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ScienceDirect

Procedia Computer Science 122 (2017) 221–228

Procedia Computer Science

www.elsevier.com/locate/procedia

Information Technology and Quantitative Management (ITQM 2017)

Impact of Emissions Trading System on Renewable Energy Output

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Abstract

In this paper, a cross-national panel is used to assess the impact of emissions trading system (ETS) on renewable energy output with a difference-in-difference design. From 2002 to 2013, several countries adopted ETS as a primary vehicle to drive carbon pollution reduction and boost the growth of renewables. By exploiting the cross-nation and cross-time variation in the timing of ETS, we find that ETS has materially improved renewable energy output, thereby indicating that the growth of the renewables has been successfully boosted through ETS. In addition, we examine the dynamics of the relationship between ETS and renewable energy output. Estimation result shows the ETS establishment has a trend effect on renewable energy output.

Peer-review under responsibility of the scientific committee of the 5th International Conference on Information Technology and Quantitative Management, ITQM 2017.

Keyworks: ETS; Renewable energy output; Policy evaluation

1. Introduction

Exploring factors and mechanisms that may affect renewable energy output is necessary because of the importance of renewable energy for future economic and social development. Although many scholars conducted many investigations about the relationships of renewable energy output with other economic and social factors, such as economic growth, real income, capital formation, labor, and techniques, the impact of policy on renewable energy output are rarely empirically evaluated. In previous studies in this area, the effect of energy and environmental policies, especially the carbon emissions trading system (ETS), on renewable energy output was not considered. Thus, in this study, we examined this effect and used a multivariate difference-in-difference (DID) specification to assess the impact of ETS on renewable energy output in 60 countries from 2002 to 2013. The dynamic impact of ETS establishment on renewable energy output was also considered on the basis of its

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1877-0509
Peer-review under responsibility of the scientific committee of the 5th International Conference on Information Technology and Quantitative Management, ITQM 2017.
10.1016/j.procs.2017.11.364

year of establishment. Student's t-test was then used to test the trend of the dependent variables of the treatment and control groups prior to the establishment of ETS to circumvent the potential nonparallel trends between the treatment and control groups.

Section 2 provides the empirical literature about the factors and mechanisms that affect renewable energy output and provides hypotheses regarding the relationship between renewable energy output and ETS establishment. Section 3 discusses the data, methodology, and empirical results. Section 4 provides the concluding remarks.

2. Literature review

Many researchers empirically investigated relevant economic and social variables that affect renewable energy output in different countries and regions, especially the renewable energy-economic growth nexus [1]. Sadorsky used panel cointegration techniques to investigate the relationship between renewable energy use and income in a sample of emerging economies and found that real income per capita have a positive and statistically significant impact on renewable energy use per capita [2]. In another paper, Sadorsky presented and estimated an empirical model of renewable energy use for G7 countries, showing that real GDP per capita and CO_2 per capita are the major drivers behind renewable energy use per capita in the long term [3]. Bowden and Payne examined the causal relationship between renewable and nonrenewable energy use by sector and real GDP in the US using the annual data from 1949 to 2006. They found that the great use of renewable energy sources in commercial and industrial sectors do not have an adverse effect on real GDP [4]. However, the increased use of renewable energy sources in residential sectors curbs greenhouse gas emissions, and renewable energy technologies develop and evolve further. Apergis and Payne summarized four possible causal relationships, namely, the growth, conservation, feedback, and neutrality hypotheses, between renewable energy use and economic growth. They also established and conducted multivariate panel models, including the measures of economic growth, renewable and non-renewable energy use, and capital and labor, revealing the bidirectional causality between renewable energy use and economic growth in the short and long run [5-7].

However, empirical research on the effects of special energy or environmental policy on renewable energy output remains limited. In the early stages of the European Union ETS (EU ETS), according to interviews for Germany, EU ETS appeared to only indirectly benefit RD&D (research, development and demonstration) on renewables and indirectly contribute to the diffusion of renewables [8-9]. Besides that, Blanco and Rodrigues found out that EU ETS was unlikely to provide sufficient incentives to promote wind power, and so other policies to internalize the societal benefits that accrue from deploying this technology should be used [10]. Polzin et al. examines the impact of public policy measures on renewable energy investments in electricity-generating capacity made by institutional investors. They found that ETS could have strong influence on renewable energy investments by institutional investors [11].

The causal relationship between renewable energy output and economic growth is important in the design and implementation of environmental and energy policies. Public policies also have important effects on the creation and development of renewable energy industries, as well as on economic growth. More than 30 countries are currently using emissions trading system (ETS) to drive carbon reduction. Nevertheless, although emission trading schemes have become increasingly popular, they remain heavily criticized because they are costly and lack effectiveness and provide insufficient support for the growth of renewables [12]. Thus, to determine whether ETS boosts the growth of renewables, we performed DID estimation to evaluate the effect of ETS on renewable electricity output.