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Decomposition of the factors influencing export fluctuation in China's new energy industry based on a constant market share model

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ABSTRACT

In this study, we investigate the factors influencing the fluctuation in the export trade of China's new energy industry, and the export trade fluctuations in its subdivision industries, using a constant market share (CMS) model and UN Comtrade export data for China's new energy industry from 1996 to 2014. The study reveals that the import demands of the international market for China's new energy industry dominate the fluctuations in the export trade of the industry. Moreover, there are different reasons for the fluctuations in the different export markets of China's new energy industry as well as the export trade fluctuations in the subdivision industries. To promote the development of China's new energy industry, numerous policy suggestions are proposed. These include culturing domestic markets, solving problems in the grid-connection and consumption of new energies, and carrying out international cooperation. Some corresponding suggestions for subdivision industries of the new energy industry are also presented.

1. Introduction

Extreme weather events are more frequently occurring around the world as a result of global warming. The negative influence of such disasters has further deepened the people's concerns about environmental problems. There is no doubt that consumption of fossil fuels is a major source of greenhouse gases. Therefore, due to the drawbacks of using fossil energies (including effect on climate and non-renewability), developing new energy sources should yield better alternatives to replace the fossil energies (Patrick and Damon, 2016).

As China is a rapidly-developing emerging economy and a country that consumes a vast amount of energy, the new energy industry is a strategic emerging industry in China. With the release of relevant subsidy policies to support the various subdivision industries of China's new energy industry, the development and support system for China's new energy industry has gradually improved. Moreover, standard systems for the new energies have been established and the quality of new-energy equipment is steadily improving, which is having an effective promotion effect on the development of various new energies. However, considering that energy sources (e.g. wind, solar, and biomass energies) often have higher generating costs than traditional fossil energies, there is a large financial deficit associated with the subsidies and the new energies greatly depend on these supporting policies on the whole. Thus, the new energies are significantly influenced by policy adjustment and are less competitive in export. Additionally, the expansion of the new energy industry has been somewhat disorderly as a result of the government's generous subsidies and shrinkage in the international markets. Thus, serious overcapacity problems occur in parts of China's new energy industry and industrial competitiveness still needs to be improved in the global markets (Shi, 2012; Xiong and Yang, 2016). Therefore, investigating the export trade fluctuations in the new energy products and deriving appropriate targeted suggestions for increasing China's new energy exports and improving industrial development are conducive to solving the overcapacity problem and improving product competitiveness. Such developments will also have an important effect on the sustainability of the developing new energy industry.

There is a copious amount of research on the export trade of China's new energy industry in the existing literature. However, the focus of much of it tends to fall into two extreme categories, concentrating on either the new energy industry as a whole or just one particular single subdivision industry. As a result, the different but related economic significance of the two levels is ignored. As is well known, compared with some other new energy subdivisions (e.g. the biomass energy industry), the solar and wind energy industries have developed so rapidly that they are experiencing overcapacity problems (Xiong and

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Yang, 2016; Liu and Kokko, 2010). Therefore, it is insufficient to give policy suggestions on the basis of studying the new energy industry as a whole. To address this problem, an important innovation is made in this study in that we decompose and analyze the subdivision industries in China's new energy industry so as to acquire different, more appropriate, policy suggestions. Furthermore, the existing research on the new energy industry rarely focuses on analyzing the export trade fluctuations in the new energy industry. In this context, we note that an important model which is commonly used to analyze export fluctuations and competitiveness in the field of international trade — the constant market share (CMS) model — has not yet been applied to decompose and explore the export fluctuations in the entire new energy industry and products of the subdivision industries. We use the CMS model for this purpose in this work.

This paper tries to make up for the shortages identified in the existing research. We consider three aspects: (1) Based on export trade data for China's new energy industry over the period 1996–2014, we introduce a CMS model to quantitatively analyze the degrees of influence and changes in factors affecting the fluctuation in the export trade in the new energy industry. (2) Considering the inadequacy of studying the new energy industry as a whole, this research further decomposes the export fluctuations in terms of the subdivision industries of the new energy industry. (3) Based on the above studies, overall policy suggestions are presented for the healthy development of both China's entire new energy industry and products of the subdivision industries.

The remainder of this article is organized as follows. Section 2 consists of a literature review which introduces and reviews the existing research on the development and foreign trade of the new energy industry, as well as the CMS model, in some detail. Section 3 describes the current state of the export trade in China's new energy industry. Section 4 deduces the empirical CMS model used in the study and analyzes its theoretical basis and export fluctuation mechanism. Section 5 displays our empirical results and gives a discussion of the export fluctuations in China's new energy industry. Section 6 summarizes the study and presents policy suggestions for China's entire new energy industry and its subdivision industries.

2. Literature review

2.1. Research on development and foreign trade of the new energy industry

In recent years, the new energy industry has been widely studied by scholars around the world and many have approached the subject from the perspectives of the significance, implementation strategies, and challenges presented to the industry. For instance, Fang et al. (2013) introduced the new energies into a nonlinear evolutionary system to empirically analyze energy conservation and emission reduction. Their results show that simply increasing the economic input to the new energies can hinder the development of the economy in the early stages. However, as the new energies gradually become more mature, the benefits of such investments to the economy gradually increase. Roula (2016) indicated that the influence of renewable energy consumption on economic growth is positive, and statistically significant. This means that promoting renewable energies has economic benefits as well as environmental ones.

Shi (2012) pointed out that the problem of overcapacity that appears in the initial stage of development of China's new energy industry arises for various reasons such as shrinkage in the international market and lack of coordination between industrial development and market cultivation (as well as between productivity development and system construction). In view of the causes outlined above, solutions to the overcapacity problem need to be proposed, as we do here.

Luo et al. (2015) has recently summarized and introduced the development of several new energies including solar energy, biomass energy, nuclear power, and wind energy, and outlined the major technical challenges to be faced by new energy development in China. These challenges include that the new energy industry in China lacks the high-tech technology required (i.e. key technologies relating to the industry lag behind those expected at international level), and that environmental friendly new energies also produce a large amount of pollution and have high energy consumption.

The studies mentioned above highlight the internal production and development of the new energy industry. At present, scholars are paying more attention to studying foreign trading of new energy industries as the industries gradually develop. Representative research is exemplified as follows.

Based on data from input–output tables for 1992, 1997, and 2002, Zhao and Hong (2009) empirically studied the influence of foreign trade in China on energy consumption using a factor decomposition model for the input–output structure. Their results show that controlling the net export of energy-intensive products, promoting the export of high-tech products for clean energies (including renewable energy sources), and developing new energies can reduce China's energy consumption and consumption of exported products for fossil energies. Unfortunately, the United States has implemented a dual anti-subsidy strategy which acts against China's new energy industry. However, Chen and Tu (2013) put forward effective strategies to respond to the implementation of this strategy. Apart from this, Liu and Kokko (2010) demonstrated how overcapacity problems associated with wind power had spilled over into international trade relations. Fu (2013) and Liu (2015) constructed a spatial gravity model and Trade Competitiveness index according to customs data and used them to study international trade relationships and export competitiveness of China's new energy industry, respectively.

2.2. The use of the CMS model to probe export fluctuations

The CMS model was first proposed, modified, and improved by Tyszynski (1951) and Jepma (1989). It is used to explain the fluctuations in export volumes of certain products in a particular country and has been one of the most important models in the field of international trade. It is mainly used to analyze export trade fluctuations and competitiveness. It is worth noting that although export trade fluctuations can be obtained through export trade volumes, the two concepts are not completely identical. Theoretically, an export trade fluctuation corresponds to a difference in trans-period export trade volumes and the two concepts have different economic significance. However, as an empirical model which can be used to decompose and analyze export trade fluctuations, the CMS model does not try to explain how a certain economic variable affects the export trade volume. (In fact, there is a large number of such economic variables and they cannot all be measured.) In contrast, the CMS model *explains* the reason for a fluctuation in the export trade volume within the CMS analytical framework. It accomplishes this by dividing the fluctuations in the export trade volume into three parts each with different economic significance (including scale effects, competitive effects, and second-order effects) and this makes it superior to other approaches. Thus, by using the CMS model, better policy suggestions can be proposed to promote further growth in export trade.

The essence of a CMS analysis is to reveal whether the fluctuations in the export volumes of a country are caused by a change in its own market share (change of product competitiveness) or by an expansion or shrinkage of the total import market (Ahmadi-Esfahani, 2006). CMS analyses have been widely used in academia to investigate the causes of foreign trade growth and international competitiveness trends in export products (Zhang and Liu, 2012). Chen and Duan (2001) measured the competitiveness of Canada's agricultural products in Asian markets during 1980–97 using a CMS model. After extending the