Renewable Energy 86 (2016) 354–359

Contents lists available at ScienceDirect

Renewable Energy

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

The effect of renewable energy generation on import demand

Andrea Vaona [a, b, *]

[a] Department of Economic Sciences, University of Verona, Viale dell'artigliere 19, 37129 Verona, Italy
[b] Kiel Institute for the World Economy, Hindenburgufer 66, D-24105 Kiel, Germany

ARTICLE INFO

Article history:
Received 10 February 2014
Received in revised form
25 May 2015
Accepted 22 July 2015
Available online xxx

JEL Codes:
F10
Q20
Q43
C23

Keywords:
Renewable energy generation
Import demand
Panel data

ABSTRACT

In the present paper the link between renewable energy generation and imports dynamics is explored in import demand equations. We find that renewable energy generation reduces import growth. The results display a considerable robustness across estimation methods and model specifications.

1. Introduction

The present paper investigates the connection between renewable energy generation and import demand. This research question is interesting because a recent stream of literature has found, both on analyzing cross-country and cross-region datasets and relying on panel data econometrics, that renewable energy generation can spur economic growth [1–3,15,30,31]. One of the explanations proposed for this result is that renewable energy can hasten economic growth because it softens the balance-of-payments constraint of an economy, which would support Thirlwall's Law (see for instance [22–24,38–40]). In other words, renewable energy generation raises the sustainable level of output, boosting the productivity of production inputs.[1]

In principle, one can presume, for instance, that renewable energy reduces external demand for traditional energy sources while at the same time increasing the external demand for inputs to its production process. Therefore, we do not focus here on magnitudes concerning the energy balance alone (as in Refs. [7,20,32,45]). Instead, we concentrate on the total imports of the economy because we want to capture the overall effect of renewable energy generation.

Furthermore, there is scant evidence concerning renewable energy generation and foreign trade magnitudes available in the literature. To our knowledge, the only study following this research path is that by Chien and Hu [10]; who conducted empirical tests regarding the theory advanced by Domac et al. [14]. According to these authors, renewable energy generation spurs business formation and growth, and employment as well, ultimately hastening economic growth. Moreover, it leads to import substitution, improving the trade balance of a country.

For the purpose of their research Chien and Hu [10]; adopted a structural equation model and assessed how renewable energy sources affect the trade balance and capital accumulation. Support was found for the latter relation, but not for the former one. Although Chien and Hu's analysis was path breaking, it is necessary to deepen our knowledge of this research field further. This is because their analysis considered only the year 2006 and

* Department of Economic Sciences, University of Verona, Viale dell'artigliere 19, 37129 Verona, Italy.
E-mail address: andrea.vaona@univr.it.

[1] Other possible interpretations are that renewable energy generation is able to reduce the exposure of an economy to the volatility of the oil market - and, therefore, uncertainty - and to the negative effects on the environment and human health stemming from non-renewable energy generation (see the literature cited in Ref. [15]. Moreover Chien and Hu [9]; used a data envelopment analysis covering 45 countries over the period 2001–2002. They showed that macroeconomic efficiency can be boosted by renewable energy sources.

http://dx.doi.org/10.1016/j.renene.2015.07.062
0960-1481/

Table 1
Description of variables.

Variable	Description
m	Imports of goods and services (constant 2000 US$), percentage change
p_m	Opposite of the percentage change in the real effective exchange rate index (2005 = 100)
y	Percentage change in GDP (constant 2000 US$)
d_m	Customs and other import duties as percentage of imports of goods and services
re	Electricity production from renewable sources (kWh), % change
n	Electricity production from nuclear sources (kWh), % change
f	Electricity production from oil, gas and coal sources (Kwh), % change

the equation of trade balance and energy imports had only two regressors. For these reasons, we believe that more research is needed in this area. All the more so because it is often acknowledged that fossil energy can hamper the long-run sustainability of the external debt of an economy (see for instance [37,41]).

Specifically, we believe that a better understanding of the issue at stake can be gained by building on a consolidated framework in the economics literature, namely that of import demand equations.

This approach models imports, M, as a function of their relative price, P_m, and of the income level of a country, Y:

$$M = P_m^{\beta} Y^{\pi} \tag{1}$$

where β and π are coefficients.

Taking logs and first differences, one can write:

$$m = \beta p_m + \pi y \tag{2}$$

where lower case letters denote percentage changes.

Usually (2) is estimated in partial adjustment form

$$m_t = \beta_0 + \alpha m_{t-1} + \beta_1 p_{m,t} + \pi y_t + \varepsilon_t \tag{3}$$

where t is a time index, β_0, β_1, α are coefficients and ε is a stochastic error.

Many studies have investigated the determinants of import demand. In regard to developed countries, it is possible to list [11–13,42,8,21,27]. As for developing countries, instead, one can mention, [4,5,16–19,28,36]. Overall, these studies concluded that import demand is driven by income and relative prices, but by the former to a greater extent than by the latter.

A recent strand of this literature has focused on the effect of trade liberalization policies: for instance, see Santos-Paulino [35] and Santos-Paulino and Thirlwall [34]; who added further regressors to (3) to control for import duties, d, and for the timing of liberalization policies. Their findings were that import duties have a negative impact on import growth, which, instead, rises after the reduction of trade distortions. We build on their approach by further adding renewable energy generation. We also experiment with fossil and nuclear energy.

The rest of this paper is structured as follows. First we describe our dataset and data sources. Then we illustrate our methods, results and robustness checks. Finally, we conclude.

2. The data

The World Development Indicators (WDI), produced by the World Bank, were our data source (http://databank.worldbank.org/data/home.aspx). Table 1 lists our variables and their definitions. There was good variability in the data, as shown by Table 2. We considered 26 countries over different time periods. More details on these are provided in Table 3, which also sets out the percentage change in renewable energy generation for each country over the period of observation, the average electricity production from fossil sources, the average electricity production from renewable sources, and average net energy imports. We chose the countries with the best relevant information available within the WDI. As can be seen, countries can be very diverse – an issue that we took into account when performing our estimations. Table A1 in the Appendix shows that there is no evidence of collinearity among our main variables of interest.

Table 2
Descriptive statistics.

Variable	Observations	Mean	Std. Dev.	Min	Max
m	192	0.04	0.16	−0.69	0.57
p_m	192	−0.02	0.21	−1.73	0.75
y	192	0.03	0.05	−0.16	0.11
d_m	192	0.05	0.05	0.00	0.21
re	192	0.02	0.23	−0.93	0.94
n	45	0.08	0.34	−0.20	2.07
f	192	0.01	0.45	−3.27	1.97

Notes. For variable description see Table 1.

3. Methods, results and robustness checks

3.1. Methods

Following the example of Santos-Paulino [35] and Thirlwall (2004) [34]; we adopted the panel system-GMM estimator proposed by Blundell and Bond [6] and coded by Roodman [29]. We also used the finite sample correction proposed by Windmeijer [44]. This approach is necessary because standard methods, such as the least squares dummy variables one, are well known to provide biased estimates in dynamic panel data models [26].

We preferred this estimator not only because of its above properties, but also because it is an instrumental variables estimator able to overcome possible problems of endogeneity. The system-GMM estimator developed by Blundell and Bond [6] entails estimating the relevant equations both in levels and first differences and using as instruments variables in first differences for the former and in levels for the latter.[2] In one of our robustness checks, we also resorted to the OLS, the fixed effects and the random effects estimators in a static model.

[2] Note that even if one uses first differences of logged variables, estimators robust to unobserved heterogeneity are nonetheless interesting. For instance, there may well be country-specific effects on import growth. In this research field, first differences are taken to be more confident to deal with stationary variables.