

# Study on the effect of wind power industry policy types on the innovation performance of different ownership enterprises: Evidence from China



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## ABSTRACT

Studying effect of different types of wind power industry policies on the technological innovation of enterprises is the core issue that academics and policymakers pay close attention to nowadays. Based on systematically carding the quantization of 254 wind power industry policies issued by governmental departments at the ministerial level and above in China from 1994 to 2016, this paper categorizes innovation policy instruments into supply-side, environmental-side, demand-side, and employs Negative Binomial Regression Estimation Model to research the impact of industry policies on wind power enterprises' innovation performances. The research results show as follows: the effect of different types of policy instruments on enterprise innovation is significantly different: demand-side policy and environmental-side policy have significant inhibitory effects on enterprises' innovation performance, but supply-side policy has a significantly positive effect especially on the core technological innovation. The effect of wind power industry policies on the innovation quality of different ownership enterprises is significantly different: comprehensive policy and supply-side policy have positive impacts on the core technological innovation of private-owned enterprises, while demand-side policy and environmental-side policy have only positive impacts on the non-core technological innovation of state-owned enterprises. Finally, this paper proposes certain recommendations to consummate wind power industry policies for China.

## 1. Introduction

Since the reform and opening up (beginning in 1978), China has made remarkable achievements in its economic development. At the same time, it has also caused a great increase in energy consumption and carbon dioxide emissions. China faces the dual challenges of economic development and environmental governance. Therefore, ensuring sustainable economic growth and energy structure adjustment is two of China's major concerns (Huang et al., 2018). In the global context of environmental pollution and energy crisis, renewable energy technologies are one of the most representative emerging technologies in the future and are of crucial importance to the sustainable development of the country. Compared with renewable energies such as solar energy and biomass energy, wind energy has more advantages in terms of technical reserve, economic benefits and development potential, attracting general attention from abroad and within China (Hong et al., 2013). In China, the wind power resources are rich and low development and utilization costs, occupying an important position in the new

energy industry (Zhao et al., 2016a). Driven by a series of supporting policies issued by the Chinese government, China's wind power industry has also achieved rapid growth in the past two decades. By the end of 2016, China added 23,370 MW of new installed capacity with a cumulative installed capacity of 168,732 MW, ranking first in the world<sup>1</sup> (GWEC, 2016). However, at present, the development of wind power industry has also exposed serious bottlenecks. For example, most of wind power enterprises have relatively low innovation levels and innovation efficiency, and rely on a high degree of external dependence on core or major technologies, which leads to low quality of wind turbines and in turn causes accidents and technical obstacles in the process of operation (Kang et al., 2012). In addition, the construction and operation of wind power farms are in chaos, the power grid construction lags behind and the “wind curtailment” phenomenon occurs frequently (Zhao et al., 2014).

Technological innovation is an important way for Chinese wind power enterprises to achieve industrial upgrading and leapfrog development by breaking through the bottleneck of overcapacity and lack of

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<sup>1</sup> The top three countries with cumulative installed capacity of wind power-China, the United States and Germany-respectively account for 34.7%, 16.9% and 10.3% of the cumulative installed capacity of the global wind power.

core technology. To this end, central government of China launched a package of industry policies and it issued 254 wind power industry policies from 1994 to 2016<sup>2</sup> (see Fig. 1). Specific measures involve preferential tax policy, financial support policy, technology research and development supporting policy, wind power grid-connected supporting policy and preferential policy for foreign-direct-investment enterprises, etc. (Sahu, 2018; Zhao et al., 2016b), which aim to promote wind power enterprises breaking through the existing development bottleneck and getting advantage backwardness, and further to promote the innovation performance of wind power enterprises. Studies have shown that support policies have quickly promoted the production ability of wind power enterprises. However, high spending did not effectively improve their innovation performance, lack of key technologies and dependence of core components on imports remain the severe pressure on Chinese wind power enterprises (Curran et al., 2017). Although industrial innovation policies urge enterprises to focus on core technological innovation, they have failed to achieve the technology catching-up effect at the national level (Qiu et al., 2013), and the implementation effects of wind power industry policies have deviated and therefore lead to policy failure.

Concerning the reasons for the deviation of the policy implementation in the wind power industry, the previous researches included many perspectives such as the goals, positioning, action point and the “crowding out” effect of the policy (Gao et al., 2017a). According to our findings from previous literatures, most scholars explained the reasons for the deviation of the policy implementation on a macro-level, generally believing that there were problems of instability and inconsistency in the policies issuing of the wind power industry (Yoon et al., 2017; Reichardt and Rogge, 2016; Wang et al., 2016; Liao, 2016). What's more, wind power industry policies didn't yet solve the root problems of insufficient core competitiveness in the wind power equipment manufacturing industry (Kang et al., 2012). Hence, analyzing the implementation of wind power industry policies and current policy instability and inconsistency from a macro perspective can explain, to a certain extent, the deviation of the implementation effect of China's wind power industry policies, but it lacks researches on the influence mechanism of wind power industry policies on the enterprises' innovation performance and the relationship between policy instruments and the innovation quality of enterprises. On the positive side, previous studies pointed out the types of industrial policy instruments for technological innovation in the wind power industry and the effect-deviation phenomenon in the implementation of policies, and identified the factors influencing the effect of industry policies. These studies have laid a solid theoretical and practical foundation for revealing the effect of wind power industry policies on the innovation performance of micro-enterprises, and for the analysis on different influence on the innovation of different ownership enterprises.

The existing literature on the impact of the industry policies on enterprises' innovative behavior were classified more according to the

<sup>2</sup> Chinese government continued to vigorously support the development of wind power industry in 2017 and 2018. 23 wind power industry policies were promulgated in 2017. In 2018, the National Energy Administration also issued the *Notice on Relevant Matters Relieving the Burden of Enterprises in the Renewable Energy Sector*. Strictly implementing the requirements of the *Renewable Energy Law*, the healthy development of the renewable energy industry should be effectively ensured, the investment environment should be optimized and the cost of renewable energy development should be reduced. Besides, the public services such as the government's release of management services should be improved to stimulate market vitality, and industry management should be improved to reduce investment and business burdens. Policy regulations emphasize that the tax burden on wind power enterprises should be reduced. The financing costs of wind power enterprises can be reduced through green finance, and wind power grid-connected and guaranteed acquisitions should be strongly supported to promote the sustainable development of wind power enterprises.

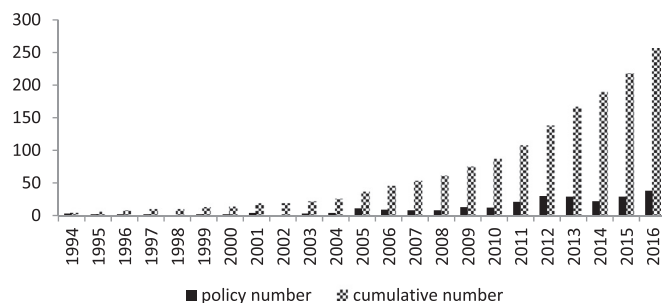


Fig. 1. The number of wind power industry policies (1994–2016).

innovation content and the innovation strength, and few of them analyze enterprises' innovative behavior from the perspective of the innovation quality (Li and Zheng, 2016). Dang and Motohashi (2015) think that although the Chinese government R&D subsidy program has played an important role in enterprises' patent application as well as the increasing number of granted patents and the government R&D subsidy has a promoting effect on enterprises' non-core technical innovation (such as a patent application of low quality), its incentive effect on enterprises' core technical innovation is barely satisfactory, which shows the Chinese patent foams. In fact, besides those innovative behaviors from enterprises for promoting technical advances and maintaining the competitive advantages, there are other innovative activities, which are a kind of strategic behavior for obtaining other benefits. Since there is a “decouple” phenomenon in enterprises, some patents are perhaps only for catering to the governmental supervision instead of the core technical innovation (Li et al., 2015; Wagner and Wakeman, 2016). Therefore, a mismatching phenomenon of “goals-instruments” is existing during the implementation of the industry policies to some extent (Fan and Tan, 2017), and industrial policy instruments has not yet effectively promoted enterprises' core technical innovation. In view of this, this paper is trying to identify the innovation performance of different qualities and to study the impact of policy instruments of Chinese wind power industry on the innovation of micro-enterprises, which plays a significant role in terms of the academic value and the policy implication when understanding the interaction between the government and enterprises, making comments on the effect of the policy implementation and making arrangements for the action mechanism during the process of implementing the policy of Chinese wind power industry

## 2. Literature review

The main objectives of the industry policies supporting for enterprise innovation include improving national innovation capacity and social productivity, and enhancing the competitive environment as well as innovation environment for enterprises and helping enterprises gain technological competitiveness to lead the market (Guan and Yam, 2015). Many scholars believe that the market failure caused by information asymmetry, financial market defects and externalities will lead to insufficient investment in market research and development, and R&D investments of enterprises may remain below the social optimum (Boeing, 2016). In order to overcome the market failure, the government has introduced a series of industry policies including financial support (tax incentives, financial loans, government subsidies, etc.), information provision, government procurement, education and training, registration and supervision (Storey and Tether, 1998), which helps to eliminate the negative externalities of R&D activities, guarantee the return on R&D investment and strengthen the innovative behavior of enterprises (Xu et al., 2014). Industry policies can potentially influence both the pace and direction of enterprise innovation through its role in industrial systems, consumers and public service demands. Some industry policies may effectively promote technological

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