Influence of Carbon Allowance Distribution Scheme and Auction System of Chinese Pilot Carbon Market on Carbon Price - AR-GARCH-based Analysis

Wenxiu Zhang, BeiHang University, 15600280923, zwxiu0818@126.com

Overview

Carbon emission trading scheme, as an effective emission reduction means, currently has been widely applied and studied, China has established multiple pilot regions to promote and implement carbon emission trading scheme, and made efforts in establishing national carbon emission permit trading scheme. This paper adopts AR-GARCH model to describe the changing characteristics of carbon price in the three pilot regions of Shanghai, Guangdong and Hubei, adopts the bilaterally modified dummy variable to describe the influence of carbon allowance distribution scheme and allowance auction policy on carbon market, it was found through fitting result that the developments of the three pilots of Shanghai, Guangdong and Hubei reflected relatively big difference due to the territory difference and policy difference, the setting of total allowance and change of distribution method would indeed generate influence on carbon price fluctuation; allowance auction could to certain extent guide the trend of carbon price, allowance auction before market opening could play the role of price discovery. Targeting the development situation of carbon markets in three pilot regions, this paper proposes some policy suggestions for China to establish national carbon market.

Methods

We adopt AR-GARCH model to describe the changing characteristics of carbon price in 3 pilot regions, as well as adopt the bilaterally modified dummy variables to add to the fitting process of carbon price return rate, so as to describe the impact of the release of carbon allowance distribution scheme and carbon auction on the carbon market, uses the AIC (Akaike information criterion) information code as the standard of measuring model fitting excellence, and selects the parameter combination that minimize model AIC value to realize the optimization of fitting effect of model.

$$r_t = c + \sum_{s \geq 1} a_s r_{t-s} + b d_t + \varepsilon_t \tag{1}$$

$$\varepsilon_t = v_t \sqrt{h_t} \tag{2}$$

$$h_t = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1} \tag{3}$$

$$d_t = \begin{cases} 1, & \text{There is carbon emission permit quota distribution scheme that is released on current day} \\ 0, & \text{There is no carbon emission permit quota distribution scheme that is released on current day on} \end{cases} \tag{4}$$

In formula (1), r_t means the logarithmic return rate of carbon price of various pilot regions, formula (1) means the auto-regression model of the logarithmic return rate of carbon price, in which s means auto-regressive process of order, formula (2) and formula (3) together described the GARCH (1, 1) model, and gives the definition of first-order lag variable of ε_{t-1}^2 and h_{t-1}, ε_t means the residual error of fitting process, while v_t means a white gaussian noise series. Formula (4) defines the traditional dummy variable, it describes the impact of carbon emission permit allowance distribution scheme and allowance auction on carbon market price fluctuation.

In order to enable the description of impact of dummy variable on allowance distribution scheme and allowance auction to be fitting the actual circumstance more, we shall adopt the bilateral modification to modify the traditional dummy variable.

Results

In the aspect of influence of allowance distribution scheme release, the allowance distribution scheme at Shanghai pilot and Guangdong pilot generated relatively obvious influence on carbon price, meaning the change of total allowance setting and distribution would indeed generate influence on price, and verified our forecast before, but only the first allowance distribution scheme at Hubei pilot generated influence on carbon price, while the latter two

schemes didn't have significant influence, meaning there was difference in the development situation of different pilot carbon markets, from the development situation of Hubei pilot, the total allowance setting was too high, causing market oversupply, maybe it was the fundamental reason why the carbon price kept dropping.

In the aspect of the impact of allowance auction, the results of Guangdong pilot and Hubei pilot was relatively obvious, meaning that allowance auction could indeed have the effect of discovering carbon price and guiding carbon price to certain extent, but the impact of allowance auction on carbon price was not significant at Shanghai pilot, by integrating the development situation of Shanghai pilot, the main cause of such result might be that the purpose of allowance auction was different, the allowance auction of Shanghai pilot was at the end of contract performing period, and mainly was to assist the enterprises that failed to completed contract performance to timely complete contract performance, which was different from the allowance auction in other pilot regions in terms of purpose.

Conclusions

Generally speaking, the development of carbon markets in various Chinese pilot regions varied a lot due to regional differences and policy differences, and there are still many phenomenon of irrational total allowance setting, unfair allowance distribution, etc., the related policy and system of carbon market is still incomplete, through the analysis of the development situation of Chinese pilot regional carbon markets so far, we have the following conclusions, and propose some policy suggestions for the establishment of national carbon market in the future: Firstly, we shall guarantee the rationality of total allowance setting and the fairness of allowance distribution. Secondly, we shall guarantee the high efficiency and circulation of carbon market. Besides, the improvement of related policies and systems of carbon market to give market participants confidence is also very important. Other than that, allowance auction is a very good price discovery means and market price adjustment and control means.

References

[1] Fan Y, Mo J L, Zhu L. China's Carbon Market: Policy Design and Social Economic Influences [M]. Science Press, 2016.

[2] Fan Y, Jia J J, Wang X, et al. What policy adjustments in the EU ETS truly affected the carbon prices?[J]. Energy Policy, 2017, 103:145-164.

[3] Wei Y M. Carbon Finance and Carbon Market: Methods and Empirical [M]. Science Press, 2010.

[4] Bank W. State and Trends of Carbon Pricing 2017[J]. World Bank Other Operational Studies, 2017.

[5] Su L,Cao Y K, Chen Y. Current Situation and Revelation of European Union Emission Trading Scheme [J].World Forestry Research,2012,25(03):55-58

[6] Shen W Q, European Union Carbon Market Development Study [D], Jilin University, 2011

[7] Liu H, Analysis of European Union Carbon Market and Its Reference to China [D], Fudan University, 2011

[8] Gloaguen O, Alberola E. Assessing the factors behind CO2 emissions changes over the phases 1 and 2 of the EU ETS: an econometric analysis[J]. 2013.

[9] Chevallier J. Evaluating the carbon-macroeconomy relationship: Evidence from threshold vector error-correction and Markov-switching VAR models[J]. Economic Modelling, 2011, 28(6):2634-2656.