ISSN 2959-6130

The impact of COVID-19 on the new energy sector portfolio in the Chinese market

Shenge Liu[1,*]

[1] King's Business School, King's College London, London, The United Kingdom
*Corresponding author: shengeliu@stu.sdp.edu.cn

Abstract:

The new energy industry is developing continuously in China, and new energy products are also gaining popularity. Investors' attention to the new energy industry has increased significantly. In the Chinese market, due to the impact of the new coronavirus epidemic, the development of the entire new energy industry has ups and downs. This research selects 15 representative stocks in the new energy sector. After distinguishing between the epidemic era and the post-epidemic era, the Markowitz model is used to calculate the corresponding tangential portfolio under the maximum sharpe ratio of the two periods respectively. After comparing the change of position weight and analyzing the reasons for the change, four representative high-quality stocks are established. Corresponding to four hybrid large enterprises. Finally, according to the stability of the overall return and risk of the industry, it is concluded that investors in the new energy industry should regularly review the investment profit and loss, and appropriately incorporate traditional energy into the asset portfolio for risk hedging.

Keywords: New energy industry; COVID-19; Portfolio; Markowitz model; Sharpe ratio.

1. Introduction

The development of the new energy industry is an important part of the global energy revolution. From the perspective of global trends, green and low-carbon has become a consensus. In this context, the development of new energy industries such as wind power, photovoltaic, biomass energy, hydrogen energy and other subsectors has adapted to the needs of international carbon neutrality. In China, the new energy industry has been strongly supported by national policies, and technology continues to progress and the scale of industrialization is becoming larger.

In early 2020, China was hit by the coronavirus outbreak. In the two years affected by the novel coronavirus epidemic, China's economy has suffered a certain impact, but it has also spawned the re-layout and development of the new energy industry. In the short term, the pandemic has disrupted global supply chains. This affects short-term capacity, such as battery manufacturing and solar panel production. But in the long term, the gradual recovery of supply chains and advances in technology help to reduce costs and improve efficiency, thus increasing the attractiveness of new energy assets. From the outbreak of the epidemic to the end of 2022, after two years of adjustment, the valuation of the new energy sector is generally low. However, since the beginning of 2023, the new energy theme index of the Chinese market has remained rising. This shows the recognition of the new energy industry by all types of investors, and is also in line with the global trend of green and low-carbon development.

In general, portfolio movements reflect an investor's asset allocation strategy. Investors adjust their asset allocation based on market conditions, economic forecasts, personal financial goals and risk tolerance. Large position movements, especially those caused by large funds or institutional investors, can send a strong signal to the market. For example, if a number of large investment funds reduce their holdings in the wind energy sector, it could signal a negative outlook for the sector. This in turn influences more investors to do similar activities.

In general, studying portfolio movements in the new energy sector can reveal its impact on the Chinese economy from multiple perspectives. This includes investment trends in capital markets, technological advances, the expansion of industrial scale, and support for the green transition. By focusing on these changes, we can better understand the future direction of China's economy and its role in the global energy revolution. It can also provide strategic guidance for the majority of investors' asset allocation.

Qin et al. compared the practicability of Markowitz model and index model by calculating the least square handicap

and capital allocation line and other indicators. The results show that both models are good tools for investors to build an energy market portfolio [1].He et al. Took some of China's leading new energy enterprises, such as BYD and Ningde Times, as the research object. Construct a portfolio based on Markowitz theory and use Monte Carlo method to forecast the stock price within one year. The results show that the portfolio selection and prediction method is effective in expanding returns and reducing risks [2]. Ye et al. Studied the optimal weight allocation of stock portfolios in China's new energy automobile industry by using data such as circulating market value and price-earnings ratio. The research shows that the portfolio weight of China's new energy automobile industry stocks should rank first in the circulation market value. The results highlight the high contribution of leading firms to return on investment [3]. Jiang et al. used Markovitz model to study the portfolio performance of 10 stocks before and after the COVID-19 outbreak. Studies have shown that portfolio returns have declined and risks have increased since the pandemic. But diversified investment strategies can reduce the negative impact of the pandemic [4]. Mourad et al. applied the nonparametric stochastic dominance method to compare the optimal maximum Sharpe ratio (MSR) of diversified portfolios. The results show that in a post-pandemic period of economic stability, the renewable energy index can be a good alternative to a traditional diversified portfolio [5]. Rubbaniy et al. Used the time-varying parameter vector autoregressive (TVP-VAR) connectivity method to study the hedging effectiveness of portfolios such as hydrogen economy and renewable energy market in the era of COVID-19. The research shows that in the minimum variance portfolio, the portfolio weighting of hydrogen economy and renewable energy assets (equities) increased from 7% to 12% during the COVID-19 pandemic. Subsequently, the rate dropped to 6 percent during the Russia-Ukraine conflict. This suggests that people are more likely to view the hydrogen economy and renewable energy assets as hedging tools in a health-related financial crisis. In a crisis caused by a military conflict, this tendency may diminish [6]. Asl et al. Uses 18 portfolio optimization techniques to construct the optimal portfolio of traditional stock indexes, using Sharpe ratio, Omega ratio and Sortino ratio for performance comparison. The results show that including ESG-related stocks in energy and utilities assets significantly improves average returns [7]. Lean et al. Examines the cost of investing in equity in the renewable energy sector. The research found that during periods of exogenous non-financial shocks, such as the pandemic, there was no statistical difference in the alpha value of the overall energy sector stock portfolio versus the renewable energy stock portfolio [8]. Ijaz et al. Used parametric and non-parametric methods to examine risk movements among energy, gold and BRICS stock markets. The analysis shows that crude oil and the BRICS index can be used as portfolio diversifying assets to offset risks during COVID-19 [9]. Using the econometric approach proposed by Gregory and Hansen, Dias et al. evaluated the suitability of energy metals as safe haven assets in clean energy portfolios. Research shows that energy metals (excluding nickel futures) have the potential to be a safe investment for green investors' diversified portfolios. In addition, energy and precious metals can provide stability in a clean energy portfolio during periods of market volatility, such as a pandemic [10].

The purpose of this research is to use Markowitz portfolio optimization model to build the stock portfolio of China's new energy industry. Based on the historical performance of different companies in the new energy industry, 15 representative stocks are selected. According to the actual situation of the epidemic in China, it is divided into two sections, that is, the epidemic era before full liberalization and the post-epidemic era after full liberalization. Using Excel's built-in functions and solver solvers, you can determine the tangential portfolio corresponding to the maximum sharpe ratio. Combined with the state of development and policy changes in the global new energy industry, the research seeks to provide investors with actionable insights to help them navigate the dynamic landscape of the new energy industry in the Chinese stock market.

2. Method

2.1 Data Collection

The research collected historical financial data for selected 15 new energy sector stocks. The data covers a period of four years, from February 3, 2020 to May 10, 2024. The daily closing price of the stock was obtained from the Flush financial database. In addition, the research collects relevant market data, such as China's 10-year government bond interest rate and Shanghai Composite Index (SHCI), as a benchmark for calculation and comparison.

2.2 Data Preprocessing

The data needs to be briefly processed before being analyzed. This is to ensure the quality and consistency of the data set. This includes cleaning the data to remove any missing or incorrect values, and aligning time series data for all stocks and market indices. For example, during processing, there is no closing data for individual stocks on a certain trading day. In order to unify the rules and facilitate subsequent calculations, the missing values are filled with the data of the previous trading day. In addition, the research also derived daily yield data from the

database. By comparing it with the rate of return calculated by excel, abnormal data can be checked to complete the subsequent calculation analysis.

2.3 Model Construction

The Sharpe ratio is calculated as follows:

$$Sharperatio = \frac{(Portfolioreturn - Riskfreerate)}{Portfoliorisk} \quad (1)$$

According to the Markowitz model, this research chooses the following ideas (on the basis of obtaining the expected rate of return, bearing the minimum investment risk) :

$$MinU = \sum_{i=1}^{n} w_i w_j cov(r_i, r_j) \quad (2)$$

For the different investment status of investors, set the possible value range of asset weights:

$$\begin{cases} r^T w = \mu \\ \sum_{i=1}^{n} w_i = 1 \\ w_i \geqslant 0 or -1 \leqslant w_i \leqslant 1 \end{cases} \quad (3)$$

2.4 EXCEL Calculation and Solution

According to the requirements of Markowitz model, the average daily return rate, covariance matrix, portfolio return and portfolio risk are calculated. According to different qualification conditions, solver toolbox is used to plan and solve the maximum Sharpe ratio respectively.

2.5 Comparison and Analysis

The performance of the optimized portfolio is compared to the relevant benchmark, such as a market index such as the Shanghai Composite Index. This comparative analysis provides insights into whether the constructed portfolio outperforms or underperforms the overall market, thus validating the validity of the Markowitz model in portfolio optimization in the context of the new energy industry. In conjunction with current market performance and policy opportunities in the new energy sector, the research identifies investment opportunities and challenges and provides recommendations for investors to construct and manage diversified portfolios. This allows for the best risk-reward in dynamic market conditions.

3. Results

3.1 Epidemic Era

On January 23, 2020, Wuhan declared a lockdown, and China officially entered the epidemic era. Next, analyze the performance of the new energy portfolio from February 3, 2020 to December 2, 2022. Based on the 15 selected stocks, calculate their average daily return and standard deviation (Table 1):

Table 1. Average return and standard deviation (Epidemic era)

Stock Codes	601012	300750	002594	600550	600151	000651	600875	601800
Average Return	0.14%	0.21%	0.29%	0.14%	0.17%	-0.07%	0.19%	0.05%
Standadrd Deviation	3.51%	3.37%	3.38%	3.27%	3.24%	1.81%	3.06%	2.30%
Stock Codes	600192	000627	000912	600982	000571	600478	000338	-
Average Return	0.10%	-0.07%	0.06%	0.13%	0.03%	0.20%	0.01%	-
Standadrd Deviation	3.05%	1.99%	2.66%	3.04%	2.44%	3.16%	2.39%	-

Next, the covariance matrix of stock return rate is calculated (Table 2):

Table 2. Covariance matrix (Epidemic era)

Stock Codes	601012	300750	002594	600550	……	600478	000338
601012	0.1233%	0.0551%	0.0461%	0.0228%	……	0.0225%	0.0237%
300750	0.0551%	0.1132%	0.0686%	0.0245%	……	0.0300%	0.0285%
002594	0.0461%	0.0686%	0.1139%	0.0153%	……	0.0313%	0.0348%
600550	0.0228%	0.0245%	0.0153%	0.1065%	……	0.0267%	0.0183%
……	……	……	……	……	……	……	……
600478	0.0225%	0.0300%	0.0313%	0.0267%	……	0.0995%	0.0183%
000338	0.0237%	0.0285%	0.0348%	0.0183%	……	0.0183%	0.0568%

Set the initial weight of each asset as: 0.06667, and calculate the Sharpe ratio (Table 3):

Table 3. Equilibrium asset sharpe ratio (Epidemic era)

Portfolio Return	0.1046%
Portfolio Variance	0.0211%
Portfolio Risk	1.4542%
Risk Free Rate(monthly)	0.2433%
Sharpe Ratio	-9.54%

Next, use the solver toolbox to plan for the maximum Sharpe ratio (Table 4):

Suppose investors are not allowed to sell assets, that is, the weight of each asset≥0,

Table 4. Sharpe Ratio of single asset (Epidemic era)

Portfolio Return	0.2857%
Portfolio Variance	0.1139%
Portfolio Risk	3.3742%
Risk Free Rate(monthly)	0.2433%
Sharpe Ratio	0.0126

At this point, the portfolio position is (Table 5):

Table 5. Weight of single asset (Epidemic era)

Stock	Weight
002594	100%

Suppose investors are allowed to sell assets, and -1≤weight≤1 (Table 6):

Table 6. Sharpe Ratio (Epidemic era)

Portfolio Return	0.9191%
Portfolio Variance	0.4874%
Portfolio Risk	6.9811%
Risk Free Rate(monthly)	0.2433%
Sharpe Ratio	0.0968

At this point, the portfolio position is (Table 7):

Table 7. Weight for each asset (Epidemic era)

Stocks	Weight	Stocks	Weight
002594	100.00%	600192	-20.67%
600875	91.35%	000571	-21.96%
600478	81.96%	601012	-33.28%
601800	58.52%	000912	-50.01%
600151	56.65%	000338	-100.00%

300750	48.58%	000651	-100.00%
600982	21.52%	000627	-100.00%
600550	9.95%	-	-

3.2 Post-pandemic Era

According to the epidemic management policy, China has fully implemented epidemic control in December 2022, entering the post-epidemic era. Next, analyze the performance of the new energy portfolio from December 5, 2022 to May 10, 2024. According to the calculation method in 3.1, the covariance matrix can be obtained as follows (Table 8):

Table 8. Covariance matrix (Post-pandemic era)

Stock Codes	601012	300750	002594	600550	……	600478	000338
601012	0.0508%	0.0198%	0.0201%	0.0170%	……	0.0315%	0.0066%
300750	0.0198%	0.0984%	0.0203%	0.0033%	……	0.0166%	0.0036%
002594	0.0201%	0.0203%	0.0326%	0.0097%	……	0.0204%	0.0076%
600550	0.0170%	0.0033%	0.0097%	0.0372%	……	0.0321%	0.0076%
……	……	……	……	……	……	……	……
600478	0.0315%	0.0166%	0.0204%	0.0321%	……	0.0632%	0.0120%
000338	0.0066%	0.0036%	0.0076%	0.0076%	……	0.0120%	0.0295%

Set the initial weight of each asset as: 0.06667, and calculate the Sharpe ratio (Table 9):

Table 9. Equilibrium asset sharpe ratio (Post-pandemic era)

Portfolio Return	-0.0446%
Portfolio Variance	0.0153%
Portfolio Risk	1.2365%
Risk Free Rate(monthly)	0.1948%
Sharpe Ratio	-0.1936

Next, use the solver toolbox to plan for the maximum Sharpe ratio (Table 10):

Suppose investors are not allowed to sell assets, that is, the weight of each asset ≥ 0,

Table 10. Sharpe Ratio of single asset (Post-pandemic era)

Portfolio Return	0.1579%
Portfoli Variance	0.0295%
Portfolio Risk	1.7174%
Risk Free Rate(monthly)	0.1948%
Sharpe Ratio	-0.0215

At this point, the portfolio position is (Table 11):

Table 11. Weight of single asset (Post-pandemic era)

Stock	Weight
000338	100%

Suppose investors are allowed to sell assets, and -1≤weight≤1 (Table 12):

Table 12. Sharpe Ratio (Post-pandemic era)

Portfolio Return	1.0173%
Portfolio Variance	0.3211%
Portfolio Risk	5.6665%
Risk Free Rate(monthly)	0.1948%
Sharpe Ratio	0.1452

At this point, the portfolio position is (Table 13):

Table 13. Weight for each asset (Post-pandemic era)

Stocks	Weight	Stocks	Weight
000338	100.00%	601800	-18.55%
000651	100.00%	600192	-59.72%
600550	99.99%	000627	-64.79%
002594	99.99%	300750	-68.42%
600982	71.10%	600151	-99.89%
000571	58.79%	600478	-100.00%
600875	53.80%	601012	-100.00%
000912	27.70%	-	-

4. Discussion

The research named the epidemic era in China as period 1 and the post-epidemic era as period 2. Then, it makes a detailed analysis from the aspects of expected return comparison, potential risk comparison, single position comparison and long-short comparison.

4.1 Comparison of expected returns

When investing all assets in a balanced manner, the expected returns of the two stages are compared as follows (Table 14):

Table 14. Comparison of expected returns

Period	Portfolio Return
1	0.1046%
2	-0.0446%

The results show that after the full liberalization of the epidemic, the expected return rate of the new energy portfolio has been significantly reduced. This can be influenced by a number of factors. For example, after the outbreak was fully liberalized, economic activity resumed. The increasing demand for traditional energy makes the new energy industry subject to greater competitive pressure. At this point, investors may be leaning more toward the traditional energy sector. In addition, some countries or regions may adjust their energy policies, possibly reducing support for new energy sources or switching to other forms of energy. This policy change could affect the profit prospects of the new energy industry, especially for large multinational companies. This has also affected the yield of the new energy portfolio.

With the end of the epidemic, the market supply and demand relationship has changed. With the passage of time, new energy technologies continue to advance, and the cost is gradually reduced. If the supply of new energy products (automobiles, etc.) exceeds demand at this time, it will directly affect the profitability of relevant enterprises, thereby reducing the return rate of the investment portfolio. After the epidemic is released, capital mobility may change. During this period, investors will pay more

attention to safety and soundness, and reduce investment in high-risk assets. The transfer of capital leads to a reduction in demand for the new energy portfolio, which reduces its expected yield.

4.2 Comparison of potential risk

The potential risks of the two stages are compared as follows when investing each asset in a balanced manner (Table 15):

Table 15. Comparison of potential risk

Period	Portfolio variance	Portfolio Risk
1	0.0211%	1.4542%
2	0.0153%	1.2365%

The results showed that after the full liberalization of the epidemic, the potential risks of the new energy portfolio had a downward trend, but the overall change was little. This may be because of the continuous maturity of new energy technologies and the improvement of the industrial chain. At this time, some leading enterprises will gain competitive advantages in the market. For example, it has high technical barriers, brand influence or cost advantages. These enterprises have a certain moat in the market competition and can better cope with potential market risks. But overall, investors still need to pay close attention to market conditions and policy changes. Adjust the investment strategy according to the market information in a timely manner to ensure the robustness of the portfolio and long-term returns

4.3 Comparison of optimal investment targets

When maximizing the Sharpe ratio, the tangential portfolio for the two phases looks like this (Table 16):

Table 16. Comparison of optimal investment targets

Period	Stocks	Companies
1	002594	BYD
2	000338	WPC

The results show that the investment strategy with the largest Sharpe ratio during the epidemic is: only hold BYD. After the full unsealing (after December 2022), the investment strategy with the largest Sharpe ratio has changed to only hold Weichai Power. This may involve the following reasons:

During the epidemic and after the full unsealing, the trend of different industries has changed significantly. Byd, which is mainly involved in the new-energy vehicle industry, is likely to do well during the pandemic because of increased demand for clean energy. After the full unencapsulation, Weichai Power, as a company mainly engaged in diesel engine manufacturing, may be affected by the economic recovery and the recovery of traditional energy demand and perform well.

In addition, investors' preferences adjust as market sentiment and economic conditions change. In different market environments, investors' expectations and confidence in different industries and companies will change significantly. During the epidemic, investors may be more inclined to invest in the new energy industry and pursue excess returns[6]. In the post-epidemic era, investors may pay more attention to investment opportunities in the traditional energy industry to pursue stable returns. This can affect the proportion of different assets in a portfolio.

4.4 Comprehensive comparison

Allow investors to sell some assets appropriately (Table 17):

Table 17. Variation of various ratios

Period	Portfolio Return	Portfolio Risk	Sharpe Ratio
1	0.9191%	6.9811%	0.0968
2	1.0173%	5.6665%	0.1452

The results showed that in the post-epidemic era, the expected return of the investment portfolio increased, the

potential risk decreased, the sharpe ratio increased, and the overall performance was stable and good. Table 18 shows the position movements by portfolio:

Table 18. Change of Position

stocks	Weight 1	Weight 2	Tendency	Companies
000338	-100.00%	100.00%	↑	WP
000651	-100.00%	100.00%	↑	GREE
600550	9.95%	99.99%	↑	BTBE
002594	100.00%	99.99%	-	BYD
600982	21.52%	71.10%	↑	NEG
000571	-21.96%	58.79%	↑	SH
600875	91.35%	53.80%	↓	EEC
000912	-50.01%	27.70%	↑	STC
601800	58.52%	-18.55%	↓	CCC
600192	-20.67%	-59.72%	↓	GWE
000627	-100.00%	-64.79%	↑	HBPC
300750	48.58%	-68.42%	↓	CATL
600151	56.65%	-99.89%	↓	SAAE
600478	58.52%	-100.00%	↓	HNE
601012	-33.28%	-100.00%	↓	LGET

The results show that the investment targets of the epidemic era and the post-epidemic era have changed significantly. 000338 and 000651 changed from all selling to all buying, 600550 also directly bought the highest, and 002594 still maintained the full position. Correspondingly, 600151 and 600478 were all sold from the half position of the stock immediately, and 600192, 300750 and 601012 were sold to varying degrees.

It is not difficult to see that hybrid enterprises (based on traditional energy and the development of new energy) have played a huge advantage in the post-epidemic era. Weichai Power, Gree, Baobian Electric and BYD these hybrid enterprises outperform for the following reasons:

① Diversified operation and risk dispersion. These enterprises have a layout in both traditional and new energy fields, and can better diversify business risks. Not dependent on a single market or technology, it can maintain relatively stable performance amid market fluctuations.

② Technology accumulation and innovation. These enterprises have deep technical accumulation in the field of traditional energy, but also actively invest in the research and development and application of new energy technologies. For example, BYD's innovation in electric vehicles and battery technology has enabled it to maintain a solid market share in areas such as traditional cars and rail transit. Weichai Power's leading position in the internal combustion engine field and its investment in fuel cell technology have given them a head start in the competition in the new energy market.

③ Policy support. Governments around the world, especially the Chinese government, have actively promoted the development of new energy and introduced a number of policies to support the new energy industry. These large enterprises can make full use of the policy dividend to accelerate the layout and development of new energy business. As a power equipment manufacturer, Baoban Electric has advantages in the traditional transformer business, and is also actively developing new energy transmission and distribution equipment to comply with the trend of intelligent and green transformation of the power system.

④ Market demand growth. With the global attention to environmental protection and sustainable development, the market demand for new energy has shown rapid growth. The market demand for electric vehicles, clean energy equipment and other products continues to expand, providing a broad market prospect for these enterprises. It is worth mentioning that these companies have integrated in the fields of traditional energy and new energy. This can not only optimize supply chain management, reduce production costs, but also improve resource utilization efficiency. For example, Gree is able to effectively reduce overall operating costs through the dual layout of air con-

ditioning and new energy equipment. In addition, Gree actively expanded new energy businesses, such as photovoltaic products and energy storage equipment, forming a new growth point.

⑤ Brand effect and customer base. These large enterprises have established a strong brand effect and customer base in the traditional energy field, and can quickly gain market recognition and customer trust when entering the new energy market[3]. At the same time, these companies are actively expanding the international market. Through the international layout, we can not only obtain more market opportunities, but also optimize the allocation of resources on a global scale and enhance the comprehensive competitiveness of enterprises. This gives them strong support to compete in new markets.

5. Conclusion

In this research, the Markowitz model was used to maximize the Sharpe ratio, and Weichai Power, Gree, Baoban Electric and BYD were identified as the main investment portfolios of the new energy industry in the post-epidemic era. However, considering the uncertainty and effectiveness of the new energy industry, investors should continue to pay attention to industry changes and product innovation. For example, the hybrid SUV recently launched by Dongfeng Motor Corporation has set a new record of 2,162.8 kilometers, which will have a major positive impact on the new energy vehicle industry. However, it should be noted that the overall return on investment of the new energy industry portfolio may not be as stable as that of traditional energy. Therefore, investors should reasonably adjust the overall position proportion of the new energy industry according to their own risk tolerance, and consider the use of traditional energy and precious metals for risk hedging. In general, investing is a long-term process, and investors should regularly review investment gains and losses, assess expected gains and potential losses, and adjust their positions in a timely manner.

References

[1] Qin L ,Wu X ,Xiao F , et al.Analysis of the Energy Company Stock's Portfolio in the Past Twenty Years by Using the Markowitz Model and the Index Model[C]//Wuhan Zhicheng Times Cultural Development Co., Ltd..Proceedings of 2022 International Conference on Financial Market and Enterprises Management Engineering (FMEME 2022).St.John's Prep;Sierra Canyon School;The Experimental School Affiliated to Nanjing Normal University;Beijing Bayi High School;,2022:6.

[2] He X .Investment portfolios construction under the industrial chains of new-energy vehicles[C]//Wuhan Zhicheng Times Cultural Development Co., Ltd..Proceedings of 2022 International Conference on Company Management, Accounting and Marketing (CMAM 2022).School of Information,Central University of Finance and Economics;,2022:10.

[3] Ye X ,Qin J ,Lin J , et al.Weighting Analysis of a Fund Portfolio of China's New Energy Vehicle Stocks[C]//Department of Economics, King's Business School, King's College London,Cardiff Business School, Business School.Proceedings of the 2nd International Conference on Business and Policy Studies(part11).Hongwen School Qingdao Campus;High school affiliated to nanjing normal university jiangning campus;Business department Anhui University of Technology;Hangzhou New Channel School;,2023:14.

[4] Jiang Y .Using Markovitz Model to Analyze Covid-19's Impact on Portfolio[C]//Department of Economics, King's Business School, King's College London,Cardiff Business School, Business School.Proceedings of the 2nd International Conference on Business and Policy Studies(part7).University of Science and Technology Beijing;,2023:11.

[5] Mourad M ,Hejer B ,Nader N .Dynamic links between renewable energy, commodities, and financial stock markets: Implications for portfolio diversification[J].International Journal of Financial Engineering,2022,09(01).

[6] Rubbaniy G ,Maghyereh A ,Cheffi W , et al.Dynamic connectedness, portfolio performance, and hedging effectiveness of the hydrogen economy, renewable energy, equity, and commodity markets: Insights from the COVID-19 pandemic and the Russia-Ukraine war[J].Journal of Cleaner Production,2024,452142217-.

[7] Asl G M ,Rashidi M M ,Tavakkoli R H , et al.Does Islamic investing modify portfolio performance? Time-varying optimization strategies for conventional and Shariah energy-ESG-utilities portfolio[J].Quarterly Review of Economics and Finance,2024,9437-57.

[8] Lean H H ,Pizzutilo F ,Gleason K .Portfolio performance implications of investment in renewable energy equities: Green versus gray[J].Corporate Social Responsibility and Environmental Management,2023,30(6):2990-3005.

[9] Ijaz Y ,Ullah W S ,Besma H , et al.Risk co-movements and portfolio strategies between energy, gold and BRICS markets[J].Resources Policy,2023,82.

[10] Dias M R ,Chambino M ,Teixeira N , et al.Balancing Portfolios with Metals: A Safe Haven for Green Energy Investors?[J].Energies,2023,16(20).