

## *Retraction*

# **Retracted: Study on Announcement Effect of Stock Repurchase from the Perspective of Configuration Analysis**

### **Advances in Mathematical Physics**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

### **References**

- [1] H. B. Wang, A. H. Jin, and H. Y. Yu, "Study on Announcement Effect of Stock Repurchase from the Perspective of Configuration Analysis," *Advances in Mathematical Physics*, vol. 2021, Article ID 5975325, 9 pages, 2021.

## Research Article

# Study on Announcement Effect of Stock Repurchase from the Perspective of Configuration Analysis

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This paper takes the stock repurchase cases in 2018-2019 after the promulgation of the New Company Law as the research object. Using the qualitative comparative analysis method and PSO-ICA-GARCH model, we analyze the influencing factors of the stock repurchase announcement market reaction. Through the analysis of the degree of premium (DP), repurchase ratio (RR), natural logarithm of total assets (LAS), return on net assets (ROE), top 10 shareholder equity ratio (CR10), and executive shareholding ratio (MSL), it is found that the paths of high CAR stock repurchase effect include repurchase clause-oriented type and centralization-proportional matching type; the path of nonhigh CAR stock repurchase effect includes size-premium limit type, profit-proportion limit type, and repurchase clause limit type. Compared with GARCH model, it has higher separation accuracy and more accurate model prediction effect.

## 1. Introduction

At present, stock repurchase has gradually become a tool and means for listed companies to manage market value and safeguard the interests of shareholders. The stock repurchase announcement represents a listed company's recognition of the value of its own stock and is also a "commitment" to market investors [1]. Whether stock repurchase can achieve the stability of stock prices and promote the return of undervalued stock prices to value is a question worthy of study [2, 3].

The main multivariate volatility models include the BEKK model and constant value condition correlation number (CCC-GARCH) model [4] and dynamic condition correlation coefficient (DCC-GARCH) model [5]. A new GICA-GARCH model is proposed, which combines ICA and the multivariate GARCH (MGARCH) model [6].

This paper uses the method of qualitative comparative analysis to study 240 stock repurchase cases in China's Shanghai and Shenzhen markets from 2018 to 2019 from the perspective of configuration analysis and explores the interaction and mutual matching relationship between the

influence factors of the stock repurchase announcement effect. Through the configuration analysis of the effect of high and nonhigh cumulative excess return (CAR) stock repurchase announcements, it provides a basis and reference for the behavior selection of securities regulatory authorities, listed companies, and investors.

The rest of this paper is organized as follows: Section 2 discusses the effect analysis of the stock repurchases announcements. The research on the stock repurchase announcement from the perspective of configuration analysis is discussed in Section 3. Section 4 shows the data analysis, and Section 5 concludes the paper with summary and future research directions.

## 2. Effect Analysis of the Stock Repurchases Announcements

Since the launch of stock trading, the legal system and operating mechanism of the Chinese securities market have been continuously improved and improved [7]. Looking back at the history of the securities market, the development of the stock repurchase market can be divided into three stages

TABLE 1: The development of stock repurchase of listed companies.

| Development stage                         | Basic features   |
|---|--|
| Before the split share reform (1992-2004) | Exception management is implemented, repurchase is limited to nontradable shares, and only “write-off repurchase for the purpose of reducing the company’s share capital” and “company merger repurchase” are allowed. Only agreement repurchase is allowed. A total of 15 share repurchases occurred during the period [8].   |
| In the split share reform (2005-2007)     | The repurchase has expanded from nontradable shares to tradable shares, and the scope of implementation has been expanded to four situations such as capital reduction, merger, share awards, and division objections. The repurchase agreement is mainly based on repurchase agreements, and there are fewer centralized auction repurchases in the open market. A total of 41 share repurchases occurred during the period.  |
| After the split share reform (2008—)      | Further relax the restrictions on repurchase, especially after the revision of the company law in 2018, promote the marketization of share repurchase, regulate information disclosure, and increase transparency. Stock repurchases are mainly based on centralized bidding in the open market, with less agreement repurchase. A total of 141 share repurchases occurred during the period from 2008 to 2017, and a total of 755 share repurchases occurred during the period from 2018 to 2019. |

before, during, and after the equity division reform. The basic characteristics and performance of each stage are shown in Table 1.

China’s stock repurchase still has the following shortcomings: (1) The market adaptability of existing research is insufficient. After the completion of the share-trading reform in China, the marketization process of stock repurchase has continued to advance [9]. Especially in recent years, with the construction of relevant legal systems, market mechanisms have been continuously improved, and stock repurchase is in a new historical stage. Most of the existing stock repurchase studies are based on nontradable share repurchase, and they are case studies of agreement repurchase, which are sporadic and scattered [10]. (2) There is insufficient innovation in research methods. In addition to qualitative analysis and research, it mainly uses traditional regression analysis methods to carry out quantitative empirical research [11]. Based on the “net effect” thinking, it is assumed that the impact of each variable is “linear and additive” to calculate each independent variable. There are non-overlapping contributions to the variation of the dependent variable; however, estimation techniques designed for linear additive models often have shortcomings in estimating complex interaction effects [12]. In fact, the announcement effect of stock repurchase must be an economic phenomenon in which multiple variables are synergistic and combined.

The main reasons for the stock repurchase of listed companies include the following: (1) prevent the control from falling; (2) carry out earnings management; (3) adjust the capital structure; and (4) signal transmission [13]. Generally speaking, the announcement of a stock repurchase by a listed company can promote a significant increase in the company’s stock price and bring a positive market response [14].

The factors that affect the effect of stock repurchase announcements can be summarized into three categories: (1) corporate governance: the main research variables are equity concentration, senior management’s shareholding ratio, management equity pledge [15], etc.; (2) financial status: the main research variables include company size, book value, debt ratio, price-earnings ratio, and capital expenditures [16]; and (3) repurchase terms: the main research variables

are repurchase ratio, premium rate, etc. For example, based on the stock repurchase data in the United States, Canada, and other markets [17], it is found that the repurchase ratio, the repurchase premium ratio, the degree of change in the asset-liability ratio, the management shareholding ratio, and the cumulative excess return are positively correlated. Research from China’s Shanghai and Shenzhen markets found that executive shareholding ratio, proposed repurchase ratio, management equity pledge ratio, equity concentration, and growth ability all have a positive relationship with the repurchase effect [18].

### 3. Research on the Stock Repurchase Announcement from the Perspective of Configuration Analysis

*3.1. The Framework Design of the Stock Repurchases Announcements Effect.* This article intends to integrate factors such as corporate governance, financial status, and repurchase terms and explore the multiple concurrent path factors and causal complex mechanisms of the difference in the effect of different companies’ stock repurchase announcements, that is, how to link the various antecedent conditional variables and how to match the stock repurchase, the purchase announcement effect.

The framework of the stock repurchases announcements effect is shown in Figure 1. We analyze the effect of announcements by synergizing the size of the company, profitability, premium level, governance structure, repurchase ratio, and equity concentration.

According to the public company’s repurchase announcement, the purpose of stock repurchase is to promote stock prices to rise above the market. This article chooses “cumulative excess return (CAR)” as the measurement indicator of the announcement effect, that is, the explained outcome variable. This article also selects the degree of premium (DP), repurchase ratio (RR), natural logarithm of total assets (LAS), return on net assets (ROE), top 10 shareholder equity ratio (CR10), and executive shareholding ratio (MSL) as statistical data [19].

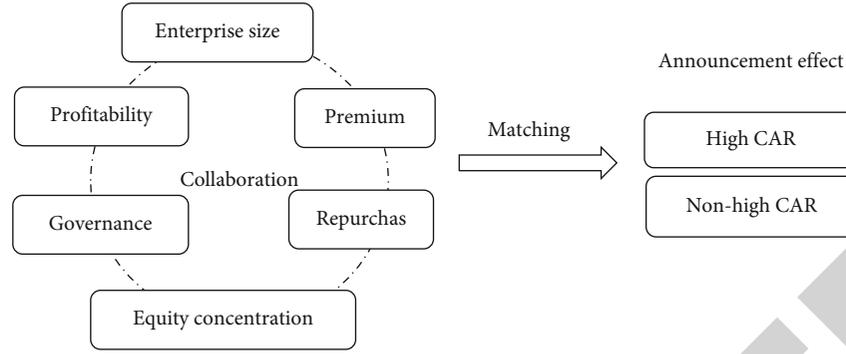


FIGURE 1: The framework design of the stock repurchases announcements effect.

The formulas for the degree of premium (DP) and repurchase ratio (RR) are as follows:

$$DP = \frac{P_n}{P_q} \times 100\%, \quad (1)$$

$$RR = \frac{S_n}{S_q} \times 100\%, \quad (2)$$

in which  $P_n$  is the proposed repurchase price (maximum price),  $P_q$  is the closing price on the trading day before the announcement,  $S_n$  is the proposed repurchase quantity (upper limit), and  $S_q$  is the total share capital, for the Buy-back Clause. For such variables, indicators that have a substantial impact on repurchase should be selected. There are many terms in the announcement of the stock repurchase of listed companies, including the purpose and purpose of the share repurchase, the type, quantity and proportion of the shares to be repurchased, price (total amount or pricing principle), time limit, the method of repurchasing shares, the source of funds, and whether the relevant shareholders have plans to reduce their holdings. The proposed repurchase price and the proposed repurchase quantity are the key terms, which are substantively influential terms, and are also the core differences between the terms of the stock repurchase announcements of different listed companies.

**3.1.1. Natural Logarithm of Total Assets (LAS) and Return on Net Assets (ROE).** For financial position variables, indicators can usually be selected from two aspects of enterprise size and profitability. Financial status is directly expressed as the level and structure of a company's assets, liabilities, and owner's equity. It is also indirectly affected by the company's asset quality and profitability. It is a combination of static asset scale and dynamic profitability.

**3.1.2. Top 10 Shareholder Equity Ratio (CR10).** For corporate governance variables, you can usually choose indicators from two aspects: equity concentration and governance structure. The reasons are as follows: Modern corporate governance is based on the separation of ownership and management rights. Based on the classic principal-agent theory, equity concentration and governance structure are the core reflections of corporate governance.

**3.1.3. Senior Management's Shareholding Ratio (MSL).** Senior management's shareholding ratio includes the following: whether the major shareholders are substantively participating in the company's operation and management and the way they participate, whether the company's directors, supervisors, senior managers, etc. hold shares, the size of the shareholding ratio, and the "separation of the two rights." The coordination method of the organization and operation of the subordinate company has a significant impact and is the main aspect of the corporate governance structure.

**3.2. PSO-ICA-GARCH Model.** The GARCH model is a regression model for financial data, expressed as

$$r_t = c_1 + \sum_{i=1}^R \phi_i r_{t-i} + \sum_{j=1}^M \phi_j \epsilon_{t-j} + \epsilon_t, \quad (3)$$

$$\epsilon_t = u_t \sqrt{h_t}, \quad (4)$$

$$h_t = k + \sum_{i=1}^q G_i h_{t-i} + \sum_{i=1}^p A_i \epsilon_{t-i}^2, \quad (5)$$

in which  $h_t$  is the conditional variance,  $u_t$  is an independent and identically distributed random variable,  $h_t$  and  $u_t$  are independent of each other, and  $u_t$  is a standard normal distribution [20].

The GARCH model has certain problems. Some scholars have proposed the O-GARCH model and the ICA-GARCH model. When modeling the multivariate volatility of stock returns, the O-GARCH model assumes that the main components are weakly correlated. In empirical analysis, the problem of inconsistency between the forecasting effect and the actual situation will often arise. The ICA algorithm in the ICA-GARCH model has low convergence accuracy and is easy to fall into the problem of local optimization. Combining the PSO-ICA algorithm with the GARCH model to construct the PSO-ICA-GARCH model can effectively overcome the above problems.

The PSO-ICA-GARCH model first uses the PSO-ICA algorithm to decompose the stock return sequence into mutually independent components, that is, if there is a matrix and a  $d$ -dimensional vector  $s_t = (s_{1t}, s_{2t}, \dots, s_{dt})$ , for each moment  $t$ ,  $s_{it}$  and  $s_{jt}$  ( $i \neq j$ ) are all independent of

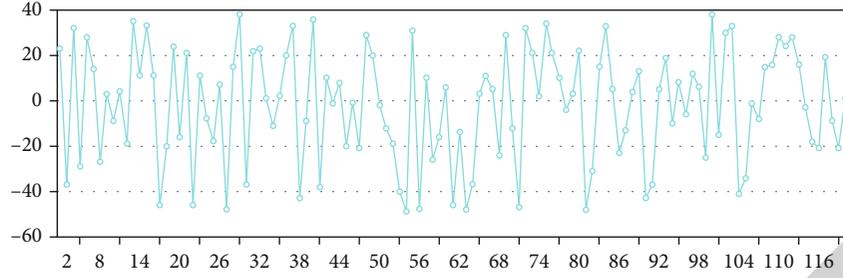


FIGURE 2: CAR value of 120 samples (%).

each other, so that Equation (6) holds. Then,  $s_t$  is said to be  $d$ -independent components of  $r_t$ . At this time, the conditional covariance matrix  $V_t$  is a diagonal matrix, and the PSO-ICA algorithm assumes that the independent components follow a non-Gaussian distribution, which is more in line with the characteristics of the financial time return sequence data, then performs unit GARCH modeling on each independent component  $s_{it}$ , and finally obtains the conditional covariance matrix  $H_t$  of the return sequence  $r_t$ . The PSO-ICA-GARCH model is as follows:

$$r_t = As_t, \quad (6)$$

$$s_{it} = v_{it}\alpha_{it}, \quad (7)$$

$$v_{it}^2 = \omega + \alpha s_{i,t-1}^2 + \beta v_{i,t-1}^2, \quad (8)$$

in which,  $A$  is the mixing matrix,  $\{s_{it}\}$  is the independent component, and  $v_{it}$  is the variance of the independent component  $\{s_{it}\}$ .

Qualitative comparative analysis (QCA) is based on technical methods such as set and Boolean algebra and combines the advantages of qualitative and quantitative research methods to explore how the interaction between antecedent conditions.

Traditional regression analysis adopts the “net effect” thinking, which believes that each variable has the autonomous or independent ability to affect the level, intensity, or probability of the dependent variable. But when independent variables are correlated with each other, the unique effect of a single variable may be masked by the correlated variable. In fact, the antecedent conditions of social phenomena are generally interdependent and nonindependent, and cause and effect are asymmetry. Therefore, to explain the causes of social phenomena, we need to adopt a holistic and combined approach. Qualitative comparative analysis can find the configuration relationship between multiple factors and the same goal by different routes.

From a configuration perspective, factors such as repurchase conditions, financial status, and corporate governance have no independent influence on the stock price of listed companies that implement repurchase, but they play a role in linkage and matching. Various factors may strengthen or offset each other. It is more practical and exploratory to test the “joint effect” of different conditional factors on the realization of stock repurchases goals, that is, what we need

to care about is the collective relationship between different configurations and result effects.

## 4. Data Analysis

**4.1. Data Source and Data Calibration.** This article uses the fsQCA3.0 software for data processing. Using python software, we collected and sorted out 755 stock repurchase announcements in 2018 and 2019 from the website (<http://www.eastmoney.com>). Because stock repurchase must be a stock case where all the processes have been completed, the following samples should be excluded: (1) those who have not completed the repurchase (including the suspension of implementation) cases; (2) repurchase cases that are only at the stage of the board of directors plan or passed at the general meeting of shareholders but did not formally initiate repurchase; (3) repurchase cases in nonpublic market such as agreements; and (4) repurchase cases announced before the promulgation of the new “Company Law.” Finally, this paper obtains 240 public market stock repurchases that have been implemented.

This article takes the announcement date as the origin and adds up the daily excess returns for a total of 16 days from 5 trading days before the origin to 10 trading days after the origin to get the cumulative excess return “ $CAR_{[-5,10]}$ .”

Basic data such as daily excess return rate, total assets, return on net assets, top 10 shareholder equity ratios, and senior management shareholding ratios are taken from the Xenophon database and processed manually according to research requirements. The data on the degree of premium and the repurchase ratio are calculated based on the repurchase announcement.

Qualitative comparative analysis methods need to calibrate different research variables, that is, the process of assigning collective membership to cases on the basis of considering the differences between cases. The three anchor points (or critical values) of full affiliation, no affiliation, and crossover point of calibration need to be determined according to the basic theory and actual knowledge of the research. The case set processed by the calibration function is between 0 and 1 to determine the data basis for subsequent analysis.

Through the measurement of 120 sample data, the CAR value, DP value, LAS value, and ROE value are shown in Figures 2–5. The range of CAR value is between -60 and 40; the range of DP value is between 50 and 380; the range of CAR value is between -60 and 40; the range of LAS value

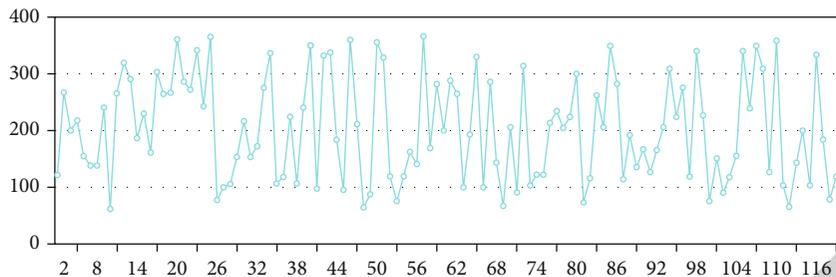


FIGURE 3: DP value of 120 samples (%).

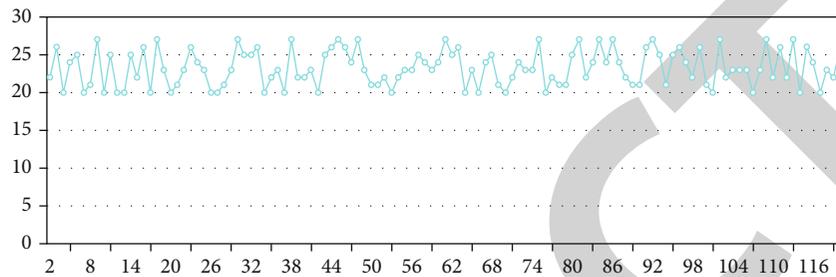


FIGURE 4: LAS value of 120 samples (Yuan).

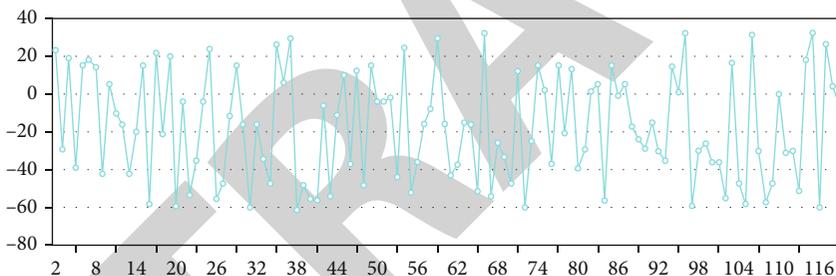


FIGURE 5: ROE value of 120 samples (%).

TABLE 2: The outcome variables and condition variables.

| Variable   | Average value | Standard deviation | Minimum | Max    | Calibration      |              |                       |
|------------|---------------|--------------------|---------|--------|------------------|--------------|-----------------------|
|            |               |                    |         |        | Fully affiliated | Intersection | Not affiliated at all |
| CAR (%)    | 2.9506        | 10.0727            | -50.1   | 38.28  | 8.955            | 3.2913       | -2.373                |
| DP (%)     | 150.4426      | 35.4733            | 56.9110 | 366.75 | 161.797          | 144.8179     | 127.8387              |
| RR (%)     | 2.4365        | 2.0224             | 0.01    | 14     | 3                | 2.0575       | 1.115                 |
| LAS (Yuan) | 22.5388       | 1.2901             | 19.964  | 27.293 | 23.3053          | 22.5139      | 21.7224               |
| ROE (%)    | 8.7528        | 7.9406             | -61.782 | 31.471 | 11.9721          | 8.6682       | 5.3644                |
| CR10 (%)   | 56.2520       | 19.2112            | 9.7426  | 88.5   | 69.365           | 57.7888      | 46.2124               |
| MSL (%)    | 17.8728       | 10.2887            | 0       | 73.49  | 14.9919          | 7.5624       | 0.1329                |

is between 10 and 30; and the range of ROE value is between -60 and 40.

The descriptive statistics of the result variables and condition variables involved and the value of the calibration anchor points are shown in Table 2. It can be seen from Table 2 that the maximum value of CAR of 240 sample cases is 38.28%, the minimum value is -50.1%, the mean is 2.9506%, and the standard deviation is 10.0727%. The cases with CAR greater than or equal to 8.955% are classified as “fully subordinate,” less than or equal to -2.373% of the cases

were classified as “completely nonaffiliated,” and the CAR value of the “cross-point” cases was set to 3.2913%.

4.2. Necessity Analysis of Single Factor. Qualitative comparative analysis requires that each condition must be individually tested for necessity before performing condition configuration analysis. If a certain condition always exists when the result occurs, the condition is considered a necessary condition of the result (that is, the condition is a superset of the combination of results). The judgment is based on

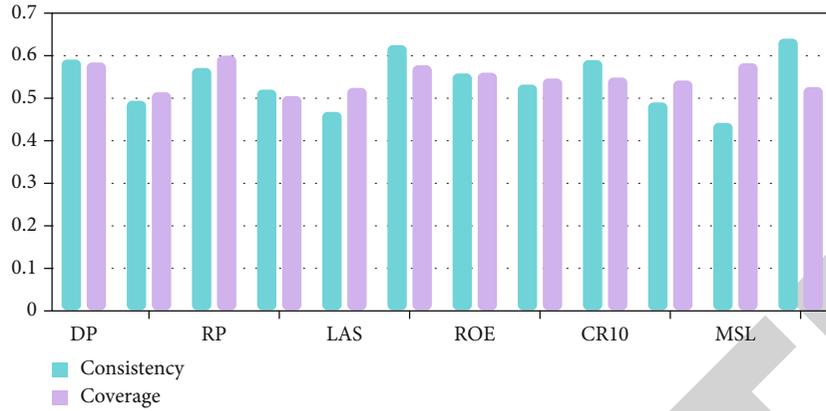


FIGURE 6: Analysis of  $CAR_{[-5,10]}$ .

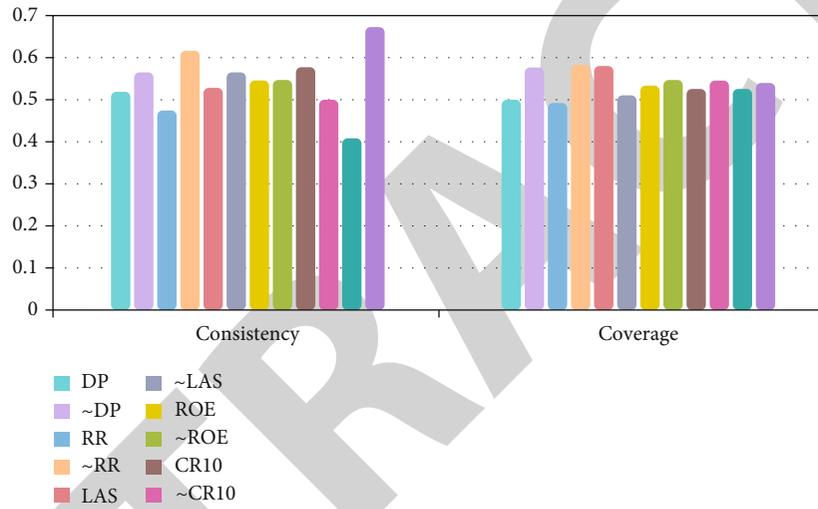


FIGURE 7: Analysis of  $\sim CAR_{[-5,10]}$ .

TABLE 3: Necessity analysis of single factor.

| Conditions tested    | $CAR_{[-5,10]}$ |          | $\sim CAR_{[-5,10]}$ |          |          |
|----------------------|-----------------|----------|----------------------|----------|----------|
|                      | Consistency     | Coverage | Consistency          | Coverage |          |
| Buy-back Clause      | <i>DP</i>       | 0.591421 | 0.583211             | 0.520037 | 0.500406 |
|                      | <i>~DP</i>      | 0.493373 | 0.513012             | 0.566861 | 0.575158 |
|                      | <i>RR</i>       | 0.568618 | 0.602810             | 0.474648 | 0.491011 |
|                      | <i>~RR</i>      | 0.519881 | 0.503508             | 0.616047 | 0.582204 |
| Financial position   | <i>LAS</i>      | 0.466205 | 0.523721             | 0.527967 | 0.578748 |
|                      | <i>~LAS</i>     | 0.625010 | 0.575718             | 0.565511 | 0.508303 |
|                      | <i>ROE</i>      | 0.559315 | 0.558304             | 0.546106 | 0.531925 |
|                      | <i>~roe</i>     | 0.531077 | 0.545262             | 0.546528 | 0.547544 |
| Corporate governance | <i>CR10</i>     | 0.588540 | 0.548026             | 0.577153 | 0.524415 |
|                      | <i>~CR10</i>    | 0.489256 | 0.542492             | 0.502573 | 0.543770 |
|                      | <i>MSL</i>      | 0.440849 | 0.580739             | 0.408757 | 0.525430 |
|                      | <i>~MSL</i>     | 0.639746 | 0.525814             | 0.673837 | 0.540429 |

the consistency level higher than 0.9. The analysis of  $CAR_{[-5,10]}$  is shown in Figure 6, the analysis of  $\sim CAR_{[-5,10]}$  is shown in Figure 7, and the specific data is shown in Table 3.

From Figures 6 and 7 and Table 3, it can be seen that the consistency index of a single antecedent condition that affects the high CAR or nonhigh CAR announcement effect

TABLE 4: Configuration of the announcement effect of stock repurchases.

| Configure            | High CAR             |                         |                       | Nonhigh CAR           |        | Repurchase condition |        |
|----------------------|----------------------|-------------------------|-----------------------|-----------------------|--------|----------------------|--------|
|                      | Repurchase condition | Centralized cooperation | Scale-premium limited | Profit-proportionally |        |                      |        |
|                      | C1                   | C2                      | N1                    | N2a                   | N2b    | N3a                  | N3b    |
| DP                   | ●                    | ⊗                       | ⊗                     | ●                     |        | ⊗                    | ⊗      |
| RR                   | ●                    | ●                       |                       | ⊗                     | ⊗      | ⊗                    | ⊗      |
| LAS                  | ⊗                    | ⊗                       | ⊗                     |                       | ●      | ●                    |        |
| ROE                  | ⊗                    | ⊗                       | ●                     | ⊗                     | ⊗      | ●                    | ⊗      |
| CR10                 | ⊗                    | ●                       | ●                     |                       | ●      | ⊗                    | ●      |
| MSL                  | ⊗                    | ●                       |                       | ⊗                     |        | ●                    | ⊗      |
| Consistency          | 0.8174               | 0.8094                  | 0.8505                | 0.8359                | 0.8202 | 0.8411               | 0.8012 |
| Raw coverage         | 0.0752               | 0.0654                  | 0.0648                | 0.1293                | 0.1012 | 0.0612               | 0.0792 |
| Unique coverage      | 0.0593               | 0.0495                  | 0.0375                | 0.0510                | 0.0151 | 0.0305               | 0.0478 |
| Solution consistency |                      | 0.8140                  |                       |                       | 0.8206 |                      |        |
| Solution coverage    |                      | 0.1246                  |                       |                       | 0.2843 |                      |        |

ranges from 0.4 to 0.7, with a minimum value of 0.408757 and a maximum value of 0.673837, all of which do not exceed 0.9. It means that each individual antecedent condition has an impact on the high or nonhigh CAR stock repurchase announcement effect. The explanatory power is weak, and a single antecedent condition does not constitute a necessary condition for the result. Therefore, it is necessary to consider all antecedents and explore different configurations that produce high and nonhigh CARs, respectively.

**4.3. Sufficiency Analysis of Conditional Configuration.** The purpose of the sufficiency analysis of conditional configuration is to try to find whether the configuration of multiple condition variables is the sufficiency condition of the result, that is, to analyze whether the configuration of multiple antecedent conditions in different combinations constitutes a result set (high, nonhigh CAR announcement effect).

We use the fsQCA3.0 software to construct a traditional Boolean algebra truth table based on the calibrated 240 sample case data, perform standardized analysis to obtain the conditional configuration, and use it to explain the complexity of cause and effect. This article has 6 conditional variables. The initial truth table has 64 rows. It is necessary to set the consistency threshold and the frequency threshold to simplify.

Setting the consistency threshold is to eliminate the combination of factors in the sample case whose consistency level with the set logical relationship is lower than the threshold. According to the general setting method of the consistency level threshold, the consistency level threshold is set to 0.8. Setting the frequency threshold is to eliminate the combination of factors whose frequency of occurrence is lower than the threshold. The frequency threshold usually depends on the sample size. In principle, the conditional configuration is required to cover at least 75% of the samples. This article sets the frequency threshold to 2. Based on this, this paper obtains two conditional configurations of high CAR announcement effect (C1, C2), and five condi-

tional configurations of nonhigh CAR announcement effect (N1, N2a, N2b, N3a, N3b). The specific condition configuration is shown in Table 4. The original coverage indicates the influence of the factors in each configuration solution on the result. The unique coverage indicates the possibility of the configuration solution being able to achieve high innovation investment.

It can be seen from Table 4 that the consistency indexes of the path solutions that produce high and nonhigh CAR announcement effect results are 0.8140 and 0.8206, respectively, which are both greater than or equal to 0.8, indicating sufficient conditions for the corresponding high and nonhigh CAR announcement effect results. The solution coverage indicators are 0.1246 and 0.2843, respectively, indicating that the corresponding configuration conditions can explain 12.46% and 28.43% of the stock repurchase cases with high and nonhigh CAR announcement effects, respectively, specifically the following:

- (1) Repurchase condition-oriented type (C1): without resorting to other conditions, the superior conditions of high repurchase premium and high repurchase ratio can achieve the announcement effect of high CAR stock repurchase, which can be defined as the repurchase condition-oriented type. This path can explain 7.52% of the high CAR stock repurchases announcement effect cases, and 5.93% of the high CAR stock repurchases announcement effect cases can only be explained by this path
- (2) Centralization-proportionally coordinated type (C2): the high degree of equity concentration and the proportion of senior management's shareholding reflect a higher degree of centralization of corporate governance, and the high repurchase ratio is more consistent with the interests of senior management holding shares. This realization of high CAR stock repurchase announcement effect can be defined as a centralized-proportional coordination type. This path can explain

6.54% of high CAR stock repurchases announcement effect cases, and 4.95% of high CAR stock repurchases announcement effect cases can only be explained by this path

- (3) Scale-premium restriction type (N1): in the case of a small company, even if the listed company has strong profitability and high equity concentration (auxiliary conditions), if there is no attractive high repurchase premium condition, then we cannot realize the high CAR stock repurchase announcement effect, which can be defined as a scale-premium restriction type. This path can explain 6.48% of nonhigh CAR stock repurchase announcement effect cases, and 3.75% of nonhigh CAR stock repurchase announcement effect cases can only be explained by this path
- (4) Profit-proportionally restricted type (N2a, N2b): the common core conditions of the two paths of N2a and N2b are  $\sim$ RR and  $\sim$ ROE, that is, in the absence of a high repurchase ratio and high level of profitability, they will show noncompliance. The effect of high CAR stock repurchase announcements is that N2a is also supplemented by low executive shareholding ratio, which can be defined as a profit-proportion restricted type. The two paths can explain 12.93% and 10.12% of the nonhigh CAR stock repurchase announcement effect cases, respectively. The 5.1% and 1.51% of the nonhigh CAR stock repurchase announcement effect cases can only be explained by the two paths
- (5) Repurchase condition restricted type (N3a, N3b): the common core conditions of the two paths of N3a and N3b are  $\sim$ RR and  $\sim$ DP, that is, in the absence of a high repurchase ratio and high repurchase premium, supplemented by low equity concentration (N3a) or low profitability and low executive shareholding ratio (N3b) will show the effect of nonhigh CAR stock repurchase announcements, which can be defined as restricted by repurchase conditions. The two paths can explain 6.12% and 7.92% of the nonhigh CAR stock repurchase announcement effect cases, respectively. The 3.05% and 4.78% of the nonhigh CAR stock repurchase announcement effect cases can only be explained by the two paths.

Based on the comparison and analysis of the above configurations, the potential substitution relationship between the following configurations can be found:

- (1) High CAR announcement effect condition configuration. There is a potential substitution relationship between the repurchase condition-oriented (C1) and centralization-proportional coordination (C2) configurations, that is, under the same high repurchase ratio, the combination of high controlling rights and high-level management shares high repurchase premiums can be substituted for each other to achieve a high CAR announcement effect

- (2) Nonhigh CAR announcement effect condition configuration. First, there is a potential substitution relationship between the profit-proportion restricted type (N2a, N2b) and the repurchase condition restricted type (N3a, N3b), that is, under the premise that the repurchase ratio is also limited (low repurchase ratio), low repurchase premium and low profitability can be substituted for each other to achieve nonhigh CAR announcement effects. Second, there is a potential substitution relationship between the scale-premium restricted type (N1) and the repurchase condition restricted type (N3a, N3b), that is, under the premise of low repurchase premium, low asset scale and low repurchase ratio can replace each other to achieve nonhigh CAR announcement effect.

## 5. Conclusion

This article uses qualitative comparative analysis methods and the PSO-ICA-GARCH model to analyze 240 stock repurchase cases in the Chinese securities market from 2018 to 2019, and through the study of five types of 7 paths of high and nonhigh CAR stock repurchase announcement effects. We have the following findings: (1) Superior repurchase conditions are the most direct way to achieve high CAR stock repurchase announcement effects. (2) With high equity concentration and senior management's shareholding in the case of proportion, a high repurchase ratio can also achieve a high CAR stock repurchase announcement effect. (3) Under the premise of limited repurchase premium and repurchase ratio, the company's size, profitability, equity concentration (only as an auxiliary condition), and senior management shareholding ratio (only as an auxiliary condition) will restrict the high realization of the announcement effect of CAR stock repurchase. The next step is to further optimize the model to make the analysis more accurate and effective.

## Data Availability

The data used to support the findings of this study are included in the article.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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