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The impact of subsidies on overcapacity: A comparison of wind and solar energy companies in China

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ABSTRACT

Determining the level of subsidy is an important measure in addressing overcapacity in Chinese renewable energy enterprises. In this article, we employ a threshold regression model to analyze the impacts of government subsidies on the overcapacity of wind and solar energy companies. Our findings indicate the separate subsidy thresholds for solar and wind energy companies. The results reveal that even where the subsidy falls into a relatively effective interval, it will still intensify the risk of overcapacity in solar energy companies, but can help address overcapacity in the wind energy companies. The paper concludes that the level of subsidies should be unique for each industry, and suggests a prudent reform of the subsidy policy for the solar energy enterprises.

1. Introduction

Subsidization is an important tool available within the arsenals of governments in supporting their renewable energy industries. In contrast with developed countries, China attaches more importance to this policy instrument. These policies have been promulgated in *Proposals for Implementation of Tax Support Policy on Development of Bio-energy and Bio-chemical Industry* (2006), *Interim Management Measures for Special-Project Funds of Wind Power Generation Equipment Industrialization* (2008), *Interim Management Measures of Financial Subsidy for the Application of Solar Photovoltaic Buildings* (2009), *Notification on Initiating Golden Sun Demonstration Projects* (2009), *Notification on Printing and Issuing Proposals for the Implementation of Industry Revitalization of Mechanical Fundamental Parts and Components* (2010), and *the Circular on Perfecting the Price Policy of Photovoltaic Power Generation* (2013), offering financial support to solar energy, wind energy and other renewable energy companies. For instance, *Proposals for Implementation of Tax Support Policy on Development of Bio-energy and Bio-chemical Industry* (2006) stipulates that government offers flexible deficit subsidies, tax preferences and industrialized demonstration subsidies to bio-energy and biochemical production enterprises. According to *Interim Management Measures for Special-Project Funds of Wind Power Generation Equipment Industrialization* (2008), the central government should earmark special funds in support of industrialization of wind power generation equipment and subsidize enterprises whose research and development achievements are recognized by the market. *The Circular on Perfecting the Price Policy of Photovoltaic Power Generation* (2013) proposes that the surplus of photovoltaic power stations' benchmark on-grid power price over local coal-fired units' benchmark on-grid power price will be subsidized through the renewable energy development fund. Furthermore, a considerable part of renewable energy companies such as GRINM advanced materials Ltd., Linuo Solar Ltd. and Luoyang Bearing Science & Technology Co. Ltd. have been subsidized by both the central and local governments.

In theory, subsidization can distort enterprise investment behavior, especially when driven by government achievement goals. This may lead to redundant construction and bring about the risk of overcapacity, defined as excess supply relative to demand [1]. Previous work has provided evidence that PV cell production capacity in 2012 accounted for 63 percent of the world's total [2],

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and the overcapacity rate of wind energy in the same year was more than 50 percent [3]. These studies reinforce the fact that both of these industries continue facing the problem of overcapacity. Thus, elimination of renewable energy subsidies should be considered to alleviate this issue.

When the key technology lags behind and renewable energy products are the topic of anti-subsidy trade disputes, the overcapacity situation of solar and wind energy industries can become more severe, and the deficit of some enterprises steepens. For instance, once the “wind vane” of photovoltaic industry in China, Wuxi Suntech Group, has gone bankrupt under such circumstances.

If the experiences in developed countries are to be followed, determining a moderate subsidy scale instead of completely canceling subsidies is a suitable solution for dealing with overcapacity at a certain stage. This, then, begs the question: what constitutes a moderate amount of subsidy? This article will use a threshold regression model by dividing samples into multiple intervals endogenously, and assess the relationship between subsidies and overcapacity among various intervals, thus determining the optimal subsidy scale. The advantage of the threshold regression model is that endogenous, not exogenous, groupings will more accurately explain the impact of explanatory variables on explained variables within different groups. Furthermore, the model provides for the use of significance tests for threshold values. The main contributions of this paper are twofold: to provide an analysis of the overcapacity from a micro-data perspective and to compare wind and solar companies with a view to helping develop subsidy policies when faced with disparities.

2. Literature review

Currently, the viewpoints on determination of subsidies can be grouped into two types:

(1) The scale (or effect) of subsidy. Lin and Jiang adopted the price difference model to estimate price grants of Chinese energy products in 2007. The results indicate that the present scale of subsidies for clean energy is too small in contrast with subsidization of fossil energy [4]. In addition to price difference method, both the methods of renewable energy quotas and consumption side subsidies for end consumers can be used to measure subsidy scale. It should be noted that both of the aforementioned methods focus on the subsidy amount acquired by the energy consumers [5,6]. Zhang et al. applied the integrated renewable power planning (IRPP) model to estimate the potential subsidy scale for wind and solar energy [7]. As for the subsidy effect, multiple studies have focused on the relationship between subsidies and welfare loss [8], trade disputes [9], the impacts of R&D subsidies on costs [10], industrial competitiveness [11] and the impacts of investment by the enterprises in R&D [12].

Only a few of the studies directly analyzed the capacity effect of subsidies. Limited studies on the topic mainly discuss the influence of subsidies on energy supply, which indirectly demonstrated the relationship between subsidies and overcapacity. For instance, Macintosh and Wilkinson used the government projects in Australia as an example to point out that the subsidies had promoted the growth of photovoltaic industry more than six times [13]. Contrary to the results obtained by Macintosh and Wilkinson, Briggs et al. found that, within the electric power market, subsidies resulted in a reduction of energy supply [14]. Shen and Luo investigated the subsidy policy of renewable energy in China, and found that the impacts of subsidies on energy supply varied for different energy sources. That is, although subsidies resulted in an expansion for the solar and wind power generation, it had non-significant impacts on biomass power generation [15]. For the distributed power generation in Iran, Shahverdi et al. revealed that reduction of subsidies would affect distributed power generation operation and investments [16]. Our review of the literature indicates that the relationship between subsidies and energy supply is industry dependent.

(2) The factors of overcapacity. Wang et al. indicated that although no industrial overcapacity had yet occurred for the Chinese wind power equipment and photovoltaic products, the excess entry of low-end capacity had already took place for these industries. Therefore, both of these industries face the risk of industrial overcapacity in the future [17]. It should be noted that Wang et al.'s data spans a time interval between 2005 and 2010. Consequently, Wang et al.'s conclusions have some limitations. Shi attributed the overcapacity in the industry to the shrinkage of global demand, the inconsistency between industrial development and market cultivation, etc., proposing that subsidy is a crucial measure in governance of overcapacity [18]. However, the results presented by Shi deserve further scrutiny: First, the author utilized a qualitative approach, which may lead to unreliable research conclusions. Second, Shi failed to consider the government subsidies in stages of research & development and production as an important driving factor of excess capacity. On the other hand, Han and Wang et al. held the opinion that government intervention was a factor leading to overcapacity. For instance, Han pointed out that in addition to overseas demand and renewable energy prices, the excess investment of local governments also had a considerable influence on overcapacity [19]. For the development of photovoltaic industry in China, Wang et al. provided evidence that government support, industrial profit margins, entry threshold, etc. promoted the growth of capacity [20]. Instead of choosing renewable energy industry as an example, Yang et al. reached a similar conclusion of government intervention leading to Chinese-style overcapacity pointing out that subsidy is an important tool that the government uses to intervene in some specific industries [21]. To shed light on the mismatch between installed capacity and wind power generation, Lacerda and Bergh compared the utilization of wind power installations and their drivers in China, the US, Germany and Spain. They concluded that both Grid connection restrictions and lack of integration of market incentives in China were responsible for a decline in capacity utilization [22].

A few scholars focused their attention on overcapacity in the European and Taiwanese renewable energy industries. Their investigations have shown slight differences in results compared to those of mainland China. Boccard explored the capacity factor of wind power in Europe and highlighted the impacts of wind speed, the behavior of the wind power industry, political interference and the mode of finance [23]. Similar with partial views of Boccard, Chang also maintained that wind speeds were drivers of capacity [24]. Flora employed a panel data model to examine the wind idle capacity of 18 European countries. His results illustrated that improving technological efficiencies and stimulating additional wind capacity were effective remedies for capacity idleness [25].

In reviewing the literature regarding the scale of subsidies or factors that lead to overcapacity we observe the following: (1) current studies on the subsidy scale of renewable energy products adopt a macro-perspective, rather than a micro-perspective. (2) Research on factors that lead to overcapacity within the renewable energy industry mainly focuses on qualitative analysis. A review of the literature however indicates that few papers have applied empirical tests.

Furthermore, data is readily available for a number of renewable energy companies since they are publicly traded. Wind and solar energy companies account a large percentage of these publicly traded companies, hence this article focuses on these two industries to examine the impacts of subsidies on overcapacity.