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Is environmental efficiency trade inducing or trade hindering?

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ABSTRACT

Global efforts to identify strategies for sustainable economic growth and development underline the need for understanding important links between environmental policies and international trade. In this paper, by constructing an environmental efficiency index for 111 countries from 1980 to 2009, we are able to empirically test for one such link. An improvement in the environmental efficiency index in terms of carbon dioxide emissions reflects a decrease in the cost of efforts to mitigate the environmental costs associated with growth. Countries that improve their environmental efficiency are found to experience strong international trade effects, both through increased exports and increased imports. While the positive link between efficiency improvements and exports is supportive of the Porter hypothesis, the positive link between efficiency improvements and imports is supportive of strong positive income effects on account of environmental efforts. These results, which are robust to alternative estimation strategies, lend strong support to global efforts to improve countries' environmental efficiencies.

1. Introduction

Over the past few decades, both through a significant reduction in tariff barriers and through increased international trade activities, a de jure and a de facto deepening of globalization, respectively, has been occurring. This trend has been accompanied by intensified competition pressures across countries to maintain a strong position in the game of globalization. It is believed that international trade is a main facilitator of much-needed (and much-sought) economic growth and employment generation for many countries (Frankel and Romer, 1999). However, in recent decades, a very relevant debate on sustainable growth and development versus sheer growth has added environmental, economic and sociopolitical sustainability to discussions around this belief. For example, appropriate technical changes in processes that improve the environmental efficiency of production would serve as a tool to achieve the goal of sustainability.

An important question is whether production schemes that become environmentally more efficient (or *go green*,) contribute to the competitiveness of the country and hence to its goal of maintaining a strong position in global trade activities. This debate is also relevant for international and national policymakers. The WTO, for example, emphasizes the legitimacy of setting environmental goals and going green, but also warns against making such environmental goals into non-tariff barriers and implicit (or even explicit) protectionist regulations, a phenomenon they call *green protectionism*.[1] In 1994, in an effort to overcome the tension between legitimate environmental rules and green protectionism, the WTO established its Trade and Environment Committee. It also initiated several agreements that take into account these tensions, including the Sanitary and Phytosanitary Measures (SPS) Agreement and the Technical Barriers to Trade (TBT) Agreement.

Despite these globalized efforts, environmental standards do arise as an implicit non-tariff barrier that hinders international trade in many instances. As Esty (2001) notes, many of the issues tackled by the SPS and TBT agreements can indeed change international trade: "Public health standards, food safety requirements, emission limits, waste management and disposal rules, packaging and recycling regulations, and labeling policies all may shape trade flows." Many countries have complained to the WTO that their trading partners are unduly limiting their trade relationships because of environmental issues. According to Esty (2001), one such dispute was the tuna–dolphin case, in which the United States banned Mexican tuna imports in 1991 because the fishing methods resulted in incidental dolphin deaths. Another example is the European Union beef hormone dispute. The European Union has included "no added hormones in beef" as a food safety standard, and prefers this kind of beef in their imports. Yet another case is that of ongoing US sanctions against Thai shrimp, which they argue are caught using methods that kill endangered sea turtles. All such cases and disputes highlight the intertwined relationship between environmental

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[1] For details one could look at the WTO Ministerial Declarations of 1994 and 2001, http://www.wto.org/english/tratop_e/envir_e/envir_req_e.htm.

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concerns and international trade, pointing to the importance of providing further evidence on the direction of the relationship between these two very relevant variables.

The goal of this paper is to study how going green through improving the environmental efficiency of production plans is reflected in aggregate trade patterns. Environmental efficiency improvements would have important implications on countries' comparative advantage patterns, and therefore on international trade patterns.

The classic comparative advantage theory of international trade focuses on the relative costs of production as the main determinant of cross-country trade amounts. Some of the costs associated with production are environmental costs, which are influenced by changes in environmental awareness. Reductions in these environmental costs are equivalent to improvements in environmental efficiency.[2]

In the following discussion, we map the link between environmental efficiency, costs and trade. If improvement in a country's efficiency decreases its cost structure, i.e. improves its comparative advantage, this cost advantage is expected to reflect itself in increased exports and decreased imports, according to classic trade theory. These effects could be thought of as a substitution effect, where at the aggregate level, countries switch from consuming high-cost goods to low-cost goods. Alongside this substitution effect, one could also envisage an indirect income effect, where this increased efficiency is expected to be associated with a country's increased income levels. Increased income is expected to contribute to increasing imports, rendering the overall sign of changes in imports uncertain. If the substitution effect outweighs the income effect, then the cost advantage (or efficiency improvement) is expected to decrease imports. If vice versa, then the cost advantage is expected to increase imports.

Hence, ex ante, we expect that environmental efficiency and exports move in the same direction, while the direction of change of imports depends on which of the substitution and income effects outweighs the other. When the substitution effect outweighs the income effect of efficiency changes, cost and imports move in the same direction, and inversely when reversed.

As such, in this paper, we examine the environment and international trade relationship by focusing on an environmental efficiency index, an output-based measure that reflects costs and has a clear link with international trade.[3] A priori, if the substitution effect outweighs the income effect, we expect that improvements in a country's environmental efficiency would contribute positively to exports and negatively to imports. Taking this a priori expectation to data and testing for whether it holds for an extensive dataset is of empirical interest, and is the task we undertake in this paper.

This output-based environmental efficiency index used in the following analysis can best be summarized as an indicator reflecting the necessary cost to be incurred to improve the environmental quality of production, or in other words, reduce the environmentally unwanted outcomes of production. An improvement in the environmental efficiency index captures the idea that the cost of further eliminating one more unit of the "bad" will necessitate giving up fewer units of the "good," i.e. the environmental efficiency of production improves. The bad could include, but is not limited to, greenhouse gas emissions, water pollution, toxic waste discharge, overall negative impact on biodiversity and many other such negative externalities. These costs differ in where their effects are mostly felt; while some are confined locally, others generate a global impact. For the sake of generality and measurability, in this paper we will focus on those that create a global impact, mainly greenhouse gas emissions. According to a recent Environmental Protection Agency (EPA) report (2012), over 70% of the greenhouse gas emitted is carbon dioxide (CO_2). Therefore, in the remainder of the paper, we associate and measure the environmental costs related to CO_2 emissions.

We focus on the role played by environmental efficiency in influencing global trade patterns, and empirically test the link between environmental efficiency in CO_2 emissions and international trade using an extensive dataset of 111 countries over the years 1980 to 2009.[4] This extensive coverage contributes to the literature that has so far mainly focused on sub-sets of countries, due to the lack of consistent measurements regarding the environment. This study contributes to the literature by explicitly linking environmental efficiency, the main channel through which market pressures, environmental regulations and relevant technological changes play a role, with trade.

Prior studies linking international trade and environmental concerns have mostly focused on studying the role of environmental standards and regulations. This paper contributes to this literature by focusing on the role played by environmental efficiency. The literature identifies three drivers that lead to incorporating environmental concerns into production decisions: the financial returns of green production activities are expected to generate, environmental regulations and the cost reduction associated with these efforts (see Baines et al., 2012, who provide a detailed literature review on the evolution of green production). Limited evidence suggests that international environmental regulations contribute positively to countries' environmental efficiency, hence negatively to production costs (see Yörük and Zaim, 2006, 2008). Environmental regulatory stringency is expected to reflect itself as increased production costs, both for firms that opt to abide by the regulations as well as for those that choose not to. The former group will be forced to undertake costly restructuring activities. The latter group will face the risk of repercussions, bearing the implicit costs of trying to evade the regulations or the explicit costs if caught evading the regulations. Either way, environmental regulatory stringency is expected to increase costs incurred by firms. On the other hand, firms that do undertake the required costly technological restructuring are expected to benefit from improvements in their innovative state, which would be reflected as reductions in the cost of production. As such, there might be a close relationship between environmental efficiency and regulations, rendering the analysis of environmental efficiency and environmental regulations of important complementary areas.[5]

This topic of the effects of environmental standards/regulations on production schemes has been of significant interest in the literature for some time. While one strand of the literature argues that environmental standards would contribute positively to firm competitiveness by encouraging innovations and improving efficiency,[6] another strand suggests an inverse association between environmental standards and competitiveness due to green protectionism. The latter argument suggests that environmental standards and regulations increase production costs, leading to a loss in competitiveness and lower international trade

[2] The specific definition of environmental efficiency is provided in detail in the following discussion; at this stage, what is relevant is that an improvement in environmental efficiency is equivalent to reductions in environmental costs.

[3] Several studies use a similar measure of environmental efficiency, and they are reviewed in detail in the survey paper by Song et al. (2012). Even though earlier applications relied on firm-level data, the studies relevant to our analysis are those that use macro data for the Data Envelopment Analysis, which is necessary for the construction of these measures.

[4] Measuring the bad through CO_2 emissions makes it possible to include 111 countries in the analysis. If instead of a single pollutant, for example, aggregate greenhouse emissions were examined, the dataset would only include 42 developed countries.

[5] The formal empirical testing of the link between environmental regulation and environmental efficiency is beyond the scope of this paper.

[6] Porter and van der Linde (1995) is one of the first studies on this issue, which were followed by several theoretical and empirical studies; which are surveyed in detail in the studies of Wagner (2003), Ambec and Barla (2006) and Ambec et al. (2013).