Evolutionary Game Theory and Time Series Returns Rank Strategy: a Quantitative Approach Tested in Chinese Stock Market

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May 26, 2023

Abstract

This comprehensive study applies Evolutionary Game Theory (EGT) in the context of stock market investment, with particular emphasis on the Chinese stock market. We use the 000300 index, a representation of the most significant stocks traded in the country, spanning from 2018 to 2022. In this research, we leverage the financial data API "tushare", a robust tool for extracting and analyzing Chinese market data. In total, we analyze 166 stocks out of the 300 incorporated in the 000300 index, with data persistently available throughout the study period. Our model takes an evolutionary approach to investment, distributing funds across a selection of top and bottom stocks in an attempt to balance profit generation and risk management. A crucial element of the EGT strategy is the flexibility in considering historical data of varying lengths (delay) and the capacity to manage diverse portfolio sizes (stock number). Through rigorous data analysis and model testing, we identify that an optimal balance is achieved with a delay of 20 days and a portfolio comprising 12 stocks. Our findings suggest that this combination of parameters not only yields high returns but also exhibits a level of stability superior to other configurations. This approach proved resilient even during volatile market periods, such as the Covid-19 pandemic period (2020-2022), demonstrating its potential to thrive in fluctuating market conditions. Our research provides a clear example of how advanced game theory strategies like EGT can be applied to stock market investment to optimize returns and reduce risk. We believe these findings represent a significant step forward in the application of game theory in financial decision-making. Our results not only offer insight into the optimal application of EGT in the stock market but also contribute to the broader dialogue on improving investment strategies using advanced mathematical models. Further research can extend and refine these methods to further harness the potential of EGT in the complex and rapidly changing landscape of stock market investment.

Key Words: Evolutionary Game Theory, Stock Market Investment, Chinese Stock Market, Portfolio Management, Sharpe Ratio, Sortino Ratio.

1 Introduction

The Chinese stock market, characterized by its rich history and dynamic traits, presents a fascinating context for investment analysis. The Shanghai and Shenzhen stock exchanges, inaugurated in 1990 and 1991 respectively, have witnessed swift progression in market size, liquidity, and regulatory procedures, despite their brief existence compared to Western counterparts. Under China's economic reform and open-door policy, the stock market has emerged as an essential component of the national economy, enticing a large number of participants both domestically and internationally. Nonetheless, due to its inherent intricacy, the Chinese stock market is often viewed as a complex terrain to traverse, necessitating innovative models and theories for precise predictions. Evolutionary game theory, a powerful branch of applied mathematics originally designed to comprehend biological behaviors, offers such an innovative approach. It incorporates the elements of time and adaptive strategy adjustments based on players' past experiences, effectively reflecting the dynamic nature of stock markets. Unlike traditional game theory which assumes rationality and equilibrium, evolutionary game theory considers bounded rationality of players and explores the dynamic processes leading to equilibrium or persistent oscillations. This theoretical framework, thus, seems fitting for modeling the intricacies of the stock market where actors constantly modify their strategies based on the market's historical performance and their individual experiences.

In an effort to advance our understanding of the application of evolutionary game theory to the prediction of the Chinese stock market, we undertook a comprehensive and meticulous investigation of existing research available on various internet databases. Our goal was to uncover any relevant works that might have touched on this subject, however, we discovered that the existing body of research in this particular area is surprisingly sparse.

Our inquiry encompassed four esteemed academic databases: ProQuest Central, Web of Science, Scopus, and Springer Link. Selected for their comprehensive and diverse collections of scholarly papers, coupled with their reputation for quality and reliability, each database offered a unique assortment of resources, endowing us with a wide array of potential sources to scrutinize.

In our endeavor to optimize the relevance of our findings, we deployed a strategic approach to our research methodology. Our initial step entailed the application of a carefully curated set of keywords encompassing "evolutionary game theory", "stock market", and "Chinese stock market". By applying these keywords to the aforementioned databases, we exported our primary results and prepared them for a second-phase of refinement, thereby streamlining our process to identify the most pertinent papers for our research inquiry.

This primary stage was succeeded by a more rigorous secondary selection process, where we refined our search criteria by generating a word cloud including crucial terms such as "price", "market", "stock", "portfolio", and "economy". We incorporated computational techniques to filter papers containing at least one of these keywords within their titles and abstracts. We conjectured this method would enable us to unearth studies that intersected with our distinctive research interests.

Upon the conclusion of the secondary screening process for each database, we amalgamated the results, eliminated the duplicates, and consequently, we were left with 253 papers. From this repository, we meticulously screened papers to meet a more stringent criteria, requiring that they contain both "evolutionary game theory" and at least one keyword from our word cloud in their title, abstract, or keywords. This intense scrutiny led us to a narrow set of 11 papers that satisfied our rigorous conditions. We proceeded to undertake an in-depth analysis of these papers, scrupulously examining their content for potential relevance to our research topic, and painstakingly perusing their references, which led us to additional X papers tangentially related to our research.

Generally, we found that while some of the papers did indeed discuss topics related to the application of evolutionary game theory to the Chinese stock market, they primarily focused on different aspects, such as market efficiency or international connections. Other papers, on the other hand, were more focused on stock markets in different geographical locations like Egypt, or diverged from our central theme of stock markets entirely, instead discussing industries such as tourism.

Therefore, we concluded that our research endeavors would indeed represent a novel contribution to the field. By applying the principles of evolutionary game theory to the prediction of the Chinese stock market, our research promises to provide new methodologies and insights. This could potentially catalyze further explorations into this relatively uncharted territory, expanding the boundaries of knowledge and understanding in this specific area of financial economics.

2 Literature Review

2.1 Portfolio Management Stock Markets

There has been increasing research on the application of evolutionary game theory in the realms of finance, stock markets, and portfolio management. "Evolutionary Finance and Dynamic Games" by Amir, Evstigneev, Hens, and Xu [RVea11] presents a game-theoretic evolutionary model for an asset market with endogenous equilibrium asset prices. The authors explores the adaptive strategies employed by investors and their impact on market dynamics. The articles aims to examine an evolutionary model of an asset market where investors employ adaptive strategies (portfolio rules) to distribute their wealth between assets. The primary objective is to identify strategies that allow investors to "survive" by maintaining a positive and non-zero share of market wealth over an infinite time horizon. A significant contribution of the paper is the identification of survival strategies for investors in the evolutionary asset market. The authors analyze the conditions under which investors can maintain a positive share of market wealth over the long term. Furthermore, the paper also explores the implications of adaptive behavior on market dynamics. It investigates how investors' strategies, driven by evolutionary dynamics, influence asset prices, market efficiency, and the allocation of wealth. The study bridges the gap between evolutionary finance and non-cooperative market games, combining recent studies in evolutionary finance with classical approaches to market games. The authors also suggest further exploration of more complex models that incorporate additional factors, such as market frictions and heterogeneous investor characteristics, to enhance the realism of the evolutionary finance framework.

Nine years later, the same group of authors who wrote "Evolutionary Finance and Dynamic Games" [RVea11] took a step further into exploring the evolutionary finance framework. Once again, Belkov, S., and Evstigneev co-authored an article "Nash Equilibrium Strategies and Survival Portfolio Rules in Evolutionary Models of Asset Markets" [RVea20]. This time, Belkov, S., and Evstigneev investigate the impact of Nash equilibrium strategies and survival portfolio rules on the evolution of asset markets, which contributes to the understanding of strategic interactions in asset markets and their implications for individual investors. The article presents a study that explores a stochastic model of a financial market with short-lived assets and endogenous asset prices. The authors highlight the distinction between their game-theoretic approach and previous models, such as those considered by Bell, Cover, and others, which describe asset markets based on players' objectives expressed in terms of expected random payoffs. Belkov et al. employ a stronger solution concept, focusing on almost sure Nash equilibrium. This definition ensures that any deviation from the equilibrium strategy will result in a decrease in the random payoff with certainty, rather than merely a decrease in expected payoff.

Apparently, Belkov et al. are not the only group of scholars who are intrigued by the application of evolutionary finance on short-lived assets and endogenous asset prices. Amir, who collaborated with Belkov et al. on the first paper that is mentioned in our literature review, continued to expand on this topic with his colleagues in recent years as well, through the publishment of the article "An Evolutionary Finance Model with Short Selling and Endogenous Asset Supply" [RSea22]. The authors argue that the main finding in the existing EF (evolutionary finance) model without short selling is the existence of a survival strategy that guarantees an investor's long-term survival. This survival strategy, denoted as Δ_*, involves allocating wealth among assets based on their relative payoffs. The authors refer to this strategy as fundamental indexing, as it uses asset payoffs rather than equilibrium prices for portfolio allocation. In the extended model presented in this paper, investors can construct portfolios not only with long positions but also with short positions. Short selling involves issuing replicas of assets, selling them on the market, and using the income generated to purchase other assets. However, short selling also implies the obligation to pay the same payoff as the original asset. Additionally, short selling influences the equilibrium asset prices and the total supply of assets. The authors explore the consequences of short selling and the trade-offs involved in the decisions made by short sellers. The authors investigate whether the survival strategy Δ_*, which does not involve short selling, guarantees survival in a market where short sales are allowed. They affirm that Δ_* does ensure survival even when short selling is permitted. However, they also find that no other strategies involving short selling guarantee survival. If an investor engages in short selling with a positive probability, the group of rivals can construct a "spiteful" strategy that leads to the investor's bankruptcy with a positive probability in the next period. This result highlights the vulnerability of short sellers and the potential for coordinated actions against them.

Based on the three papers discussed above, we can see that Amir, Belkov, S., and Evstigneev are four of the main scholars who have exerted great influence on the development of evolutionary finance. Indeed, their work has impacted and inspired many other scholars in the field, who later ground their analysis on their previously proposed models and seek for improvement. In "A Continuous-Time Asset Market Game with Short-Lived Assets" by Zhitlukhin [M.22], the author continues to explore the models with short selling and endogenous asset supply. The paper builds upon a previous model proposed by Amir et al. [RVR13], which considers short-lived assets that yield random payoffs at the end of each period. In the initial model, short selling is not allowed, and the total amount of each asset is given exogenously. The present work extends this model by allowing short selling and endogenous asset supply. The analysis focuses on identifying survival strategies for investors in the market selection process. The main results of the paper demonstrate that the survival strategy in the original model (without short selling) guarantees survival even in a market where short sales are allowed. Additionally, the paper shows that strategies involving short selling do not guarantee survival and can be detrimental to the investor. If an investor sells short with positive probability, rival investors can form a "spiteful" strategy that leads to the bankruptcy of the short-selling investor.

These scholarly articles highlight the growing interest in applying evolutionary game theory in portfolio management and stock markets. They provide valuable insights into the benefits, limitations, and future research directions in this field. By incorporating evolutionary dynamics into financial models, we aim to enhance our understanding of investor behavior, optimize portfolio selection, and analyze stock market dynamics. The application of evolutionary game theory in portfolio management and stock markets has provided valuable insights into the dynamics of financial markets and investor behavior. By capturing the complex interactions between market participants, evolutionary game models have demonstrated their potential in optimizing portfolio selection, understanding stock market dynamics, and predicting investor behavior. By advancing the theoretical foundations and incorporating more realistic assumptions, evolutionary game theory can continue to contribute to the advancement of portfolio management and our understanding of stock markets.

2.2 Features of the Chinese Stock Market

Evolutionary Game theory has been applied in Western stock and finance markets, but the application of EGT to the Chinese stock market is limited. Though the nature of capital accumulation is similar, when applying the models to such an emerging market, there are specific and noticeable details that vary across the two systems:

(1) In the Chinese market, individual stocks are bound to a price limit, which is of their previous trading day settlement price [Exc18];

(2) The Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE) are China's two principal stock exchanges. The SSE caters to bigger, more established enterprises, while the SZSE caters to smaller, high-growth businesses.

(3) In China, short-selling operations are more limited than in the United States.

(4) Individual investors play an essential role in the Chinese stock market, given its strong retail investor base, which often dominates trade volumes and market dynamics.

(5) The Chinese stock market is characterized by more speculative and short-term trading habits motivated by ordinary investors seeking rapid profits. The US market, on the other hand, often stresses long-term investing methods and an emphasis on fundamentals. Out of its features, the Chinese stock market is showing trends of:

- (Continuous) Growth:

Established in 1990 [W.94] and as of the end of May 2010, the Shanghai and Shenzhen stock markets ranked third in the world, after the New York Stock Exchange and the Nasdaq, according to the Chinese Securities Regulatory Commission (CSRC).

- Volatility:

Fernald and Rogers [JH02] claimed that Stocks are volatile in most emerging markets, especially for domestic buyers in Shanghai and Shenzhen. According to Zhou and Zhang [XWJ12], after 2005, the Chinese stock market had a significant volatility spillover effect on other markets, witnessing massive growth in world influence.

Despite its properties, macroeconomic indicators, government policies and regulations, and global economic and political factors [XC16] are the leading and most-studied variables impacting the Chinese equity market. In recent years, social fluctuations such as the rapid development of new energy investments and the outbreak of the COVID-19 pandemic have significantly impacted the Chinese stock market outcomes.

According to Liu and Ma [WQX22] and their dynamic network model, the top market value rankings do not align with the network centralities, and the network entropy of a stock indicates trends for well-needed future predictions of the stock performances.

One of the major public events in recent decades is the COVID-19 outbroke lasting from 2020, which incurred many government policies, especially in China. Using a panel regression approach, Al-Awadhi et al. [MKAS20] concluded that the number of COVID cases negatively impacts stock returns across the Chinese stock market. Chen, Li, and Jia [LTFT23], on the other hand, used multiple linear regression models to see a positive correlation between the Chinese government's Level I emergency response policy on manufacturers' stock market values. After the government opened up in the past winter, the infamous pandemic still leaves unstable factors in Economic environments. These up-to-date factors should also be put into consideration for the prediction of the Chinese stock market activities. Following the design of the dynamic network model, panel regression approach, and multiple linear regression models, we proposed an evolutionary game theory to estimate the Chinese stock market from a different perspective.

3 Model and Methods

3.1 Data Collection and Processing

Data source: 000300 index

Tool: tushare (a powerful financial data API especially for the Chinese stock market)

Processing: 2018/1/1 - 2022/12/31 trading date (we choose stocks whose data are available for all trading dates during this time period, so 166/300 stocks remained)

3.2 Model Overview

We want to develop a multi-factor quantitative strategy that takes in two parameters: delay and stockNum (stock number). Delay stands for the number of days we trace back to compute the time series returns rank. For example, if delay=3, we look at the open price of today and that of 3 tradings ago and compute the returns for all 166 stocks. Then we rank them according to the returns, and choose the top stockNum and bottom stockNum groups of stocks based on the rank. After that we incorporated evolutionary game theory into our model by viewing the two groups as two players. Initially, the investor would assign 50% of the initial asset for each strategy. Then the returns of both strategies would come out as the open price updates each trading day. Then we reallocate the percentage of hold (or share) according to the returns by adding the absolute value of returns difference to the preferable strategy. In this case, which and how much a strategy is better than the other can be clearly shown. Since the allocation percentages of the two strategies change over time, we called it the "evolutionary share". For back-testing, we keep track of the profitability, profits, and evolutionary share of the strategies.

To help readers understand the graphs that will appear later, we are going to explain the labels here. *Base* just means that we distribute investments to all stocks equally from the first day and use no strategy at all. *All* means that we use the evolutionary game theory strategy described in this paper. *Top* means that we only invest in top stocks, and *Bottom* similarly means that we only invest in bottom stocks.

In case some readers don't have financial background, we will briefly explain the financial ratios here. The Sharpe Ratio measures the performance of an investment such as a security or portfolio compared to a risk-free asset, after adjusting for its risk (according to Wikipedia). For more information, feel free to visit Wikipedia page for Sharpe Ratio.

The Sortino Ratio is a modification of the Sharpe Ratio and measures the risk-adjusted return of an investment asset, portfolio, or strategy (according to Wikipedia). For more information, feel free to visit Wikipedia page for Sortino Ratio.

3.3 Interpretations on the Model

There are several measures we use to understand the performance of the model. This includes the relation of delay and stock number to overall profit and the two common financial modeling ratios (Sharpe Ratio and Sortino Ratio); in addition to that is an overview of evolutionary shares to top and bottom stocks and profitability overtime.

We have tested the model with two varying parameters: delay and stock number.

3.3.1 Delay and the Response Variables

(a) Where the Evolutionary Approach Stands in the Variety of Strategies

We first observe how delay affects the overall profit. As we will probably mention more than once in the analysis, $delay = 20$ is a sweet spot and can be understood as an optimal strategy. The profits overtime peaks when $delay = 20$ (this is observed through singling out the *delay* variable as the explanatory variable).

In the graphs we have attached, it is obvious that the bottom stocks' profits wins at all times (when *delay* is not too large and within reasonable range). This fits the assumption that bottom stocks' price have larger potential in growing and generating profit. From our data, when $delay = 220$, it seems that the base case profit is highest, which is not what we want; this makes sense since having a delay of 220 would mean that we are losing a lot of important up-to-date information.

That being said, $delay = 20$ is the optimal value instead of 1 because markets take time to react and information from a few weeks ago might be the most important.

However, when talking about an optimal strategy, we not only need to consider high profit, but also need to understand underlying risks. Bottom stocks win in generating highest profits, but also shows larger variations and seem more prone to change.

Another important trend in the profits is that when *delay* increases, the variations in profits from bottom/top/all stocks lowers. This means that the advantage of investing in bottom stocks is less obvious when we have less information, which would significantly affect our investing decisions.

Therefore, the idea of having an evolutionary strategy seems important: both high profit and low variations are taken into account in this case. As we can see, the profit from the "all" line (evolutionary strategy) is the most resistant to all kinds of changes. In general, it has small variations and does not change too significantly, even during the Covid period (2020-2022).

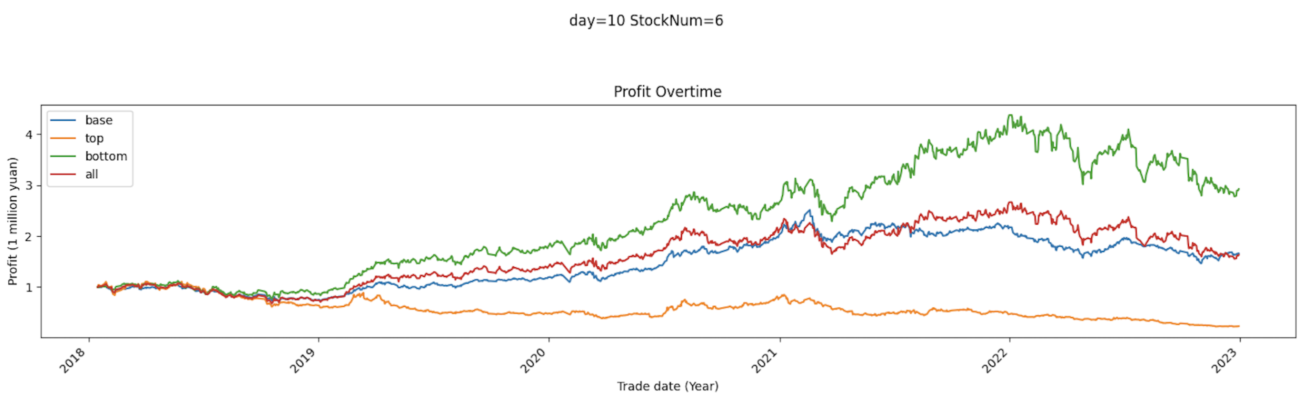

Figure 1: Delay = 10, StockNum = 6

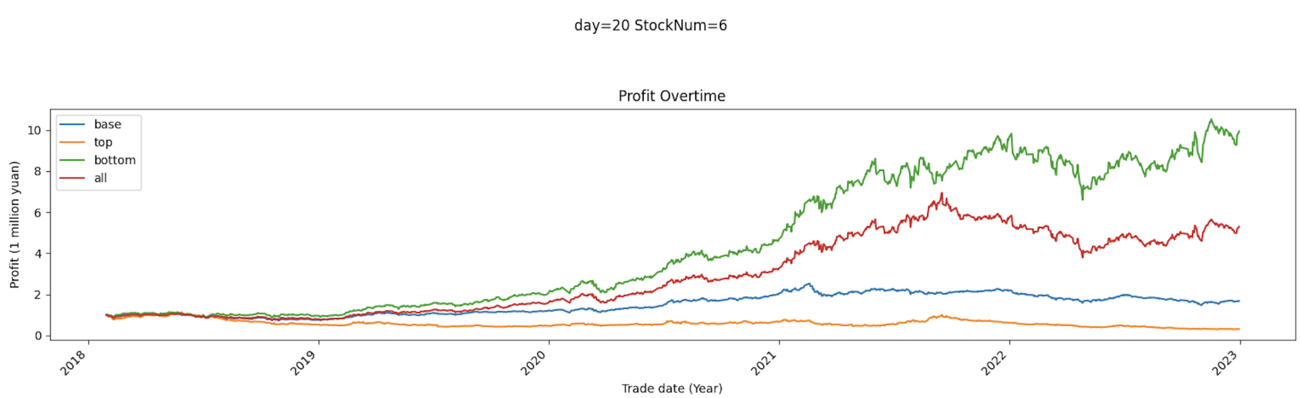

Figure 2: Delay = 20, StockNum = 6

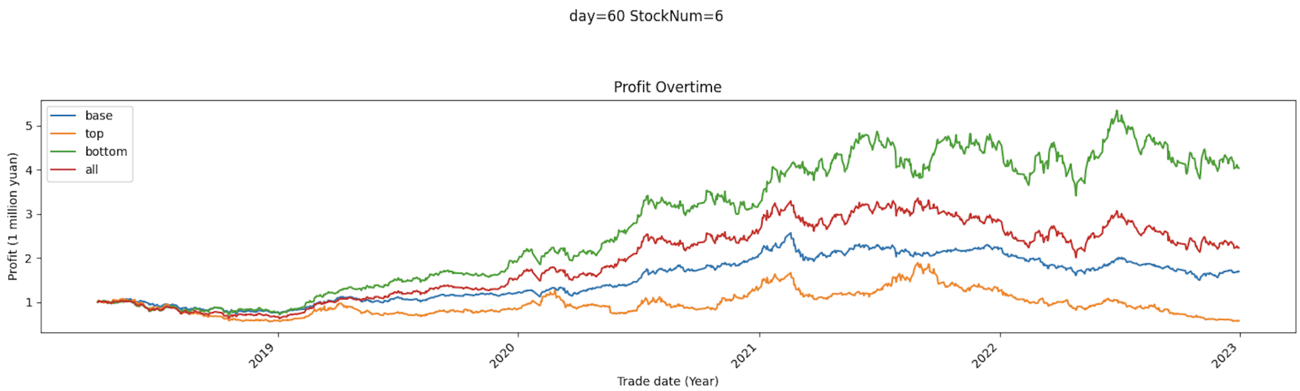

Figure 3: Delay = 60, StockNum = 6

(b) General Trends and Optimal Strategy in the EGT Approach

In the section above, we already found through an analysis of profitability that when *delay* = 20, our evolutionary approach reaches an optimal strategy, but we insist to further verify our analysis by looking into some financial ratios (indicator of optimality), including the sharpe and sortino ratio.

To find the optimal delay for our EGT approach, we fixed $stockNum$ = 2, 4, 6, 12, 22, 44, 88 and observed how having different delay affects the overall values of the Sharpe and Sortino ratios. Regardless of what $StockNum$ we use, we can observe consistently among all plots of different fixed $StockNum$ that as *delay* increases, both the Sharpe and Sortino ratios reach a peak at *delay* = 20 and experience a drop in ratio following the peak. It's reasonable that we see a peak at *delay* = 20 as an optimal delay, considering that delay represents the number of days we trace back to for computing returns. In the list of *delay* values we consider *delay* = [3, 5, 10, 20, 60, 120, 220], it makes sense that a low-range delay [3, 5, 10] would under-consider information in prediction while a high-range delay [60, 120, 220] would over-represent information by including irrelevant noise in prediction. Therefore, it explains why 20 represent the optimal delay in our EGT Approach.

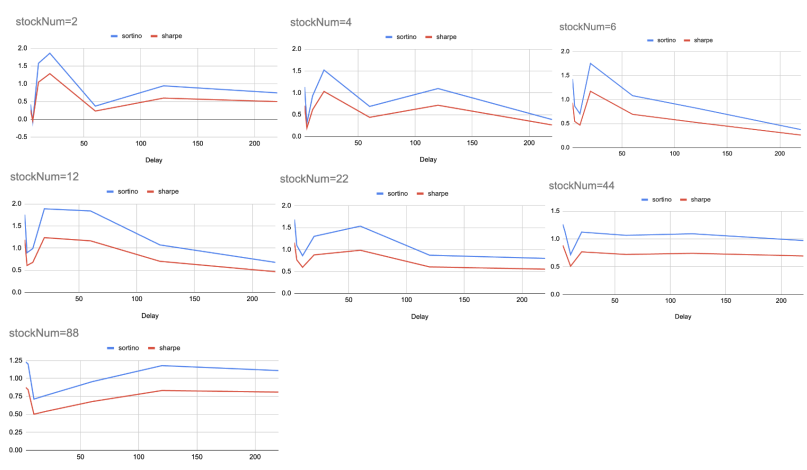

Figure 4: Delay = 20, StockNum = 12

3.3.2 Stock Number and the Response Variables

(a) Where the Evolutionary Approach Stands in the Variety of Strategies

We now switch gears and observe how the varying of stock numbers affect our understanding of the model. The next step would be to examine how stock numbers affect overall profits.

We observe how stock number affects the overall profit. As we will probably mention more than once in the analysis, $stockNum = 12$ is a sweet spot and can be understood as an optimal strategy. The profits overtime peaks when $stockNum = 12$ (this is observed through singling out the $stockNum$ variable as the explanatory variable). An adding value of the $stockNum = 12$ point is that variations are minimized while also reaching peak profits (this is true for all four lines in graph).

The non-linear trend having a peak makes sense. When stock numbers are too small, the limited sample size will most possibly give us high variations and high uncertainty. But if the stock number grows too large, we are restricted too strongly with too many conditions to consider and will certainly gain much less profit compared to the middle balancing "optimal" point.

For other general information on trends of profits that are mentioned in the previous section, we will not talk about them in detail again in this section. One thing that is worth emphasizing though, is how the evolutionary approach gives us a good balance between high profit and low variability.

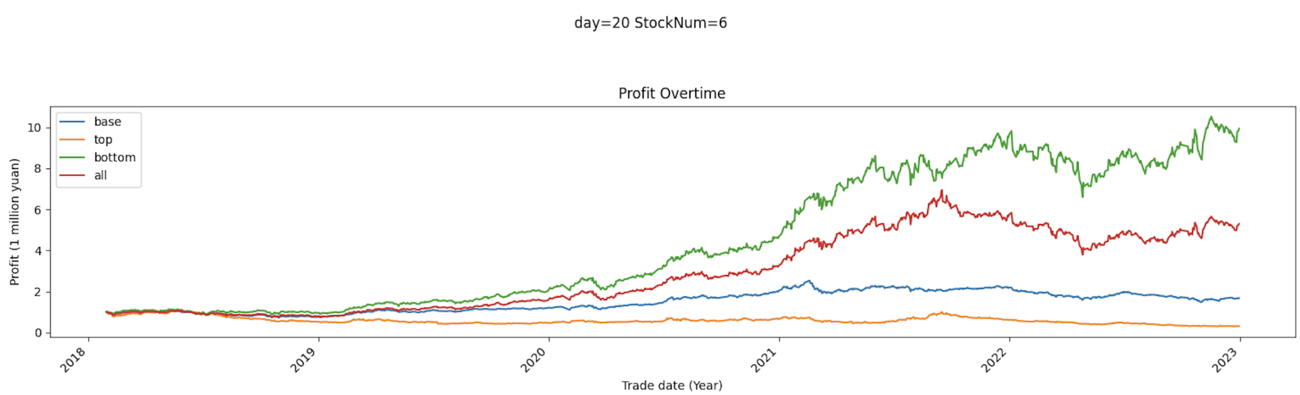

Figure 5: Delay = 20, StockNum = 6

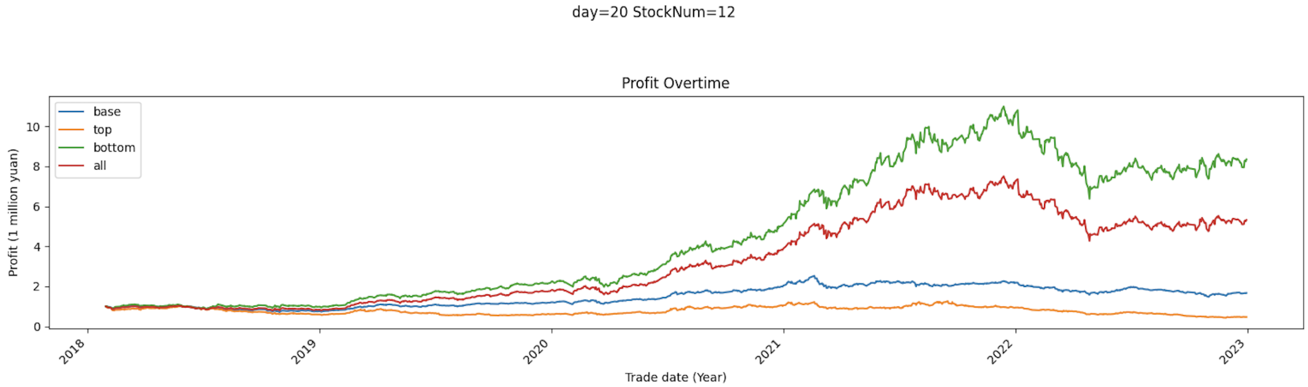

Figure 6: Delay = 20, StockNum = 12

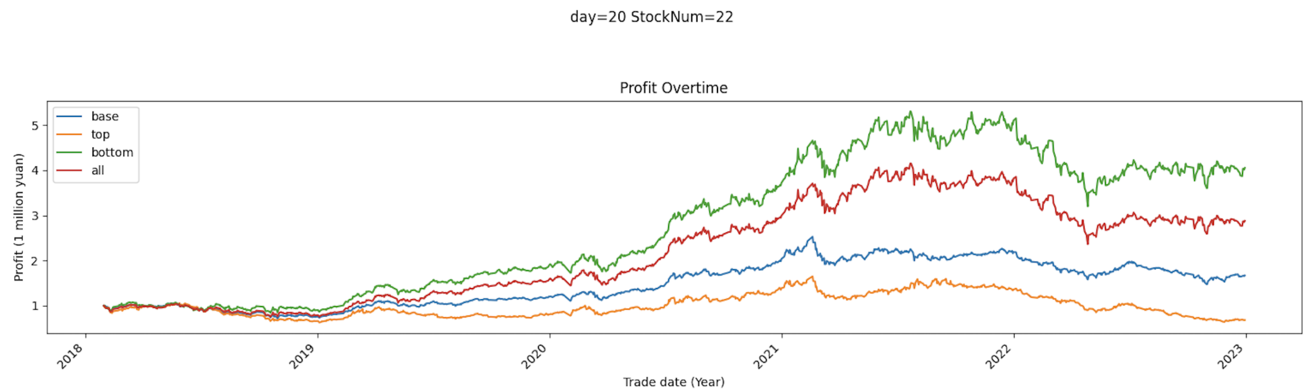

Figure 7: Delay = 20, StockNum = 22

(b) General Trends and Optimal Strategy in the EGT Approach

For our EGT Approach, there exists two parameters ($delay$, $stockNum$) to optimize.

In the section above, we already found through an analysis of profitability that when $stockNum$ = 12, our evolutionary approach reaches an optimal strategy, but we insist to further verify our analysis by looking into some financial ratios (indicator of optimality), including the Sharpe and Sortino ratio.

To find the optimal delay for our EGT approach, we fixed $delay$ = 3, 5, 10, 20, 60, 120, 220 and observed how having different $stockNum$ affects the overall values of the Sharpe and Sortino ratios. Regardless of what $delay$ we use, we can observe consistently among all plots of different fixed $delay$ that as $stockNum$ increases, both the Sharpe and Sortino ratios reach a peak at $stockNum = 12$. It's reasonable that we see a peak at $stockNum = 12$ as an optimal $stockNum$, considering that $stockNum$ represents the number of top/bottom stocks we consider for our analysis. In the list of stock number values we consider $stockNum = [2, 4, 6, 12, 22, 44, 88]$, it makes sense that a low-range stock numbers [2, 4, 6] would introduce high variations and uncertainty due to the limited sample size of stock while a high-range $delay$ [22, 44, 88] would also do the same, especially when $stockNum$ reaches 88 and already introduces overlap into the buying and selling of our stocks for the top vs. bottom strategy separation. Therefore, it explains why 12 represent the optimal number of stocks in our EGT Approach.

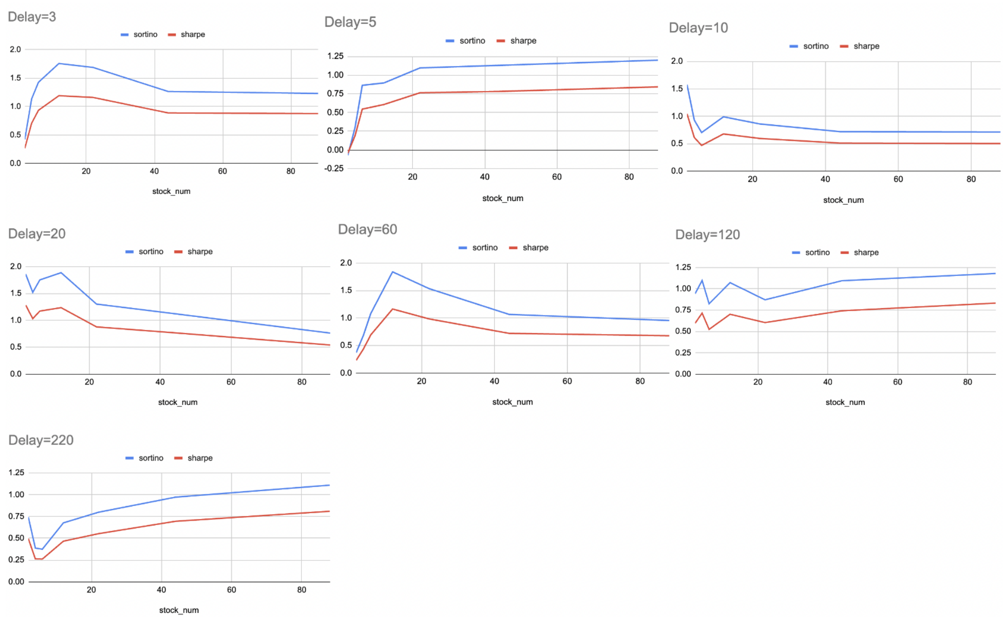

Figure 8: Delay = 20, StockNum = 12

3.3.3 Evolutionary Share Overtime

We observed that the investment shares for top and bottom stocks tend to evolve to a fixed result: bottom stocks take up most of the share and only a tiny portion is allocated to the top stocks. In general, the outcome is uniform.

However, there are some fluctuations in between that are worth pointing out. $Delay = 20$ seems to be a sweet spot: when delay grows to be larger than 20, it seems that we have information that is way too outdated for us to optimize our strategy and evolutionary shares tend to fluctuate more violently. This effect is magnified especially during the 2020-2022 time period (Covid). There are times when the evolutionary share for top ranking stocks is higher, but these times never last and are unstable.

That being said, when the delay is not too large (less than 200), the bottom stocks' return always wins; they bring us the highest profit. Examining Evolutionary Share Overtime supports our statement that $delay = 20$ is an optimal parameter selection.

3.3.4 Profitability Overtime

It is important both to observe profits and profitability. In this section, we aim to discuss the profitability trends, relying on graphs of profitability for base case, top and bottom ranking stocks, and all stocks.

We can find similar patterns in all cases. In general, the top ranking stocks' profitability (yellow line) has more uncertainty and fluctuations compared to the bottom ranking stocks, but also has higher peaks (spikes). This is reasonable since the pattern aligns with the general rule that higher risks generate higher returns.

Examining the "all profitability overtime" graphs, we can observe that in general they are more steady and less prone to variations; this is reasonable since considering a combination of a variety of stocks gives us a less biased and more omnipotent view of the stock market and its possible changes.

4 Results

From our observations of the data, we can say that the evolutionary strategy seems to work well in the investment of stocks. Although it does not generate the highest profit (like the bottom stocks), it well balances risk and return: return is second highest when other parameters are optimized, but variation is much smaller than the "bottom" case and the trends seem to be less prone to events like Covid-19.

Through intensive experimentation with data, we have pinned down an ideal set of parameters to use in the modeling code assuming no large fluctuations in the stock market other than shocks from Covid-19 in 2020-2022.

We have observed that for each delay value, when $stockNum = 12$, the profits and the Sharpe and Sortino ratios reach peak values; $stockNum = 12$ seems to be some sort of optimal value for this model. Even when $delay$ increases to as large as 120 or 200, $stockNum = 12$ still seems to be a local maximum in graphs that depict change in Sharpe and Sortino ratios.

We have observed that for each stock number, when $delay$ is 20, the profits and the Sharpe and Sortino ratios reach peak values; $delay = 20$ seems to be some sort of optimal value for this model. Even when $stockNum$ increases to as large as 88, $delay = 20$ still seems to be a local maximum in graphs that depict change in Sharpe and Sortino ratios.

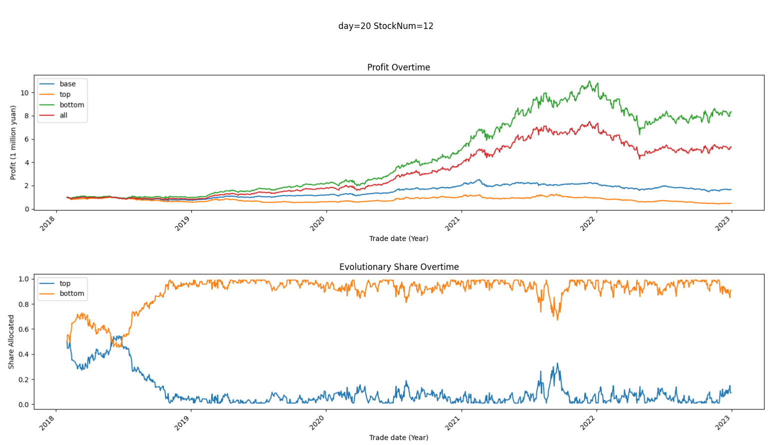

Figure 9: Delay = 20, StockNum = 12

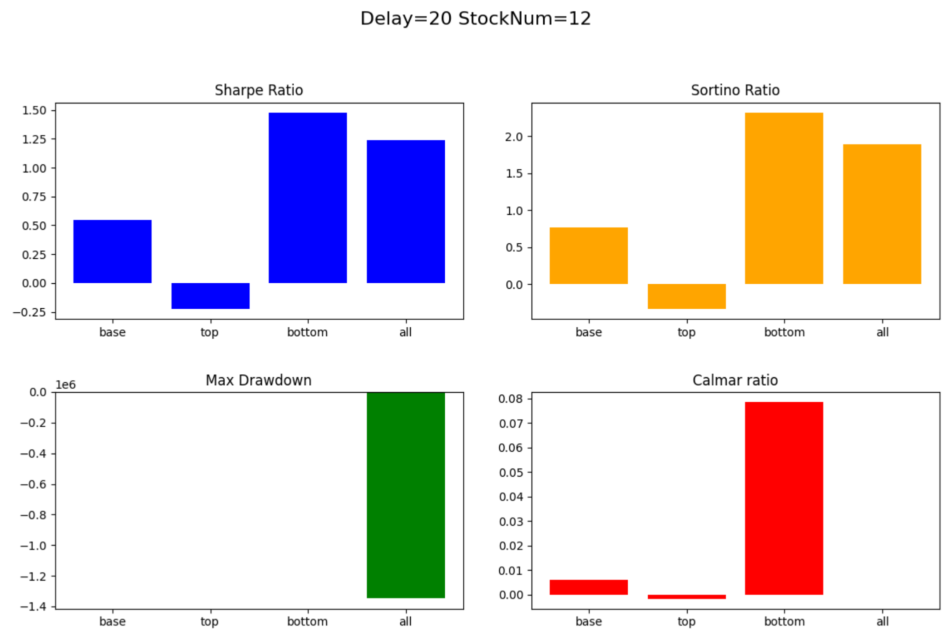

Figure 10: Delay = 20, StockNum = 12

5 Discussion

Our research contributes to improving investment strategies, showcasing the potential of Evolutionary Game Theory in the complex stock market landscape. Performance evaluation confirmed the superiority of the evolutionary strategy in terms of profitability and risk management. Future studies could explore additional factors and refine the model. Overall, EGT proved effective in optimizing Chinese stock market investment.

6 Conclusion

In conclusion, this study applies Evolutionary Game Theory (EGT) to the Chinese stock market. Using financial data from the 000300 index, a multi-factor quantitative strategy is developed, distributing funds across top and bottom stocks based on historical returns.

The optimal parameters for the model comprises a 20-day delay and a portfolio of 12 stocks, generating high returns with stability even during volatile periods like the COVID-19 pandemic. This research contributes to game theory in financial decision-making and offers insights into optimizing stock market investment using EGT. More researchers might be inspired to apply knowledge of EGT to other cross-disciplines.

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