

Comparison of Performances for Mean-reversion Strategy in Context of Different Underlying Assets

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Abstract. Mean reversion is a financial term used to assume that the price of an asset will tend to converge to the average price over time. Implementation of mean reversion as a timing strategy involves both identifying the trading range of a security and calculating average prices using quantitative methods. Mean-reverting strategies apply the classic idea of selling high and buying low in the stock market, which generally performs well in volatile markets. Based on empirical analysis, this paper calculates the value of Bilibili, iQiyi and YouTube, compares the deviation index and return rate of the three companies. Subsequently, we use the deviation multiple and average return rate of historical statistics to judge the entry time. The significance of this study is that it provides a reference for Internet video companies to choose the path of mean reversion, and also provides an investment strategy for investors. These results shed light on guiding further applications of mean-reversion strategy for different underlying assets.

Keywords: Mean reversion; Maximum Drawdown; Sharpe ratio.

1. Introduction

In general, with the boosting ability of data analysis, lots of trading algorithm and strategies are proposed [1-4]. Among various strategies, mean-reversion strategy is one that uses most widely. In terms of stock prices, this belief translates into the concept of (long-run) mean reversion [5-8]. Therefore, by analyzing the rate of mean reversion and other factors, we can see the upward or downward trend of a stock, so as to make predictions. When prices rise, new firms enter the market (or existing firms expand) to offer the goods in question. Firms will enter the market until the marginal entrant earns zero profit. This supply response will tend to dampen price increases. The relevance of this to investment models is clear. If output prices rise, firms invest more to expand. In equilibrium, however, if the demand curve is downward sloping, this supply shift will invalidate output prices. Similarly, if prices fall, high-cost firms will exit the market at some point, so as prices rise (fall), the underlying trend should start to fall (rise). Mean reversion is one way to capture this effect. We hope to predict stock price movements by calculating mean reversion rates and other indices.

This paper selects three well-known companies in video industry, i.e., Bilibili, IQIYI and Youtube. As for Bilibili, it was originally a community of lovers of secondary meta video. Bilibili's videos are diversified and creative. Most of the videos are created by bloggers, and they buy few copyright if videos. The video is short, but not in the form of short video like TikTok. It mainly relies on video websites to drive user traffic, and realizes traffic realization through mobile games, live rewards, advertising and member services. For IQIYI, through the purchase of copyright, rely on the film and television works performed by stars to drive user traffic, and make profits through membership, advertising, and game live broadcasting business. Most of the films are TV dramas, movies and variety shows. The profit mode of advance on-demand that the customers can watch some video earlier than others by pay some money was canceled since last year, it was the main way of making money. Regarding to YouTube, the videos are more diversified, including films, TV dramas and short videos. With the diversity of video, it has attracted countless people, because people send a number of videos without copyrights. It relies on advertising subscription services for profit.

2. Data & Method

2.1 Data

With the development of society, we will download video software to watch videos. Today we will analyze the laws and reasons of the rise and fall of these video software stocks. The companies we studied are three famous video websites: Bilibili, iQIYI and YouTube. They have many similarities and differences. Each company has its own unique services and ways of making profits. We collected part of the year's stock prices of Bilibili and iQIYI from the stock market in Hong Kong, China. The change of stock price can be seen more clearly by making the stock price into a broken line chart. The stock price can reflect whether the company is prosperous or not in a period of time. One can predict the future stock trend through the previous stock price, because any positive or negative news of a company will affect the stock price. By analyzing the maximum drawdown and sharp ratio of the stock and analyzing the trend with the mean evolution strategy, we can predict the high probability trend of the stock.

2.2 Evaluation Metrics

The maximum loss from a market peak to a market nadir, commonly called the maximum drawdown (MDD), measures how sustained one's losses can be [9]. The maximum drawdown occurring over a fixed investment horizon is a flexible measure that provides a different perception of the risk and price flow of this investment [10].

Sharpe ratio, also known as Sharpe index - a standardized measure of performance. Research in modern investment theory shows that the amount of risk plays a fundamental role in determining portfolio performance [11]. The risk-adjusted rate of return is a comprehensive index that can take into account both returns and risks, and can eliminate the adverse effects of risk factors on performance evaluation in the long run. The Sharpe ratio describes the extent to which the return on an asset compensates investors for the risk they bear. When two assets are compared on the same basis, the asset with a higher Sharpe ratio has a better return under the same risk. In other words, an asset with a higher Sharpe ratio is less risky if the returns are the same. However, similar to any other mathematical model, it depends on the correctness of the data. Sharpe ratio is one of the three classical indicators that can be used to comprehensively consider both returns and risks. Under the fixed risk, the pursuit of the maximum reward; or pursue the lowest risk with a fixed expected reward. The formula can be given as follows:

$$\text{Sharpe ratio} = \frac{E(r) - r_f}{\sigma_p} \quad (1)$$

where, σ_p is the standard deviation of the return rate of fund I, which is the total risk borne by the fund portfolio.

The Sharpe index reflects the extent to which the growth rate of net value per unit of risk fund exceeds the risk-free return. If the Sharpe ratio is positive, it means that the growth rate of the average net worth of the fund during the measured period exceeds the risk-free rate. If the rate of bank deposits is used as the risk-free rate during the same period, it means that investment funds are better than bank deposits. The higher the Sharpe ratio, the higher the risk return of the fund per unit of risk. Otherwise, it indicates that the growth rate of the average net value of the fund in the measurement period is lower than the risk-free interest rate. In the case that the bank deposit rate in the same period is taken as the risk-free interest rate, it indicates that the investment fund is worse than the bank deposit, and the investment performance of the fund is not as good as the national debt repurchase. When the Sharpe ratio is negative, sorting by size doesn't make sense.

3. Results & Discussion

3.1 Mean revision

First, to analyze the speed of mean reversion, we selected the data of three companies from April 2018 to February 2021 to conduct the analysis:

$$P_{t+1} = P_t + \lambda(P^* - P_t) + \varepsilon_t + 1 \quad (2)$$

Here, λ is the speed of mean reversion and P_t is price of the stock at time t . Using bilibili as an example, the speed of mean reversion is $(16.23-10.92)/(40.73-10.92)=0.17828$. Other two companies' speed of mean reversion are calculated in the same way, where speed of mean reversion for Youtube is 0.036413 and IQIYI is 0.210526, which is easy to be seen that IQIYI in total has the most fast speed of reversion

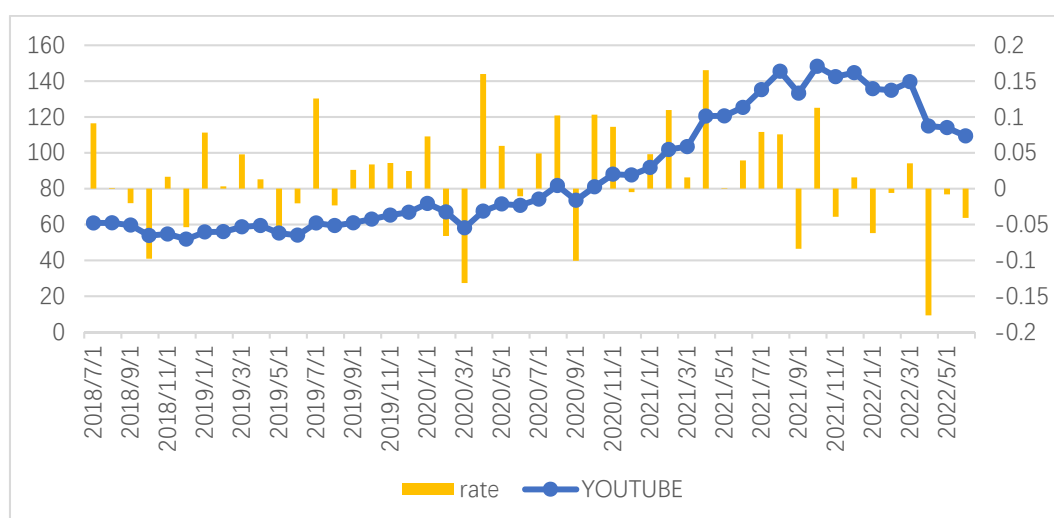
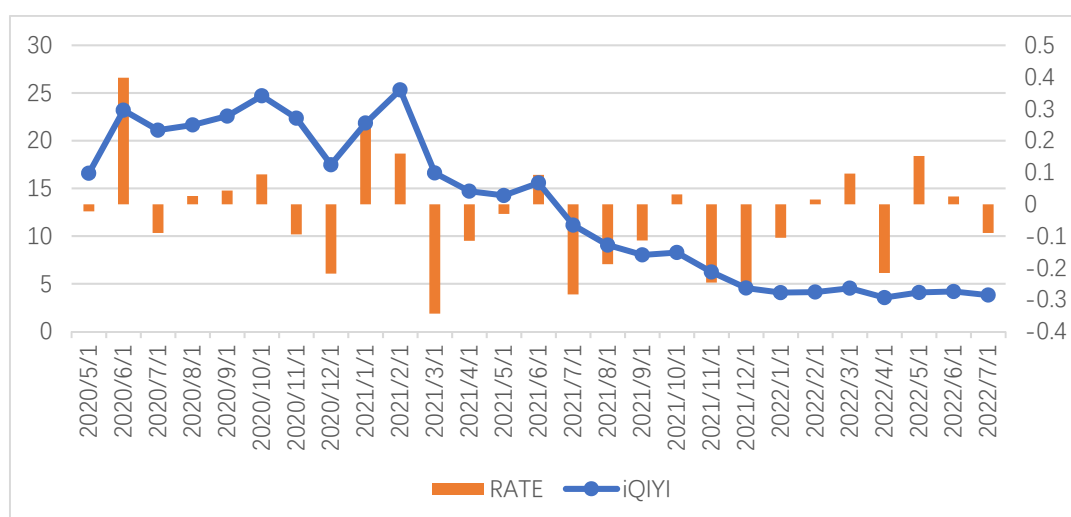
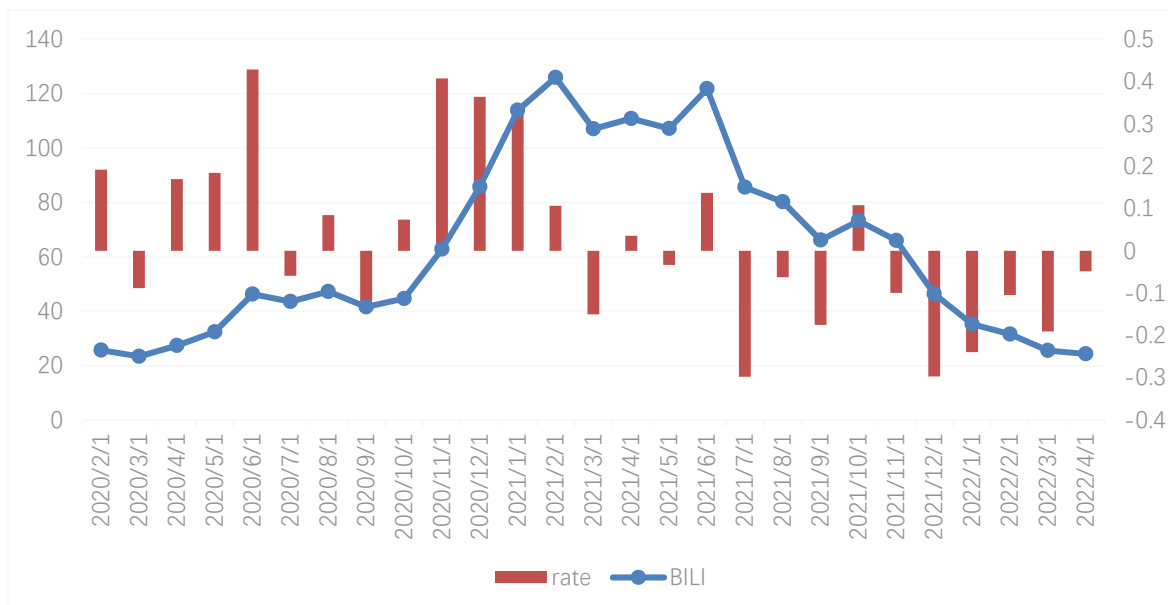
The standard deviation of a set of data is the general difference between the set of data and the mean. Input the value of stock prices of bilibili, its standard deviation is 0.180479, Youtube's standard deviation of price is 0.069085, lastly the standard deviation of IQIYI is 0.178799. It's not hard to see that YouTube's stock price is generally the least distant from the mean

Taking the closing price of the last N month s, take its standard deviation σ , set last month's stock price as P and N average moving average as A , and calculate the Deviation index, This value means that the deviation of last month's stock price from the mean over the past N months is i times the standard deviation. If the absolute value $|i|$ is larger, we determine price fluctuations than history month is more outstanding; On the other hand, if $|i|$ is small, for example "1", it can be regarded as no difference than before

By calculating the value of three company, bilibili 's deviation index is 2.21, Stock prices fluctuate wildly, and IQIY's deviation index is 1.13, Youtube is 1.1, so bilibili is supposed to back to the average value, which is supposed to fall. According to the analysis, YouTube is a good stock to buy because it has a slow return rate and a low deviation rate.

3.2 Max Drawdown

Bilibili increased about 490% from 2/1/20 to 6/1/21 and then decreased about 500% later. IQIYI increased about about 70% from 5/1/20 to 6/1/21 and then decreased about 400% later. YouTube increased about 245% from 12/1/18 to 10/1/21 and then decreased about 45% later. Nearly all the stock of the video companies in China increased from 2019 and 2020 decreased in 2021 and 2022. Because of the COVID-19, some movies has switched from offline to online that people will watch the movies on the Internet. Thus, the stock of the Video market increased. Since 2021, more and more country opened offline cinema, so people will not watch movies online any more. The Data of these three companies' stock are in the Fig. 1, Fig. 2 and Fig. 3.



3.3 Sharpe ratio

For Bilibili, we use the monthly stock price data from January, 2018 to January, 2022.7.1 to calculate the monthly return rate, expected return rate and risk factor σ . R_f is estimated using the mean of the risk-free interest rate from January, 2018 to January, 2022.7.1. For Iqiyi, we use the monthly stock price data from January, 2018.4.1 to 2022.7.1 to calculate the monthly return rate, expected return rate and risk factor σ . Regarding to Youtube, we use the monthly stock price data from January, 2010.1.1 to 2022.7.1 to calculate the monthly return rate, expected return rate and risk factor σ . The results are illustrated in Fig. 4, Fig. 5 and Fig. 6.

According to the analysis, Sharpratio (BILIBILI) =0.117, Sharpratio (Iqiyi) =-0.137, Sharpratio (YOUTUBE) =0.172. A negative Sharpe ratio for iQiyi means the portfolio is underperforming its benchmark. All else equal, investors want to increase the Sharpe ratio by increasing returns and reducing volatility. However, the negative value of the Sharpe ratio can be close to zero, either raising yields or increasing volatility. Therefore, the Sharpe ratio is not a particularly useful analytical tool for negative returns. By contrast, Youtube has the highest Sharpe ratio, which means it has the highest risk-reward,

Although the Sharpe ratio is a measure that has been recognized by many people, the Sharpe ratio is not without defects. When calculating the Sharpe ratio, it does not take into account the rise and fall, which are completely opposite feelings for investors. Investors do not reject the volatility when obtaining a relatively large rise. However, once a period of very high excess return is obtained, the influence of this sample value on the numerator of the Sharpe ratio calculation formula is much smaller than that on the denominator, which will result in a relatively low Sharpe value. This is clearly counterintuitive, since investors are not averse to a fund earning an excess return far in excess of the risk-free yield.

According to the above results, although BILIBILI's Sharpe ratio is lower than YOUTUBE's Sharpe ratio, BILIBILI's average return is 0.0314, which is significantly higher than YOUTUBE's return rate of 0.0170. In the case of compound interest, the difference of 1% per year will cause a very large yield gap.

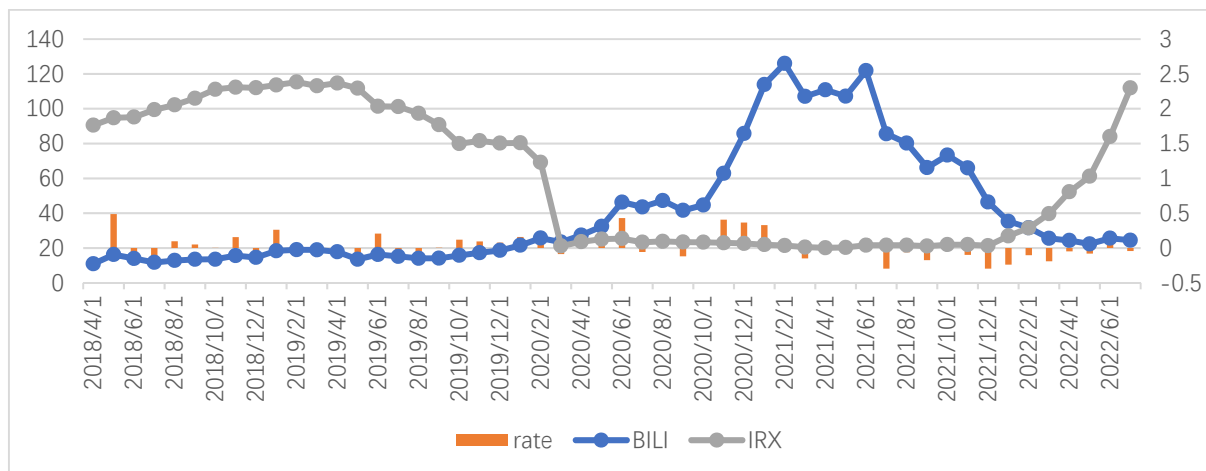


Fig. 4 Sharpe analysis of Bilibili.

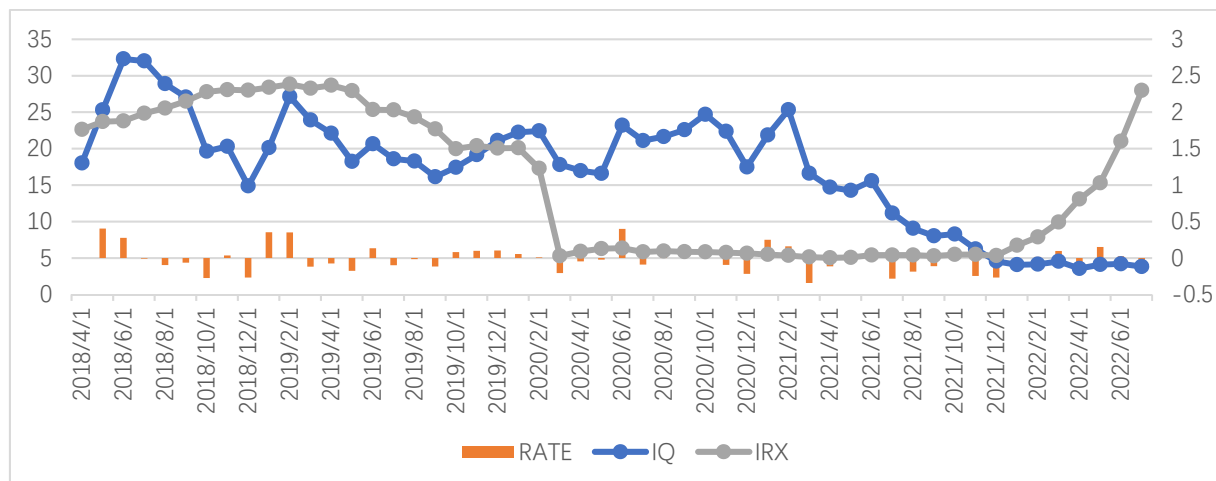


Fig. 5 Sharpe analysis of IQIYI

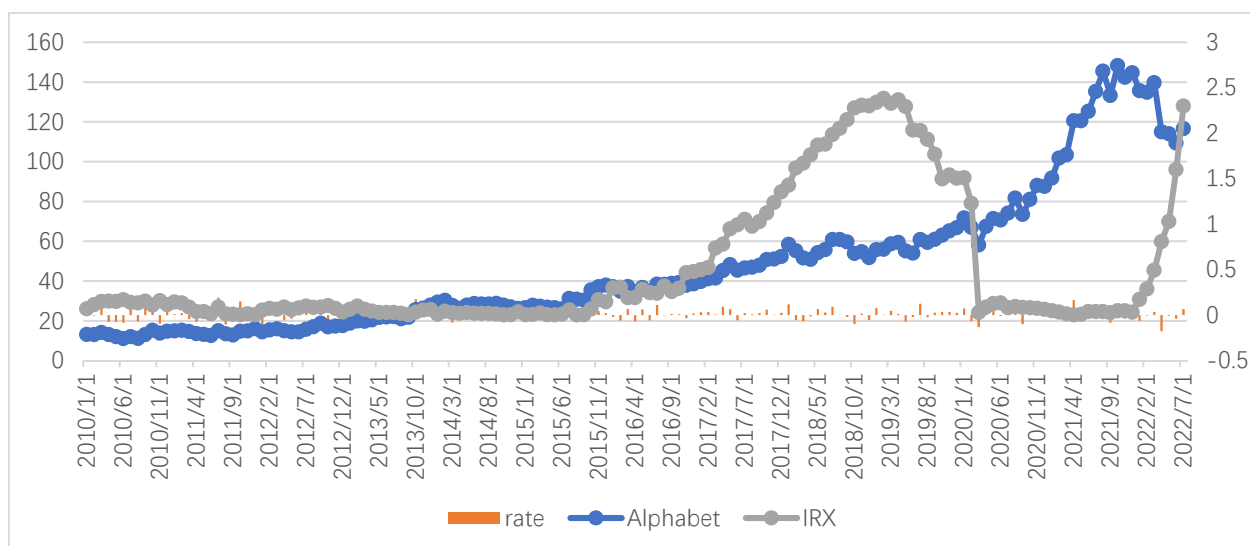


Fig. 6 Sharpe analysis of YouTube.

4. Conclusion

In summary, this paper investigates mean reversion based on bilibili, Youtube, and IQIYIs' data. This method aims to use the deviation multiple of historical statistics and the rate of mean reversion to judge the entry time, showing a way of thinking. Nevertheless, the mean itself is changing, not fixed. The mean may go down or up, but there is always a trend. The fluctuation is cyclical, but the duration of the cycle is different. For example, the COVID-19 epidemic has affected the cycle of the global economy. Moreover, the likely structural breaks during long sample periods further complicate statistical analysis of mean reversion. In the future, more complex model that takes more factors into consideration ought to be proposed. Overall, these results offer a guideline for Deviation multiples and win-loss statistics.

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