

Assessing the Post-Pandemic Performance: Risk-Return Dynamics of China's New Energy Sector Stocks

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Abstract. China's new energy sector, vital for sustainable development and environmental protection, has experienced robust growth, especially following the COVID-19 outbreak in 2020. This industry, covering renewable energies such as wind, solar, thermal, hydroelectric power, and smart grids, has become integral to China's energy independence and economic innovation. This paper explores China's new energy sector through the lenses of stock market performance and government policies that have incentivized its advancement. Employing the Capital Asset Pricing Model (CAPM), we assess the risk-return profiles of prominent new energy stocks, illustrating their potential for higher returns despite increased volatility. The analysis confirms the sector's positive investment outlook and the efficacy of the CAPM in evaluating financial prospects within this dynamic market.

Keywords: New Energy Industry; Sustainable Energy Solutions; Capital Asset Pricing Model (CAPM); Risk-Return Dynamics.

1. Introduction

The transition towards a greener future is becoming increasingly critical as environmental concerns take center stage globally. China, in its rapid ascent towards modernization, has placed significant emphasis on the new energy sector—a broad domain that transcends the automotive industry to embrace a comprehensive range of sustainable energy solutions.

Environmental imperatives have driven the shift from traditional fossil fuels to innovative energy alternatives. The burgeoning demand for fossil fuels has precipitated a pollution crisis, compelling the need for new energy sources that promise to minimize carbon footprints and champion environmental stewardship. Economically, the new energy sector is a tapestry of industries including energy generation—wind, solar photovoltaic, thermal, hydroelectric, and tidal power—and applications like smart grids, renewable heating and cooling systems, and green buildings. This sector not only generates employment and tax revenue but also acts as a catalyst for transforming the national energy infrastructure, igniting robust economic growth. These industries are foundational to enhancing China's economic strength, providing the dual benefits of economic development and energy security. The strategic shift to new energy reduces reliance on imported fuels, shielding the nation from geopolitical flux.

Our focus extends to the multifaceted landscape of China's new energy sector, which has become a lighthouse of sustainable progress amid mounting environmental concerns. The sector is not without its challenges, with reports of certain actors exploiting state subsidies. However, the overarching narrative remains one of positive growth, with government incentives reflecting a strong commitment to nurturing this industry. Ultimately, genuine innovation in the new energy sector should aim for sustainable financial strategies beyond governmental aid, leveraging market financing to expand and innovate, ensuring a resilient and green future for all.

2. Literature review

China's burgeoning new energy industry is pivotal to its economic development, yet government backing alone is insufficient; robust support from the stock market is also essential. Investors play a crucial role in this ecosystem, where the stock market serves as a vital platform for new energy

companies to secure funding through initial and follow-on equity offerings. Such capital infusion is critical for these companies to sustain operations, innovate, and scale up to overcome financial constraints.

There are voluminous literature focusing on the Chinese new energy stock market. Most recently, Shen et al. [1](2023) introduced a Chinese investor sentiment index based on deep learning algorithm and investigated how investor sentiment impacts returns and value at risk (VaR) in both the new energy and the traditional energy sectors. Another strand of literature focused on the relationship between new energy stocks with other traditional energy sector. For instance, Wen et al.[2] (2014) analyzed the return and volatility spillover effects between Chinese new energy and fossil fuel company stock prices, revealing significant and symmetric dynamics that have implications for asset allocation, financial risk management and energy policy marking. Zhang and Du [3](2017) examined the dynamic relationships among the stock prices of new energy, high-technology, and fossil fuel companies in China, and revealed that new energy stocks are more highly correlated with the high technology stocks than the coal and oil stocks. Dai et al. [4](2022) investigated the volatility spillover effects and dynamic relationships among WTI crude oil, gold, and various Chinese stock markets related to new energy vehicles and environmental protection.

Turning to the CAPM, this cornerstone of modern finance theory—developed in the 1960s by William Sharpe, John Lintner, and others—links portfolio returns to systematic risk and provides a formula to calculate expected returns. Elbannan [5] (2015) and Barberis et al. [6] (2015) have affirmed the CAPM's practicality within the stock market, underscoring its applicability to China's new energy stocks. This study aims to adapt the CAPM to evaluate the risk-return dynamics of these stocks.

The performance of the new energy sector in China's stock market is currently subdued, chiefly due to inadequate product development. Having progressed through the conceptual phase, the industry is now grappling with product realization, leading to a significant erosion of market confidence. Investors face a crucial decision on whether to invest in this sector. Lin & Chen [7] (2019) highlight the sector's interconnectedness with other industries and its fundamental indispensability. Coupled with unprecedented governmental support and its inherent profitability - particularly in new energy vehicles - the sector's potential for growth is substantial. Hence, analyzing the risk-return trade-off is of paramount importance.

Given that the previous literature largely focused on the comovement of China's new energy sectors with other sectors such as the fossil fuel and new technology. Here we opt to employ a more macro approach. We devise a CAPM-based model that encapsulates the risk-return profile of specific stocks within China's new energy sector, thereby aiding investors in making informed decisions. This choice echoes the work by Kinnunen [8] (2013), who emphasized the general relevance of the risk-return concept in stock markets; it extends the work of Refai & Eissa [9] (2016), who applied the CAPM to the Jordanian market with Chinese evidence. Through this research and subsequent data analysis, we aim to equip investors with the insights necessary for prudent investment in the new energy industry.

3. Methods

The utilization and importance of the CAPM model were outline in the preceding section, in the subsequent analysis, I will employ data from Chinese stocks in the new energy, primarily leveraging the CAPM model for computation.

The CAPM is a widely used finance theory that establishes a linear relationship between the expected return of an asset and its risk, measured by beta. The main equation of CAPM is

$$E(r_i) = r_f + \beta_i(E(r_m) - r_f) \quad (1)$$

Where $E(r_i)$ the expected return on the asset is, r_f is the risk-free rate, β_i is the beta of the asset, $E(r_m)$ is the expected return of the market, $E(r_m) - r_f$ is known as the market risk premium. In

essence, CAPM asserts that investors are compensated in two ways: for the time value of money measured by r_f , and for taking on additional risk (measured by $\beta_i(E(r_m) - r_f)$).

In empirical analysis, we focus on the “excess return” form of the CAPM, specifically,

$$r_{i,t} - r_{f,t} = \alpha_i + \beta_i(r_{m,t} - r_{f,t}) + \epsilon_t \quad (2)$$

Where we imposed a time series structure to the regression, $r_{i,t}$ is the stock's rates of return at time t , $r_{f,t}$ is the risk free rate at t , α_i is the intercept term, $r_{m,t}$ is the market rates of return (proxied by index returns) at t , and ϵ_t is the error term (assumed to be white noise). In this form, the intercept term α_i , has a clear interpretation. A statistically significant positive α_i indicates that the asset, on average, provides a return above what would be expected based on its beta and the market risk premium. Conversely, a negative α_i suggests the asset underperforms relative to its beta. This form is also more in line with economic intuition, suggesting that investors care about the return of a security relative to a risk-free investment, rather than the absolute return.

4. Results and discussion

4.1. Preliminary analysis

A fundamental outcome of the Capital Asset Pricing Model (CAPM) is the determination of the expected return for a specific stock. To this end, we have chosen a diverse portfolio of stocks that represent the trajectory of China's new energy market. We consider prominent players in the market, such as BYD, Sungrow, Powersource, CRRC, and TF energy; as for the market performance, we utilize the Shenzhen and Shanghai composite indices; finally, the Chinese national bond yield serving as a benchmark for risk free rate. Our data are downloaded from the WIND database, started from 5th January 2015 to 8th August 2023.

The rationale for selecting these particular stocks is outlined as follows. First, BYD stands at the forefront of China's new-energy vehicle segment in terms of market share and sales. It holds a significant stature within the industry, with its influence on the new energy vehicle sector being substantial, as noted by an [10] (2021). BYD's stock trend mirrors the long-term trajectory of the market for China's new energy vehicles, making it a suitable proxy for the sector's health. Second, Sungrow, specializing in new energy power supplies such as photovoltaic equipment and battery conversion/storage technology, represents a granular aspect of the new energy sector. Post the downturn of the Xinguang epidemic, Sungrow has emerged as a front-runner in the battery industry—a critical component of new energy. Third, Powersource, with its focus on fast-changing technologies for infrastructure like charging stations, offers stability and moderate market reactivity, providing a counterbalance to the more volatile segments of the new energy market. Fourth, CRRC, an integral part of China's new energy infrastructure, derives its revenue from urban transit and railway transport, also incorporating new energy vehicles into its portfolio. Its stock movement is indicative of the long-term trends in China's new energy sector. Fifth, TF Energy, a comprehensive new energy enterprise, is involved in various facets from hydropower to gas energy conversion. Gu et al. [11] (2014) acknowledge the broader impacts of such energy sources on the new energy industry, highlighting TF Energy's extensive influence. Finally, the Shanghai and Shenzhen composite indices, as discussed by Yao et al. [12] (2008) and Zhang & Kong [13] (2022), are pivotal. These indices not only reflect the overall market but are also intertwined with the new energy sector's developments, indicating potential susceptibility to broader market shifts.

4.2. Visualization

Figure 1 illustrates the historical closing prices for BYD, CRRC, Powersource, Sungrow, and TF Energy. Reboredo and Wen [14] (2015) have analyzed the impact of China's evolving new energy policies on the stocks within this sector, a perspective that is highly compelling. The ever-changing landscape of policies and benchmarks within the new energy industry is reflected in these five stocks,

which collectively serve as a microcosm of the market. Notably, there are distinct upward trends in 2015, 2018, 2020, and 2021, coinciding with significant increases in stock values and, consequently, substantial investment returns and high ROI.

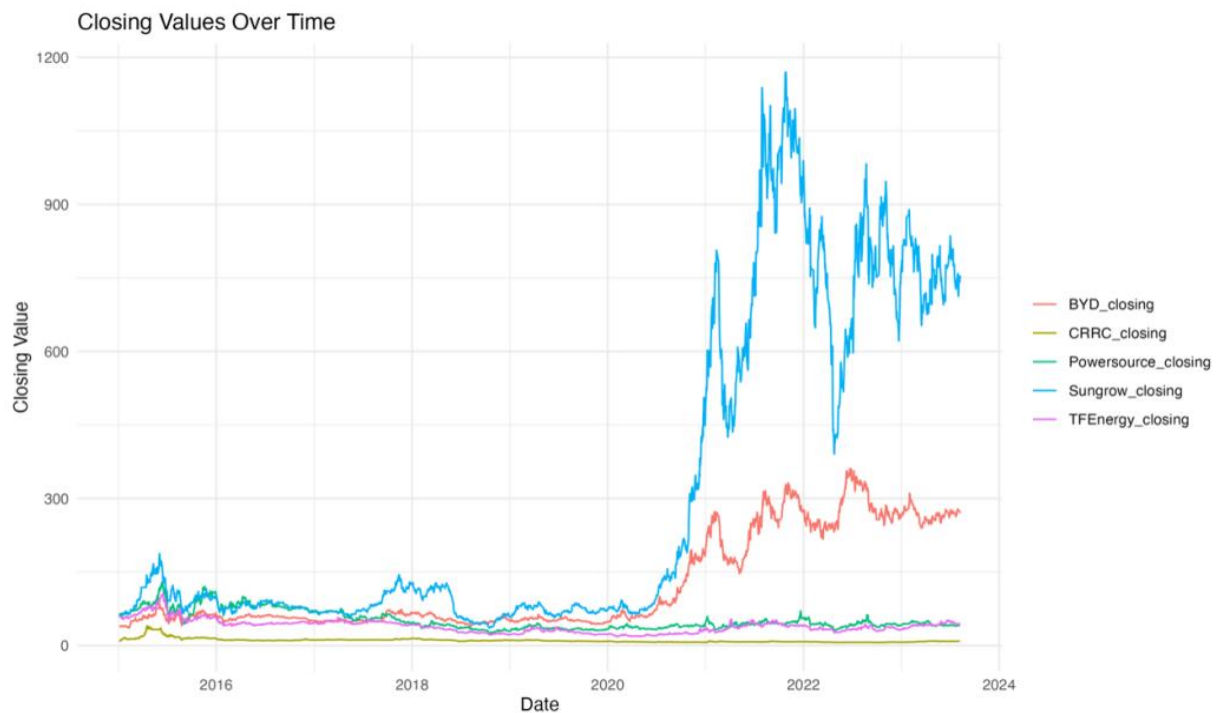


Fig 1. Closing prices for BYD, CRRC, Powersource, Sungrow and TF energy.



Fig 2. Shenzhen composite index and the Shanghai composite index.

Figure 2 reveals the striking similarity between Shenzhen and Shanghai composite indices. The influence of these indices on the Chinese stock market, discussed in-depth by Wang et al. [15] (2012), is evident. A correlation between the movements in these indices and the aforementioned five stocks is discernible, suggesting that overall market trends positively influence individual stock performance.

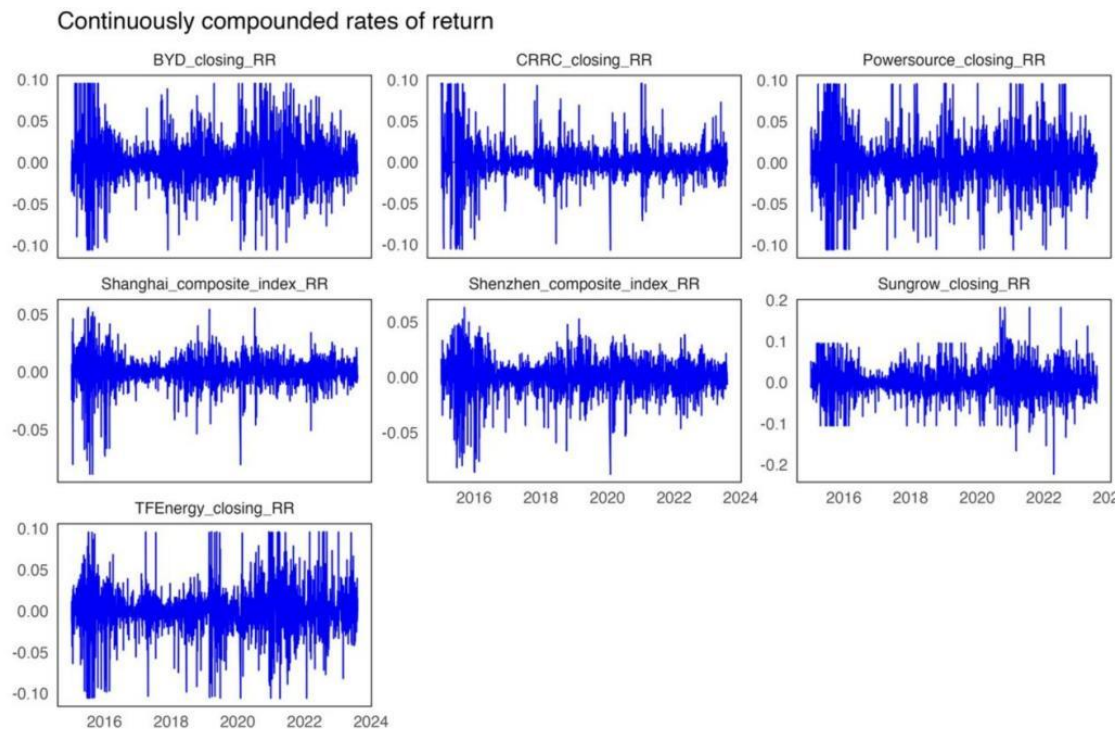


Fig 3. The continuously compounded rates of return.

Figure 3 presents an analysis of the continuously compounded rates of return for both the individual stocks and the indices. The graphic indicates notable price volatility among some stocks. When viewed in conjunction with the previous two figures, it becomes apparent that such fluctuations are attributable to the considerable scope for price movement within the stock market.

4.3. Analysis and discussion of results

The descriptive statistics of the continuously compounded rates of return are tabulated in Table 1.

Table 1. Descriptive statistics of the continuously compounded rates of return for BYD, Sungrow, CRRC, TFEnergy, Shanghai and Shenzhen composite indices.

	BYD	Sungrow	Powersource	CRRC	TFEnergy	Shanghai composite index	Shenzhen composite index
Mean	0.00088663	0.00119423	-0.0001923	6.00027527898981e-05	-0.0001316	-1.27E-05	0.0001923
Variance	0.00082104	0.00137565	0.00100462	0.00048583	0.0008632	0.00017213	0.00100462
Skewness	0.1728402	0.05129956	0.00100462	0.00048583	0.0008632	-0.913187	1.1548025
Kurtosis	5.56922202	5.89919338	5.4973529	10.93567	6.07903146	7.42351314	11.1685535
ADF	-12.207847	-11.537306	-13.815444	-12.938589	-13.745287	-11.68352	-12.37996
p-value of ADF	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Note: ADF stands for augmented Dickey-Fuller test.

Table 1 suggests that the mean returns vary across entities, with Sungrow showing the highest positive mean (0.00119423) and Powersource exhibiting a negative mean (-0.0001923). The variance, a measure of the spread of returns, also differs across entities, with Sungrow having the highest variance (0.00137565). Skewness and kurtosis, which measure the asymmetry and tail heaviness of the distribution, respectively, show diverse patterns. Notably, the Shanghai index has a negative skewness (-0.91387), suggesting a bias towards negative returns. The kurtosis values are all higher than 3, suggesting a higher likelihood for extreme returns. Finally, the ADF test results are all highly statistically significant, indicating stationarity of all-time series under consideration.

Table 2. CAPM results for BYD, Sungrow, Powersource, CRRC and TFEnergy.

BYD:				
Coefficients	Estimate	Std.Error	T value	Pr(> t)
α	0.0015956	0.0005578	2.861	0.00427
β	1.1031023	0.0310784	35.494	< 2e-16
Sungrow:				
Coefficients	Estimate	Std.Error	T value	Pr(> t)
α	0.0039723	0.0007448	5.334	1.06e-07
β	1.3469981	0.0414957	32.461	< 2e-16
Powersource:				
Coefficients	Estimate	Std.Error	T value	Pr(> t)
α	0.0024112	0.0006907	3.491	0.000491
β	1.2991056	0.0438404	29.633	< 2e-16
CRRC:				
Coefficients	Estimate	Std.Error	T value	Pr(> t)
α	-7.743e-06	4.596e-04	-0.017	0.987
β	9.907e-01	2.917e-02	33.959	<2e-16
TFEnergy:				
Coefficients	Estimate	Std.Error	T value	Pr(> t)
α	0.0024424	0.0006196	3.942	8.34e-05
β	1.2957028	0.0393266	32.947	< 2e-16

The Table 2 provides a summary of the CAPM results for five different companies. In CAPM, the intercept α represents the stock's expected return independent of the market's return, and β measures the stock's volatility relative to the market. BYD, Sungrow, Powersource and TFEnergy have statistically significant positive α s, suggesting they offer returns above the market average. To verify their β s are statistically different from 1, we construct a new t-statistic such that $\frac{\hat{\beta}-1}{s.e.(\hat{\beta})}$, we found the t statistics are 3.317490604, 8.362266452, 6.822601984, -0.318820706 and 7.519154974 for BYD, Sungrow, Powersource, CRRC and TFEnergy. These results suggest that BYD, Sungrow, Powersource and TFEnergy, which indicate these stocks are expected to be more volatile than the market, they may be highly sensitive to macroeconomic factors that affect the market as a whole. In bullish markets, these stocks are expected to offer substantial gains; however, during bearish phases, they may suffer greater loss.

When we correlate these findings with the fundamentals of the stocks, it's clear that they are key players in China's new energy sector. BYD, in particular, has been a standout performer over the last decade, with its stock market growth closely tracking its sales in the new energy vehicle sector. The CAPM model's insights align well with the actual performance. Sungrow, Powersource, and TFEnergy, which focus on broader aspects of the new energy sector, including clean energy research, also show expected outcomes that resonate with their current market standing. CRRC, however, shows less favorable results. Its similarity to the general market performance could be influenced by its business model and nature as a state-owned enterprise (SOE). As the world's largest rolling stock manufacturers and a holding a significant share of Chinese market, its financial performance may

reflect broader economic and industry trends rather than company-specific factors. The stability typically associated with SOEs, due to government backing and less exposure to competitive pressures that private firm's face, might contribute to a beta close to 1, indicating volatility similar to the market.

Based on the analysis of the charts and data above, we can see that China's new energy stock market began to grow at a high rate after 2020. Before the epidemic, China's new energy industry was not very developed, particularly in the area of new energy vehicles – there was virtually no new energy concept, and it was challenging for the new energy industry in China to form a distinct stock market sector. Most of the five stocks we have selected had share prices below 150 RMB until 2020, which supports the previous point. As we entered 2020, coinciding with the outbreak of the COVID-19 in China, the new energy sector experienced rapid growth, propelling all five stocks into high gear. This surge was also driven by some of China's policies during the outbreak, is further discussed in Jiang and Chen [16] (2022). These interconnections and policies are catalyzing the development of China's new energy sector, which, in turn, is fuelling the overall rise of China's new energy stock market. Following the conclusion of Covid-19, which began in 2023, China's new energy industry has entered a phase of steady development, where fluctuations in stock prices are evident, but they are expected to stabilise within a range. c This analysis supports the data in the table and suggests that the development of China's new energy industry is viable and the return on investment in the new energy stock market is relatively reliable and positive.

5. Conclusion

In conclusion, the application of the CAPM to the selected Chinese new energy stocks has provided significant insights into their risk-return profiles. Our analysis indicates that the majority of these stocks are projected to outperform the market, with the exception of CRRC, as evidenced by their statistically significant α values and β coefficients greater than 1. This suggests a potential for higher returns, albeit with increased volatility. These findings are reflective of the dynamic growth observed in China's new energy sector post-2020, propelled by supportive government policies and a rapid shift towards sustainable energy practices. The correlation of the stock performance with the broader market trends affirms the CAPM's utility as a tool for evaluating investment prospects in emerging sectors.

Future research would benefit from a granular exploration of the diverse stock categories within the China New Energy sector. An in-depth examination of segments such as China New Energy Automotive, Eco-Power, and Eco-Hydro would not only enrich our understanding of specific market dynamics but also potentially unveil nuanced investment opportunities poised within these burgeoning sub-sectors.

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