



Research on the Path to Improve the Financial Performance of New Energy Listed Companies Based on Configuration Perspective

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Abstract. Green development is the basic concept of China's economic development at this stage, and under the double pressure of resource crisis and environmental crisis, green development has put forward higher requirements for the development of new energy industry. This study selects a sample of 456 cases from Chinese listed companies in the new energy industry from 2013 to 2021 in the RESSET database, and uses the Fuzzy-set Qualitative Comparative Analysis (fsQCA) to investigate the effects of macroeconomic policy uncertainty, corporate social responsibility, R&D investment and The fuzzy-set qualitative comparative analysis was applied to analyze the mixed effects of macroeconomic policy uncertainty, corporate social responsibility, R&D investment and shareholding structure on corporate performance, and six high performance antecedents were identified. The results show that: (1) CSR positively affects firm performance. (2) Under low economic policy uncertainty, higher equity balance improves corporate performance; under high economic policy uncertainty, higher equity concentration improves corporate performance; (3) R&D investment has a 2-year lag effect on corporate performance.

Keywords: Economic policy uncertainty · corporate social responsibility · R&D investment · equity structure · firm performance · fuzzy set qualitative comparative analysis

1 Introduction

The report of the 19th Party Congress clearly points out that China adheres to the concept of green development, actively promotes the reform of energy production methods and the revolution of consumption methods, and will further develop new energy sources such as clean and low-carbon as the main direction of energy structure adjustment. The new energy industry also complies with the construction of ecological civilization. With the proposed carbon compliance and carbon neutral goals, new energy technologies such as wind power and photovoltaic have become the key direction for the future flourishing of the new energy industry, and China is paying more and more attention to the application of new energy. The widespread use of new energy technologies has effectively alleviated the global warming problem while reducing various environmental

pollution. To achieve high-quality development of the new energy industry, enterprises need to actively cooperate with government departments, partners, society and various stakeholders, and take the initiative to assume social responsibility, enhance the concept of environmental protection, assume environmental responsibility, and promote the realization of green and low-carbon sustainable development of the industrial economy. The new energy industry, as a strategic emerging industry in China, has been relatively slow to develop overall. It is of great practical importance to study how companies in the new energy industry respond to different environments to achieve higher corporate performance.

2 Literature Review and Model Construction

Regarding the research on the impact of CSR on corporate performance, Orlitzky (2003) conducted a meta-analysis of a large body of research literature and found that corporate financial performance can be improved through active social responsibility [1]. Through empirical research, Tian Min et al. (2014) found that corporate social responsibility behavior can significantly improve consumer brand evaluation and thus establish a good corporate image, which in turn maximizes corporate benefits [2]. Regarding the research on the impact of R&D investment on corporate performance, Hu (2004) selected and empirically analyzed the data of industrial enterprises in Beijing from 1991 to 1997 and found that R&D investment can significantly improve firm performance [3]. Bhagwat and Debrune (2011) used a production function approach to verify that R&D investment has a positive impact on the revenue of pharmaceutical companies, which is because as time progresses, the cost of R&D investment will gradually be transformed into the intellectual or technological capital of the company, thus significantly improving the performance of the company [4]. Regarding the impact of equity structure research on the impact on firm performance. X.W. Wang et al. (2014) conducted an empirical study with a sample of Chinese GEM-listed firms and found a parabolic regression relationship between the change in firm value and the shareholding ratio of the largest shareholder [5]. X.W. Cao (2020) conducted an empirical study with a sample of cultural media firms in China and pointed out that equity concentration can positively affect the business performance of firms [6].

Research on the factors influencing firm performance has been abundant, but most studies have used an isolated perspective to analyze the causal relationships between variables. The emergence of desired outcomes in management practice is often the result of the interdependence and joint influence of multiple conditions [7]. As pointed out by configuration theory, configuration analysis adopts an overall perspective to systematically analyze the complex causal relationship between the configuration composed of multiple antecedent elements and the expected results [8]. In this paper, we intend to explore the logical combination paths of antecedent elements that influence firm performance in the new energy industry and analyze how to improve firm performance in different contexts. Through literature review and systematic analysis, this paper considers the lag effect of R&D investment from the perspective of configuration theory and set theory, and uses the fsQCA method to analyze the interaction of four dimensions of economic policy uncertainty, corporate social responsibility, R&D investment and equity structure

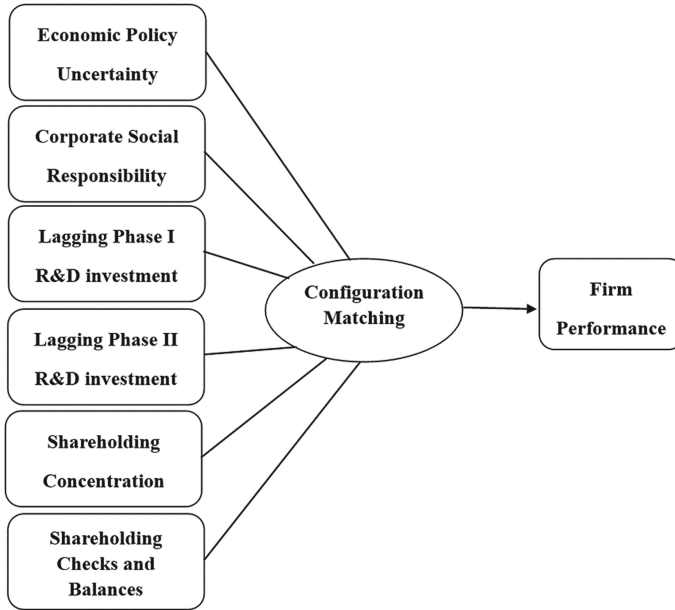


Fig. 1. Theoretical model

on the path of corporate performance, to further enrich the research theory of corporate performance in new energy industry and to provide It provides theoretical guidance for enterprises to build a reasonable corporate governance system.

Based on this, this study constructs a theoretical model of antecedent factors affecting firm performance improvement based on configuration theory and set theory (Fig. 1). The model includes six antecedent conditions affecting firm performance, including economic policy uncertainty, corporate social responsibility, lagged phase I R&D investment, lagged phase II R&D investment, equity concentration and equity checks and balances, and the antecedent configuration for firms to obtain high performance are derived through the fuzzy set qualitative comparison analysis method.

3 Research Design

3.1 Fuzzy Set Qualitative Comparative Analysis

QCA is based on the set theory of Boolean algebra, which examines the subset of relationships between multiple antecedent conditions and outcomes, and explores the configuration analysis method of multiple antecedent paths leading to outcomes from a holistic perspective. The main reason for choosing the fsQCA method in this paper is its advantages over traditional regression analysis and the other two QCA methods: i) traditional regression analysis analyzes the “net effect” of each variable on the dependent variable in isolation [9], although it is possible to study the effect of multiple interdependent independent variables on the dependent variable by constructing interaction terms

Table 1. Variable measurements.

Variables	Symbols	Calculation method
Firm performance	ROA	Net profit/total assets
Economic Policy Uncertainty	EPU	Macroeconomic Uncertainty Index
Corporate Social Responsibility	CSR	Corporate Social Responsibility Score
Lagging Phase I R&D investment	L.RD	R&Dt-1/ (Total operating revenue) t-1
Lagging Phase II R&D investment	L2.RD	R&Dt-2/ (Total operating revenue) t-2
Shareholding Concentration	First	Percentage of shareholding of the largest shareholder
Shareholding Checks and Balances	Z	Shareholding ratio of the second, third, fourth and fifth shareholders / Shareholding ratio of the first largest shareholder

Although the effect of multiple interdependent independent variables on the dependent variable can be investigated by constructing interaction terms, interaction terms with more than three independent variables are difficult to explain. ② Compared with csQCA and mvQCA, instead of allowing only two mutually exclusive states (i.e., full membership and full nonmembership), fsQCA extends csQCA to allow for affiliation levels in the interval from 0 to 1. The five antecedent conditions in this study are all continuous variables and are suitable for study using fsQCA.

3.2 Variables and Measurements

Economic Policy Uncertainty uses the Economic Policy Uncertainty Index jointly compiled by Stanford University and the University of Chicago, and an arithmetic average of the monthly uncertainty indices is able to obtain an annual Economic Uncertainty Index (EPU). Corporate Social Responsibility (CSR) uses Hexun's CSR composite score. Equity concentration is measured by the percentage of shares held by the top shareholder, and equity checks and balances are measured by the Z index. In this paper, the return on total assets (ROA) is used to measure corporate performance. In summary, the variables are measured, as shown in Table 1.

3.3 Descriptive Statistical Analysis

The sample comes from 109 A-share listed new energy companies in different years, and 89 companies meet the requirements after excluding ST companies. Data on corporate performance, R&D investment, equity concentration and equity checks and balances were obtained from the RESSET database. In this study, cases with missing data are excluded, and a total of 456 cases are obtained. This paper uses fsqca3.0 to conduct descriptive statistical analysis on the outcome variable corporate performance involved in the study as well as the antecedent conditions, and the relevant data situation, as shown in Table 2.

Table 2. Descriptive statistics.

Variable	Mean	Std. Dev.	Minimum	Maximum	N Cases	Missing
ROA	4.567	7.206	-45.795	45.765	456	0
EPU	507.887	215.627	181.290	791.870	456	0
CSR	20.586	12.236	-9.970	82.610	456	0
L.RD	3.272	2.721	0.000	20.060	456	0
L2.RD	3.136	2.633	0.020	20.060	456	0
First	0.333	0.139	0.055	0.721	456	0
Z	0.707	0.610	0.018	2.986	456	0

As can be seen from Table 2, the average value of return on total assets, which is a measure of enterprise performance, is stable at the level of 4.6%, indicating the efficiency of the utilization of total assets in the new energy industry, with a maximum value of 45.77% and a minimum value of -45.8%, indicating that some of the new energy enterprises in China are experiencing more serious losses, and the large standard deviation indicates that the level of return on total assets varies widely from sample to sample, and the wide range of fluctuations again indicates that there is a large gap in the profitability of new energy enterprises.

3.4 Calibration

Before using fsQCA, the collected sample data need to be fuzzy calibrated to transform the raw data into geometric data in the interval [0,1], thus satisfying the conditions for fsQCA Boolean logic analysis. In this study, the variables were calibrated using the direct calibration method, where the cross-over point was set as the median, the criterion for full membership was set as the upper quartile, and the criterion for full nonmembership was set as the lower quartile. The calibration results are shown in Table 3.

Table 3. Calibration results for variables.

	Full nonmembership	The Cross-over point	Full membership
ROA	2.21	3.93	7.04
EPU	363.87	460.47	747.86
CSR	14.21	19.79	25.64
L.RD	1.28	2.94	4.72
L2.RD	1.28	2.81	4.41
Frist	0.24	0.31	0.43
Z	0.25	0.54	0.99

Table 4. Adequacy and necessity tests of the antecedent conditions.

Antecedent conditions	Firm performance	
	Necessity	Adequacy
EPU	0.513472	0.556073
~EPU	0.569777	0.527124
CSR	0.792317	0.780448
~CSR	0.328513	0.332133
L.RD	0.489825	0.495091
~L.RD	0.600545	0.591702
L2.RD	0.491319	0.499174
~L2.RD	0.591095	0.579480
FIRST	0.535932	0.544671
~FIRST	0.541075	0.530284
Z	0.550130	0.553194
~Z	0.534350	0.529140

3.5 Correlation Test

This study tested whether the six antecedent conditions involved (including their non-states) were sufficient and necessary conditions for the achievement of high firm performance, respectively. The results of the tests are shown in Table 4: none of the single antecedent conditions can significantly influence the improvement of firm performance in this study. Based on Schneider's (2012) criteria [10], the antecedent conditions with necessity exceeding 0.9 were selected as necessary conditions for the outcome variable and those with sufficiency exceeding 0.8 were selected as sufficient conditions for the outcome variable in this paper. In terms of necessity, none of the antecedent conditions affecting high performance has a necessity exceeding 0.9, i.e., the set of outcomes becomes a subset of the set of single conditions to a lesser extent, and therefore all of the single antecedent conditions cannot constitute a necessary condition for high firm performance. In terms of sufficiency, the consistency of the antecedent conditions affecting high performance does not exceed 0.8, so all the single antecedent conditions are not sufficient conditions for a firm to achieve high performance. In conclusion, there is no causal relationship between the single antecedent conditions and the outcome variables, and there is no need to do exclusion for the single antecedent conditions.

4 Results

Frequency thresholds and consistency thresholds need to be determined prior to the qualitative comparative analysis of the selected sample data for fuzzy sets using fsqca 3.0, and due to the large sample size selected for this study, the frequency threshold was set to 2 [10]. Referring to the criteria of Rihoux (2008) [11], the consistency threshold

was set to an acceptable minimum value of 0.8 in this study. To avoid potential common subset relationships, this study also introduced a third analysis metric in addition to the frequency and consistency thresholds, the PRI (proportional reduction in inconsistency, PRI), with reference to previous studies in the literature [12] and the characteristics of the sample data, in the case that the first two indicators are satisfied, it is also necessary to satisfy the corporate performance PRI greater than or equal to 0.75, and finally the truth table rows that satisfy these three conditions simultaneously are included in the logical minimization process.

In this study, the conditions in the simple solution are considered as the core conditions, and the intermediate solution with reasonable evidence and moderate complexity is selected as the result of the group analysis for reporting. Since all the antecedent conditions appear in the parsimonious solution, all six antecedent conditions are core conditions. The final results of the histogram analysis are shown in Table 5.

The results of the configuration analysis in this study are presented with reference to Fiss' criteria, and as shown in Table 5, there are six causal configurations that are conducive to improving firm performance (H1, H2, H3, H4, H5, and H6), and the consistency and overall consistency of these six causal configurations are in the range of 0.834–0.866, all of which satisfy the minimum criterion of consistency greater than 0.75, indicating that the logical combination of antecedent conditions obtained in this study is a high degree of high performance set subset. The overall coverage of the six histories that lead to improved firm performance is 0.515, which meets the criteria for QCA research coverage in the field of organization and management [13]. fsQCA effectively identifies the six antecedent configurations.

Table 5. Intermediate solutions for ROA.

Antecedent conditions	Firm performance					
	H1	H2	H3	H4	H5	H6
EPU	●	○	●	○	●	●
CSR	●	●	●	●	●	●
L.RD	○		●	○		●
L2.RD	○	●	●		●	●
FIRST				○	●	●
Z		●	○	●	○	
Consistency	0.848	0.864	0.837	0.866	0.838	0.834
Raw Coverage	0.254	0.177	0.121	0.162	0.116	0.127
Unique Coverage	0.152	0.083	0.003	0.063	0.002	0.010
Overall coverage	0.515					
Overall consistency	0.838					

Note: ● indicates that the variable is present in the combination, ○ indicates that the variable is not present in the combination, and blank spaces indicate that the presence or absence of the variable has no effect on the results.

5 Discussion

As can be seen from Table 5, there are six causal configurations that trigger improved firm performance. The configuration H1 (EPU * CSR * ~L.RD * ~L2.RD) indicates that when economic policy uncertainty is high, high CSR scores and low lagged Phase I and lagged Phase II R&D investment are conducive to improved corporate performance. This indicates that when external economic policy uncertainty is high, companies actively fulfill their social responsibility to strengthen their relationship with various stakeholders and thus gain more stakeholder support, while maintaining lower R&D investment in lag phase I and lag phase II helps companies to shrink their costs and thus improve their performance. The configuration H2 (~EPU * CSR * L2.RD * Z) indicates that when the external economic policy is more stable, it is beneficial to improve the firm's performance when the firm is active in social responsibility, has more lagged Phase II R&D investment and has higher equity checks and balances. This indicates that when the external economic environment is stable, companies increase the shareholding of the second to fifth largest shareholder to counterbalance the first largest shareholder to avoid the situation of "dominance", while the lagged R&D investment is internalized into the company's profitable capital, thus improving corporate performance. The configuration H3 (EPU * CSR * L.RD * L2.RD * ~Z) indicates that when external economic policy uncertainty is high, active social responsibility, strong lagged Phase I R&D and lagged Phase II R&D, and low equity checks and balances are conducive to improving firm performance. The configuration H4 (~EPU * CSR * ~L.RD * ~First * Z) indicates that in a stable economic policy environment, active corporate social responsibility, high lagged phase I R&D investment and strong checks and balances between the second and fifth largest shareholders on the first largest shareholder are conducive to improving corporate performance. The configuration H5 (EPU * CSR * L2.RD * First * ~Z) indicates that under the unstable external economic environment, companies that actively fulfill their corporate social responsibility, have greater lagging phase II R&D investment and have absolute control of the top share-holder are able to make the right choice under the volatile external environment, so that the company can develop in the right direction and thus improve its firm performance. The configuration H6 (EPU * CSR * L.RD * L2.RD * First) indicates that in the case of high external economic In the case of high policy uncertainty, if firms with more concentrated equity have a high degree of fulfillment of social responsibility and a high intensity of lagged Phase I and lagged Phase II R&D investment, it is beneficial to improve firm performance.

6 Conclusions

From the analysis of CSR, 100% of the samples (H1, H2, H3, H4, H5, and H6) were found to have high corporate performance triggered by actively fulfilling social responsibility, which shows that actively fulfilling CSR is a more necessary condition for improving corporate performance. This paper argues that companies in the new energy industry must pay high attention to stakeholders such as employees, consumers, government, and the environment, meet the demands of stakeholders to the greatest extent possible, continuously improve corporate social responsibility, raise the awareness of low carbon and environmental protection in society as a whole, and achieve evergreen development.

According to the antecedent configurations that trigger high performance and the corresponding theoretical logic, this study proposes the following 2 propositions.

There are 2 configurations (H2, H4) when external economic policy uncertainty is low. It takes longer time for R&D investment to be transformed into capital that helps firms to make profits, the configuration H2 demonstrates that lagged second-period R&D investment is associated with the ability to help firms with high equity checks and balances to make profits in a stable economic environment. From the principal-agent theory, each shareholder of a firm with significant equity checks and balances monitors each other, shrinks the agency costs of the firm, and thus improves the performance of the firm. As a result, the following propositions are proposed.

Proposition 1. Under low economic policy uncertainty, firms that invest more in lagged-phase II R&D and have higher equity checks and balances are more likely to improve corporate performance.

There are four configurations (H1, H3, H5, and H6) when external economic policy uncertainty is high. From H1, when the equity structure is not considered, companies that are active in social responsibility are favorable to improve corporate performance when both lagged Phase I R&D investment and lagged Phase II R&D investment are low. Although it can temporarily save a large amount of money for enterprise expansion and market development, which improves enterprise revenue in the short term, in the long term, it is not conducive to the formation and enhancement of enterprise's core competitiveness, and thus is not conducive to the improvement of future enterprise performance. From the three configurations of H3, H5 and H6, under the uncertainty of external economic environment, enterprises actively undertake social responsibility while maintaining a low degree of equity checks and balances or a high degree of equity concentration, and both the R&D investment in the lagged phase I and the R&D investment in the lagged phase II have a positive impact on enterprise performance.

Proposition 2. Firms with strong R&D investment and higher equity concentration in lag phase I and lag phase II are more likely to improve their corporate performance in the presence of high economic policy uncertainty.

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