**Does renewable energy policy crowd out innovation? perspective from zombie firms**

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## Overview

## With the increasing prominence of climate change and resource shortage, it has seriously affected people's living environment, physical health and social welfare. The development of renewable energy has been incorporated into the key development plans of various countries, and 179 countries have established national or regional renewable energy development goals. The effectiveness of renewable energy policies plays a crucial role in promoting the widespread use of renewable energy worldwide. Renewable energy companies interact with the central government and local governments to form a policy community. They are participants in formulating key policies. Besides, the willingness and ability of companies to innovate in renewable energy technology is the key to energy transition and low-carbon development in the economy and society. By analyzing the relationship among renewable energy policies, zombie companies, and technological innovation, we try to reveal the reasons why China’s renewable energy industry is "big but not strong" and enters overcapacity in advance, so as to better promote the healthy development of renewable energy.

Based on the unbalanced panel data of China's renewable energy listed companies from 1995 to 2019, this paper explores whether different renewable energy policies (mandatory regulation and fiscal incentive regulation) all trigger zombie companies and if so, how this influence can be transmitted to the technological innovation of other companies in the industry. In addition, we further investigate whether the heterogeneity of enterprises will affect the renewable energy policies effects on the probability of becoming zombie companies and the technological crowding-out effects from the perspective of the enterprise's ownership, the external financing dependence, and the locations.

## Methods

## We adopt the mediation analysis of categorical variables proposed by Iacobucci (2012), and take zombie companies as the mediating variable to explore the relationship between renewable energy policy and technological innovation. The mediation analysis of categorical variables is adopted to solve the process and mechanism of the influence of independent variables on dependent variables when explanatory variables, explained variables and mediating variables are discontinuous variables. In this paper, the mediating variable zombie firm is a discontinuous variable, and the modified FN-CNK method proposed by Fukuda and Nakamura (2011) is adopted to judge whether renewable energy companies are zombie companies through the profit standards and evergreen lending standards.

## Results

The empirical results show that mandatory regulations (development plans, on-grid and mandatory purchases) can reduce the probability of becoming a zombie company. However, due to the lack of strict implementation standards, the negative effects are not significant. The fiscal incentive policies (subsidies and green credits) can significantly increase the probability of becoming a zombie company, thereby crowding out technological innovation. Moreover, we further discuss the heterogeneity of the crowding-out effect for different enterprises, and conclude that the crowding-out effect of state-owned enterprises and enterprises with high external financing dependence is more significant, and the crowding-out effect in the western region is higher than that in the eastern and central regions.

## Conclusions

## Firstly, based on the unbalanced panel data of listed renewable energy companies in China from 1995 to 2019, we evaluate the impact of mandatory regulations (development planning, on-grid, and mandatory purchases) and fiscal incentive regulations (subsidies and green credit) on the formation of zombie companies to explore which policies would curb the growth of zombie companies. We also adopt the mediation analysis of categorical variables to explore how the effects of different renewable energy policies and zombie companies are transmitted to technological innovation, and further analyze the mechanism of the effect of renewable energy policies on technological innovation.

## Secondly, we further explore whether the effectiveness of renewable energy policies will change due to the heterogeneity of enterprises. Therefore, we analyze the impact of renewable energy policies on increasing the probability of becoming zombie companies in different enterprises' ownership nature, different regions, and different external financing dependence to estimate the influence of different enterprises' nature on increasing the probability of becoming zombie companies and how this influence can be transmitted to technological innovation.

## References

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