, however, show that they are only modestly effective at reducing leakage. Moreover, carbon border adjustments are complex to impose and are likely to be highly inaccurate and subject to avoidance.

Methods

To better understand the design of regional carbon policies, this study uses a simple model of trade and climate change. The model captures the key features of regional carbon policies, including their effect on leakage and trade. At the same time, the model can be solved analytically, allowing the authors to find the optimal set of policies for any given region and compare the optimal policy to standard carbon prices or those prices combined with carbon border adjustments.

The model simplifies the world by dividing it into two regions: Home, which imposes a carbon policy, and Foreign, which does not. Each region extracts energy, produces goods (using energy and labor) and services (using labor), and consumes goods and services. Energy trade establishes a law of one price, absent taxes. Trade of goods is determined by comparative advantage and is limited by trade costs. Foreign responds to Home's carbon policy by adjusting its extraction, production, and consumption, creating the possibility of leakage. For example, if production becomes more expensive in Home due to a price on carbon, Foreign becomes the low cost supplier across a wider set of goods and it increases production.

The key variable in determining Foreign's response to Home's carbon policy is the effect of the policy on the price of energy seen by Foreign actors compared to Home actors. A lower price of energy in Foreign induces Foreign to increase its production of goods (i.e. with lower energy costs production is cheaper so they produce more) and consumption of goods (because goods are less expensive). A higher price of energy induces Foreign to increase extraction (i.e. extractors are making more to extract so they extract more).

Key Findings

The optimal regional carbon policy combines two principles. First, the policy combines taxes on supply of energy, such as an extraction tax, with taxes on the demand for energy, such as a tax on emissions from the use of energy in production or a tax on the consumption of the energy embodied in goods. The logic behind combining taxes on the supply and demand for fossil fuel energy is that these taxes have offsetting effects on the price of energy seen by Foreign. A tax on the extraction of fossil fuels results in fewer fossil fuels extracted domestically (reducing supply), raising the global price of energy and increasing extraction abroad. A tax on the use of fossil fuels in production or on the energy embodied in goods that are consumed makes these products and the production process more expensive, slowing production and reducing demand for these products at Home. With less demand, the global energy price goes down, resulting in traditional forms of leakage, such as an increase in production abroad and a loss of trade share. Combining taxes on extraction, production, and consumption allows Home to offset and balance these effects, minimizing the inefficiencies from leakage.

Second, the optimal policy maximizes the tax base, by including all goods produced domestically (whether consumed at home or exported) and all goods consumed domestically, including all imports. Moreover, it expands its reach by subsidizing the export of lower carbon goods, to replace those produced abroad with a higher carbon intensity.

Implementing the optimal policy would consist of Home imposing:

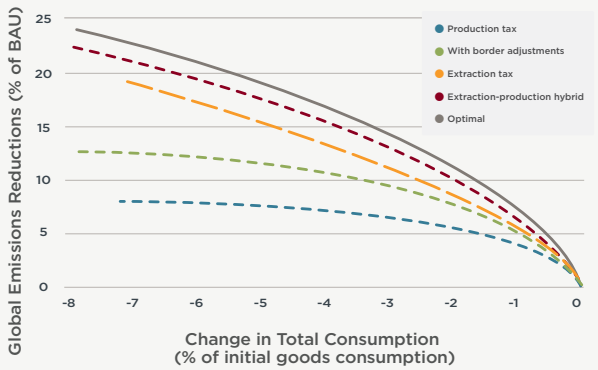
1. A nominal tax on extraction equal to the social cost of carbon.

2. Carbon border adjustments on fossil fuels—taxes on fossil fuel imports and rebates on fossil fuel exports—as well as border adjustments on the energy content of other imports. The border adjustments would be at a lower rate than the extraction tax rate.

This feature shifts a portion of the tax downstream to production and consumption, but because it is at a lower rate, maintains a portion of the extraction tax.

3. A subsidy for exports. The subsidy ensures that there is still the incentive for producing low-carbon goods, and even expands the export of such goods. The study compares the optimal policy to more conventional policies, such as taxes on emissions from domestic production or those taxes combined with carbon border adjustments. The simulations (Figure 1) show that the optimal policy is able to achieve two to three times the emission reductions for the same cost as conventional policies. Moreover, relatively simple policies built on the underlying principles of the optimal policy also significantly outperform conventional policies. In particular, a tax on domestic extraction combined with border adjustments on imports and exports of fossil fuels, but at a lower rate than the extraction tax (an extraction-production hybrid tax), would be simple to implement and performs nearly as well as the optimal tax.

Figure 1 · Optimal Tax Compared to Simpler Taxes



CLOSING TAKE-AWAY

The best climate policies would optimize emissions reductions while balancing trade and economic concerns. Policies can do so by combining taxes on the supply and demand for fossil fuels to control the price of energy in regions without strong policies. This approach utilizes international trade to expand the reach of stronger climate policy.

The Energy Policy Institute at the University of Chicago (EPIC) is confronting the global energy challenge by working to ensure that energy markets provide access to reliable, affordable energy, while limiting environmental and social damages. We do this using a unique interdisciplinary approach that translates robust, data-driven research into realworld impacts through strategic outreach and training for the next generation of global energy leaders.