Applied Energy xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Applied Energy

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

The role of multi-region integrated emissions trading scheme: A computable general equilibrium analysis ☆

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HIGHLIGHTS

- Optimizing the allocation of emissions permit can yield economic welfare gains for permits importing countries.
- The integration of emissions trading scheme also results in the redistribution of clean energy in participating countries.
- The multi-region integrated ETS has significant impacts on international competiveness of each country.

ARTICLE INFO

Article history:
Received 15 August 2015
Received in revised form 4 November 2015
Accepted 30 November 2015
Available online xxxx

Keywords:
Emissions trading scheme (ETS)
Multi-region integration
CGE model

ABSTRACT

Globally, emissions trading scheme (ETS) as a cost-effective method to facilitate emissions abatement is raising more and more concerns. Moreover, according to the prevailing goal to reach a global agreement for climate mitigation, integrating emissions trading schemes has emerged as a prominent international cooperation option. This paper implements different scenario analysis and simulates the establishing of a conceivable multi-region integrated emissions trading scheme with China, U.S., Europe, Australia, Japan and South Korea included by utilizing a computable general equilibrium model; specifically, the economic and energy impacts on China in context of multi-region integrated ETS are explicitly investigated. Results indicate that the integration of emissions trading schemes would optimize the allocation of emissions permit and yield economic welfare gains for permits importing countries. Countries with higher abatement cost like U.S., Japan and South Korea would reduce the national GDP loss by 0.16%, 1.33% and 1.42%, respectively. Furthermore, the integration of emissions trading scheme also results in the redistribution of clean energy in participating countries. For China, joining the multi-region integrated ETS would facilitate the development of clean energy, the proportion of which climbs up by 33.7% in MR scenario compared with BAU scenario. In addition, it is worth noting that the multi-region integrated ETS would have significant impacts on the role each region plays in international trade, leading to 11% decline of net export for China in MR scenario compared with SR scenario.

1. Introduction

Global climate change has become a severe threat to the sustainable development of human beings; thus, most of the countries have adopted measures to reduce carbon emissions. Over the past years, as the cost-effective approach to facilitate emissions abatement, emissions trading schemes have been emerging at various geographic scales. Currently, there have been more than 15 emissions trading schemes in force around the world, covering European Union, California in U.S., New Zealand and seven pilot programs in China, etc. [1]. The past years have witnessed the significant milestones in the development and expansion of emissions trading schemes since the 1st UK emissions trading scheme was set up.

As the kernel of the EU's policy package to combat the climate change and to achieve the emissions reduction target for 2020, EU has modulated and redesigned ETS mechanism to maintain a stabilized carbon price [2]. Since 1st July 2012, Australia has imposed a fixed carbon price of AU$23 per metric ton of carbon dioxide equivalent on certain industries. The "fixed carbon price"

☆ This paper was presented at the 7th International Conference on Applied Energy (ICAE2015), March 28–31, 2015, Abu Dhabi, UAE (Original paper title: "Research on the energy and economic impacts of multi-region linked emissions trading system" and Paper No.: 244).

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http://dx.doi.org/10.1016/j.apenergy.2015.11.092
0306-2619/

Please cite this article in press as: Zhang X et al. The role of multi-region integrated emissions trading scheme: A computable general equilibrium analysis. Appl Energy (2015), http://dx.doi.org/10.1016/j.apenergy.2015.11.092

mechanism was also planned to transit to "emissions trading market" from 2015; however, uncertainties exist with the new Australia government coming into power [3,4]. So far, a U.S. national carbon market has not been in force, but several regional emissions trading markets have been established including the Regional Greenhouse Gas Initiative (RGGI) in eastern US [5]. China has been taking action to establish the domestic ETS since 2011; specifically, in the "Twelfth Five-year Plan", Chinese government has explicitly announced to "establish carbon emissions trading systems gradually". As the cornerstone to establish a national emission trading system, the National Development and Reform Commission of China has initiated carbon trading pilots in two provinces (Hubei, Guangdong) and five cities (Beijing, Tianjin, Shanghai, Shenzhen and Chongqing) [6,7]. As the first ETS in Asia, the Tokyo Cap-and-Trade Program (Tokyo-ETS) was launched in 2010, followed by the heated discussion on imposing a national ETS in Japanese National Diet [8]. Since 1th January 2015, the first national emissions trading scheme in Asia-Korea Emissions Trading Scheme has begun in force, which is the first step for South Korea to achieve part of its emissions reduction target by using carbon credits from international market mechanisms [9]. In addition, emerging economies like Brazil, etc. are all considering the emissions trading schemes as a policy option to achieve the climate mitigation target [1].

As more national and regional emissions trading schemes are established, interest has grown in the scheme integration and globalization [10]. The integration of regional emissions trading schemes offers several advantages that make it attractive as an international cooperation option, such as economic welfare gains or abatement cost reduction, the expansion of a larger and more liquid market and potential diminishment of carbon leakage [11]. Notably, the integration creates more abatement opportunities among the whole participating regions; therefore, it transits reduction from the region with higher abatement cost to the lower one, resulting in the total abatement cost reduction. In addition, the liquidity in the multi-region integrated market will increase as a consequence of the increase of allowance. Some authors also suggest that integration among participating regions also contributes to the potential diminishment of carbon leakage [12].

The paper is organized as followings. We review the relevant studies and introduce the current status of integration for ETS in Section 2. The methodology and the details of model utilized for this analysis are described in Section 3. Section 4 represents the modeling scenario and Section 5 shows the simulation results. Finally, conclusions are drawn in Section 6.

2. Background

2.1. Literature review

The related studies focus on two aspects including the discussion on institutional and political challenges for integration and the evaluation of macroeconomic impacts on participating regions. Several studies have identified the main institutional and political barriers for ETS integration by investigating the potential integration of existing and emerging trading schemes. Some authors point out that a certain degree of harmonization among the integrated emissions trading schemes is required [13]. Hawkins [11] conclude that the variety of some features including allocation methods; registry systems and monitoring, reporting and verification (MRV) may have little influence on the implementation of integration. However, other authors find that although integration of ETS is technically possible, certain differences lead to efficiency, competitiveness and equity concerns [14]. Tuerk et al. [12] suggests that only a few direct bilateral links will be viable in the short term as a consequence of the divergent policy priorities in different regions, which is reflected in critical design features, such as cost containment measures. Additionally, the cumbersome adoption procedures are also identified as main constraints as institutional barriers [15]. Furthermore, some authors suggest that if participants in an integrated ETS design their own emission reduction targets as the current situation, permit trading among participants may even deteriorate the environment [16–18].

Studies focused on the evaluation of macroeconomic impacts always conduct counterfactual scenario analysis to simulate the integration among existing or emerging trading schemes. Some authors focus on assessing the macroeconomic impacts of integration. For instance, a study evaluating the proposed Australia scheme integrated with international emissions trading suggests that Australia can benefit from such integration and should dismantle the obstacles to integration [19]. Moreover, Flachsland et al. [20] conclude that integrated emissions trading may not be welfare-enhancing for all participants due to the presence of market distortions. Meanwhile, other authors investigate the impacts of integration on industry competiveness and energy consumption as well. Alexeeva and Anger [21] explicitly assess the trade-based competiveness effects of linking the EU emissions trading scheme based on a computable general equilibrium model. They find that, EU member states improve their terms of trade by integrating with emerging ETS while non-EU participants risk competitiveness loss due to integrating. Liu and Wei [22] assess the impacts of a joint EU-China ETS by utilizing a multiregional general equilibrium model. Their conclusion is that a joint ETS facilitate China to achieve its renewable energy target while it works opposite for EU. Specifically, some authors have conducted prospective analysis on the integration of different provinces in China and they find that such integration could reduce total emission abatement cost but yield different impacts on different provinces [23,24].

In the light of the review mentioned above, multiregional computable general equilibriums have advantages to represent the economic and energy impacts [25]. Therefore, we conduct this analysis by utilizing a multi-region computable general equilibrium (CGE) model to better capture the interactions between energy and economic systems among regions.

2.2. Current status of integration

In addition to the growing academic concerns, the integration of multi-region emissions trading schemes has been put into practice in certain continents. The first integration have been taking place. In July 2007, Norway GHG emissions trading adjusted itself consistent with EU ETS Phase II, although this integration between EU-ETS with Norway as well as Iceland and Liechtenstein is regarded as a simply expansion of EU-ETS. Furthermore, Switzerland has begun to make efforts in line with EU Phase II since 2008 and the negotiations are in the final process [26]. The first successful establishment of a robust international carbon market took place in North America in 2014. California and Québec's joint auctions constitute the first multi-region integration of two directly systems with fully fungible carbon units [1]. The collaboration between California and Québec in the Western Climate Initiative (WCI) framework provides a strong demonstration effect for other regional cooperation, as it's economically and environmentally beneficial for both participants. There are also discussions and plans to integrate the California carbon market with EU trading scheme [27].

Another abortive plan to establish an international carbon market was announced in 2012 that a full bilateral integration between the two cap-and-trade schemes of EU and Australia would start no later than 1 July 2018 with absolute cap and fully fungible credits; however, uncertainties exist with the new Australia government coming into power. Moreover, there has been a growing discussion on the integration between South Korea and Japan with EU ETS or

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