Renewable and Sustainable Energy Reviews 42 (2015) 477–495

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

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

Public policy supports and export performance of bioenergy technologies: A dynamic panel approach

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ARTICLE INFO

Article history:
Received 2 September 2013
Received in revised form
21 August 2014
Accepted 17 September 2014

Keywords:
Bioenergy policy
Export performance
Dynamic panel
Causality analysis

ABSTRACT

This study investigates the effects of public policy supports on the export performance of bioenergy technologies; it uses panel data from 18 countries from the 1992 to 2008 period. Panel unit-root and cointegration tests are applied, taking into account the results of structural-break tests for each time series and testing for the presence in the panel of cross-sectional dependence. Time-series data on public supports and exports are integrated and cointegrated. The results of dynamic ordinary least squares indicate that in the long term, public R&D expenditures have a positive effect on the exports, the contribution of bioenergy to the total energy supply has a negative effect on the exports, and GDP has a positive effect on the exports. The contribution of bioenergy to total energy supply responds to deviations in the previous period from the long-term equilibrium. Additionally, Blundell–Bond system generalized methods of moments estimations are made, to determine dynamic causality in a panel vector error correction mechanism setting. Evidence of a positive strong and short-term relationship from exports to R&D expenditures, and of a positive short-term causality from exports to the contribution of bioenergy to total energy supply, is found. A positive strong bidirectional relationship between GDP and exports is also uncovered. There is a positive strong, bidirectional, and short-term relationship between GDP and the contribution of bioenergy to total energy supply. Finally, some policy implications based on the results of this study are offered.

Contents

Abbreviations: ADF, augmented Dickey–Fuller; CADF, covariate augmented Dickey–Fuller; CD test, cross-sectional dependence test; CRES, contribution of bioenergy to total energy supply (variable); CUSUM, cumulative sum of recursive residuals; CUSUMQ, cumulative sum of recursive residuals of squares; DF, Dickey–Fuller; DOLS, dynamic ordinary least squares; ECM, error-correction model; EX, exports of bioenergy technologies (variable); FMOLS, fully modified ordinary least squares; GDP, gross domestic product (variable); GL, Grubel and Lloyd; GMM, generalized method of moments; OLS, ordinary least squares; PMG, pooled mean group; QML, quasi maximum likelihood; RAD, research and development expenditures on bioenergy technologies (variable); RCA, revealed comparative advantage; RSCA, revealed symmetric comparative advantage; VECM, vector error-correction mechanism

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http://dx.doi.org/10.1016/j.rser.2014.09.013
1364-0321/

1. Introduction

Bioenergy technologies could contribute significantly to reductions in greenhouse gas emissions, and they are unique in their potential to serve all three areas of major energy demand: heat, electricity, and transport fuels and chemicals [1–3]. That is reason why bioenergy technologies have attracted great political interest from most countries worldwide. Especially, commitments to decreasing greenhouse gas emissions, the desire to secure and diversify energy supplies, and the wish to mitigate uncertainty related to oil prices are rendering various types of biomass more interesting fuels to industrialized countries [4,5]. In this context, over the last two decades, many policy instruments have been employed in a variety of countries (primarily OECD countries) to develop the bioenergy sector, principally by supporting the market introduction of bioenergy technologies. Government policies have been essential to recent growth in renewable energy [6]; domestic bioenergy technology policies have also had a tremendous effect on the global market, which means that international bioenergy technology trade development has tended to be strongly linked to support policies [7,8].

As continuously improving export performance becomes important to ensuring industrial growth, the question of whether bioenergy policy leads to an increase in exports on the global market has pushed economists to address the interrelations between policy and export performance. A few recent studies have dealt with this issue directly, through the use of descriptive analyses, case studies, and cross-sectional regression analyses. Descriptive analyses and case studies have been used to show or state the possibility that the enactment of government policies can lead to an increase in the export of bioenergy technologies [7–13]. Cross-sectional regression analysis, on the other hand, tests the trade specialization dynamics of global bioenergy technologies and the effects of public policies [2].

Although previous studies have contributed to discussions on the relationship between government policy and the export of bioenergy technologies—and to our understanding of the factors therein—most (save for Jha [2]) do not empirically evaluate how public policies affect the export dynamics of bioenergy technologies. This means that there remains extensive scope for empirical research to contribute to the existing literature on the ways in which government policy affects the bioenergy technology trade. Among other things, there has been a lack of research effort in establishing, through a review of the literature, an empirical model by which to test the effect of public policies on bioenergy technology trade. This study looks to establish an empirical model and test the role of public policy in enhancing the export performance of bioenergy technologies, by reviewing the literature on public policy and the export of bioenergy technology, including literature pertaining to other renewable energy technologies. This study also looks to pinpoint commonalities and highlight real-world implications, while contributing to the establishment of an empirical model vis-à-vis the effects of public policies on the export of bioenergy technologies.

The remainder of this paper is structured as follows. Section 2 provides a literature review on the relationships between public policies and the export of bioenergy technologies, including other renewable energy technologies. Section 3 presents the theoretical settings of this study and describes empirical methodology and the data used. Empirical results are presented and interpreted in Section 4. Finally, Section 5 summarizes the main findings and outlines the implications and limitations of this study.

2. Literature review

To date, only a few studies have addressed the question of how public policies affect the international trade of bioenergy technologies. Three significant approaches have emerged in the literature.

The first approach involves multivariate regression model-based study [2], and by using cross-sectional data, it tests the relationship between government policy and the export of renewable energy technologies. Jha [2] analyzes the effects of public policies, including technology specialization, on the export performance of renewable energy technologies in six aggregated sectors (i.e., bio, small hydro, geo-thermal, ocean, solar, and wind energy technologies) and three disaggregated sectors (solar, wind energy technologies, and ethanol). Jha [2] provides evidence that an exporting country's policy support plays a crucial role in promoting its export performance in the renewable energy technologies market, estimating that both a composite variable comprising feed-in tariffs and the contribution of renewable energy to the total energy supply may contribute to an increase in the export of aggregate renewable, solar, and wind energy technologies, and of undenatured ethanol, with coefficients of 0.410, 0.946, 0.976, and 1.710, respectively; these are significant at the 1% or 5% levels.

The second approach is taken by studies that examine country cases—e.g., Ericsson et al. [9] and Junginger et al. [10]. They review bioenergy-related policy measures and international bioenergy trade; bioenergy policy, such as R&D and market development (feed-in tariff and tax exemptions) policies, plays a key role in bioenergy technologies market development. The consensus among these studies is that changes in the policies of each country around the world largely determine current trade patterns.

The third approach is taken by descriptive-based studies—such as those of Junginger et al. [11,12] and Larmers et al. [7,8]—and they emphasize the role of government policy in promoting the export of bioenergy technologies. Larmers et al. [7,8] find that global direct trade in solid biofuels in markets influenced by energy policies has increased dramatically over the past decade, on both the demand and supply sides. They, however, state that the trade patterns of the analyzed commodities have developed differently. Junginger et al. [11] synthesize the main development and drivers of international bioenergy trade in IEA bioenergy Task 40 member countries based on various country reports written by Task 40 members; they find evidence that policy measures still determine trade flows to a great extent, and that sudden changes in policy can result in quickly changing trade patterns. They conclude, based on the results of their analysis, that international bioenergy trade is growing rapidly, far beyond what was deemed possible only a few years ago; they also conclude that in the future, some Task 40 countries may surpass their domestic biomass capabilities, especially for specific applications (e.g., transport fuel). This would mean that in the future, each country worldwide would need to develop policy measures actively to promote its export of bioenergy technologies. Based on an online survey on IEA bioenergy