Applied Energy xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Applied Energy

journal homepage: www.elsevier.com/locate/apenergy

New evidence of environmental efficiency on the export performance

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HIGHLIGHTS

- We model trade theory can quantify the Ricardian comparative advantage considering energy and environmental efficiency.
- We analyze the environment-related efficiency and export performance empirically.
- The result shows that the efficiency can be a source of the comparative advantage in industries.
- The efficiency has a smaller impact on export performance in relatively less footloose industries.

ARTICLE INFO

Article history:
Received 28 July 2016
Received in revised form 9 October 2016
Accepted 30 October 2016
Available online xxxx

Keywords:
Comparative advantage
Trade and environment
Energy efficiency
Pollution emissions per production

ABSTRACT

This article investigates the relationship between the environment-related efficiency and export performance according to the recent international trade theory which has offered to a theoretical model to quantify the Ricardian comparative advantage. We find that the energy and environmental efficiency can be a source of the comparative advantage in industries. The largest magnitude and the smallest of the efficiency on exporting are estimated to be NOx and energy efficiency, respectively. The empirical results further show that the efficiency has a smaller impact on export performance in relatively less footloose industries, and the impact of the efficiency is found to depend on industrial characteristics.

1. Introduction

One of the fundamental questions that drive the literature that connects international trade and the environment is whether trade flow affects environmental aspects, such as environmental quality and regulation, and vice versa. The related literature can be classified into two categories. The first set of literature focuses on whether trade liberation influences environmental quality. The second set concerns how the stringency of environmental regulation in an exporting country affects trade flow. This paper falls into the latter category, but it differs from previous empirical analyses in that we shift the focus of analysis from regulatory effects to the effects of energy efficiency.

The influence of trade on the environment depends on scale, technique, and composition effects [1].[1] Previous empirical analyses have attempted to quantify the influence of these effects [2–8]. In contrast, many theoretical and empirical works have studied the impact of environmental regulation on trade flow. The discussions particularly focus on the pollution haven hypothesis,[2] which claims that stringent environmental regulations induce the comparative advantage of less pollution-intensive industries because regulation imposes relatively higher costs on pollution-intensive industries [5,9–11]. However, the empirical studies provide little consensus on the relationship between environmental regulation and trade flow.

We focus on environment-related efficiency because the impact of technology that improves environmental externalities has received little attention in the main economics literature, although many economists recognize its vital importance [12]. Hence, this paper attempts to provide further insight into the roles of resources and the environment in economic activity, particularly in trade. We analyze the relationship between the environment and trade by studying the effect on export performance of environment-related efficiencies, which are measured by energy

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[1] Pollution emissions through trade depend on a magnitude relationship between these effects, but a basket of the three effects is generally undetermined in advance because the composition effect is thought to depend on a comparative advantage across countries.

[2] In addition, the Porter hypothesis is also discussed in the context of the impact of environmental regulations.

http://dx.doi.org/10.1016/j.apenergy.2016.10.126
0306-2619/

use (energy efficiency) and pollution emissions (pollution efficiency) as units of production in the exporting country.

Our work is closely related to the literature on trade and heterogeneous productivity across industries and firms. The models in the literature show positive relationships between firm scale, capital intensity, and productivity in most countries [13–15]. In these analyses, productivity plays a central role in understanding the exporting variation among domestic industries as well as among the firms in a specific industry. The productivity in these models generally refers to total factor productivity, which captures all factors except for capital and labor. We contribute to the literature by quantifying the effect of environment-related efficiency rather than the more conventionally used productivity.

We follow the setup and implication of Costinot et al. [16], hereafter CDK, which tests a Ricardian comparative advantage based on a theoretical foundation. CDK uses labor per production as productivity. We apply their framework, which connects productivity and trade flow, by replacing the labor productivity in their model with environmental efficiency measured by energy use and emission levels. We test the theoretical implications using the trade flow data and the environment-related efficiency data from the World Input-Output Database (WIOD). Our analysis indicates that the degree of energy and pollution efficiency positively affects export levels across domestic industries.

The remainder of this article is organized as follows. Section 2 reviews previous studies that consider the relationship between trade and the environment and the effect of environmental regulation on trade. Section 3 explains the empirical models and the data. Section 3 provides estimation results. Section 7 discusses the results.

2. Trade, the environment, and productivity

This paper attempts to connect trade, energy and pollution efficiency. There are two sets of literature that are particularly relevant to this work. One concerns the impact of the environment on trade, and the other focuses on the relationship between trading patterns and productivity. We review the implications of both sets of studies separately.

2.1. The environment and trade

Tobey [17] empirically showed that environmental regulation had little impact on net exports in the pollution-intensive industries in developed countries.[3] Similarly, Xu [18] found that export performance is not particularly affected by variations in the stringency of environmental regulations; the export performance of environmentally sensitive goods was found to be stable between the 1960s and the 1990s, even as environmental standards became more stringent over this period. In contrast, Robison [19] found a significant impact of environmental regulation on net exports using U.S. trade data. The author's result indicates that a marginal change in abatement cost negatively influences industrial trade volume, and thus the goods with higher abatement costs are imported whereas the goods with lower abatement costs are exported.

Earlier empirical analyses assumed the exogeneity of environmental regulations in trade patterns [17,19], but recent studies have ruled out such assumptions and addressed the endogeneity between trade patterns and the stringency of regulations.[4] Taking endogeneity into account, the empirical results appear to support the statistically significant effect of environmental regulations on trading patterns. Ederington and Minier [9] found that environmental regulation had a positive impact on net imports in the U.S. Their results showed that a usual ordinal least square (OLS) estimation that did not consider endogeneity underestimated the magnitude of the marginal effect of environmental regulation. The empirical results of Levinson and Taylor [11] also support the possible underestimation of regulatory impact if endogeneity is ignored. Using the data on environmental regulations in the U.S. and net imports to Canada and Mexico, the authors show that the positive impact of abatement costs on net imports from Mexico and the endogeneity-adjusted impact of environmental regulations are larger than the impact of unadjusted models.

The pollution haven hypothesis is popularly discussed and tested in the literature. This hypothesis predicts that the industries that are affected by stringent environmental regulations move to less-regulated environments to avoid the added costs from the imposed regulations. There is no consensus about the hypothesis in the empirical analyses; whereas Antweiler et al. [2] and Ederington et al. [10][5] find little support for the hypothesis, Managi et al. [5] present empirical evidence that supports the predictions of the pollution haven hypothesis. Not only is the supportive empirical evidence for the hypothesis inconsistent, some argue that the pollution haven may be unrelated to environmental regulations. Chua [20] built a theoretical model that implies that pollution taxes increase the prices of goods by increasing production costs, which consist of factor prices in a numeraire good and an abatement service.

There are empirical studies to investigate the relationship between a trade pattern and energy consumption at a country level. Sadorsky [21] shows that there is a positive relationship between them in the Middle East countries and Shahbaz et al. [22] also find the positive bidirectional relationship between them in China. Moreover, the relationship is also found in the South American countries [21]. These evidences illustrate that energy is an essential good for economic activities, but they seem to be hard to explain the structural mechanism of trade patterns to energy consumption and environmental regulations.

In order to connect the environment and trade, the previous studies have focused mainly on the effect of environmental regulations on the trade patterns of countries and industries. Where the importance of the regulation effect is typically emphasized, we consider the effect of the environment from a different angle, that of productivity rather than the regulations.

2.2. Trade and productivity

The effect of productivity variation on trade patterns is well documented. The previous studies on trade and firms have indicated a robust relationship between the scale of firm capital intensity, productivity and export performance. Bernard and Bradford Jensen [13] investigated a relationship between exporting and producing at the firm level using census data, and they showed that high-performance firms become exporters but that past export performance does not necessarily boost a firm's current performance. Similarly, Aw et al. [23] investigated the relationship using plant-level data from Korea and China, and Bernard and Wagner [24] investigated using German data. Pavcnik [14] analyzed the impact of tariff reductions on export performance using firm-level data in Chile and showed that tariff reductions encourage firms with relatively lower productivity to exit the market. According to that study, exiting firms' productivity is 8 percent lower than

[3] Beers and Bergh [39] highlight that his results were influenced by inaccurate environmental policy indicators in his analysis.

[4] The reason is that environmental regulation standards are commonly industry specific.

[5] They made three hypotheses regarding the superficially poor correlation between environmental regulation and trade. They indicated that the extent of the effect of regulatory stringency on trade in the 'footloose' industries is understated and that pollution-intensive industries tend to be relatively immobile.

Please cite this article in press as: Sakamoto T, Managi S. New evidence of environmental efficiency on the export performance. Appl Energy (2016), http://dx.doi.org/10.1016/j.apenergy.2016.10.126