Convertible Bond Market Factor Exploration and Quantitative Strategies (I) — Common Stock Limit-Up and Limit-Down Factors

July 31, 2024

Abstract

Stock Limit-Up and Limit-Down Factors.

1 Convertible Bond Market Data and Preprocessing

For convertible bonds, due to the use of different strategies such as daily frequency and minute frequency, the data needs to be collected at both minute and daily frequencies. The units for minute frequency convertible bond data from Tonghuashun are not consistent between the Shanghai and Shenzhen markets. The unit for the Shanghai market is "contract" (10 lots). We will standardize the units to "lots."

2 Factor Construction

Due to the relatively low maturity level of China's convertible bond market, it falls far short of the stock market in terms of market liquidity, market depth, and market breadth. One of the key points when trading quantitative strategies in the convertible bond market is the market conditions; otherwise, it is easy to encounter the situation where "a backtested strategy performs well, but in real trading, there are no counterpart orders to fill, resulting in missed excess returns and instead leading to significant drawdowns."
Similarly, studying strategies from the perspective of market factors such as market capacity and market liquidity will provide insights that are more suitable for the convertible bond market.
Core Question: How does the price limit up of the underlying stock affect the price movement of convertible bonds? Specifically, do convertible bonds associated with a stock that hits its Limit-up mostly see gains within three days? And do they mostly decline within three days after the stock hits its price limit down?

	date	thscode	open	close	changeRatio	volume	amount
0	2018-01-02	110032.SH	122.60	126.64	4.05	218.4	2.773
33	2018-01-03	110032.SH	126.77	127.53	0.70	117.7	1.500
67	2018-01-04	110032.SH	127.25	127.07	0.03	115.4	1.461
101	2018-01-05	110032.SH	127.09	130.14	2.42	248.0	3.221
135	2018-01-08	110032.SH	130.22	132.33	1.68	367.8	4.892

Figure 1: Data

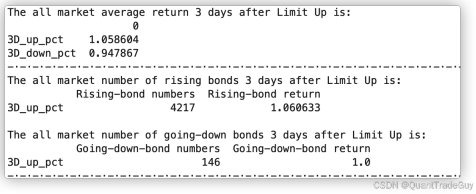

Figure 2: After Limit up

2.1 Conclusions First

Next Day Convertible Bond Performance After the Underlying Stock Hits Limit Up...

1. There is a 96.7% probability of an increase, with an overall maximum gain of approximately 5.9% and a maximum drawdown of 5.3%.

2. Enthusiasm and volatility diminish after the limit is lifted (by about half), but this is primarily due to the quick decay of the signal's effectiveness. When only considering the day after the limit, the effectiveness has already decreased significantly.

3. Strategy Construction: Buy convertible bonds at the close on the day the underlying stock hits its limit up (Day 0) and sell at the open on Day 4, which can yield an average annualized return of 70%, with a drawdown of only 19.8% and a Sharpe ratio of 3.6. This strategy signal is stable and effective, making it the best strategy.

Next Day Convertible Bond Performance After the Underlying Stock Hits Limit Down...

1. The reversal effect is significant: there is a 97.7% probability of an increase, with an overall gain of approximately 5.7% and a very low maximum drawdown of 2.9% (compared to a maximum drawdown of 1.9% in the entire market over three days).

2. Similarly, enthusiasm and volatility diminish after the limit is lifted, primarily due to the quick decay of the signal's effectiveness. Again, when only considering the day after the limit, the effectiveness has already decreased significantly.

3. Strategy Construction 1: For a more conservative approach, buy convertible bonds at the close on the day the underlying stock hits its limit down (Day 0) and sell at the open on Day 1, which can yield an average annualized return of 20%, with a drawdown of only 8.6% and a Sharpe ratio of 2.3.

4. Strategy Construction 2: For a more aggressive approach, buy convertible bonds at the close on the day the underlying stock hits its limit down (Day 0) and sell at the open on Day 4, which can yield an average annualized return of 76%, with a drawdown of about 29.3% and a Sharpe ratio of 2.59.

2.2 Statistical Analysis of Price Changes

Observe the average max return after Limit-up and Limit-down.
It can be seen that after the underlying stock hits the upper limit, in 97% of the cases, the convertible bond experiences an average maximum increase of 6% within three days. However, there is also significant

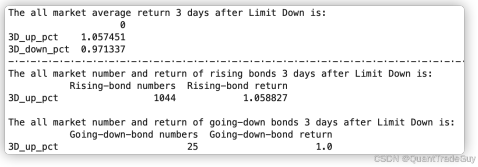

Figure 3: After Limit Down

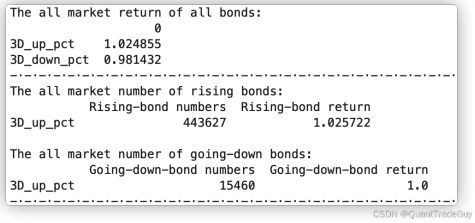

Figure 4: Robustness Testing

volatility, with an average maximum drawdown of 5.3%. Overall, on average, the maximum return achievable after three days is about 5.9
The performance of convertible bonds after the underlying stock hits the lower limit is also quite good. In 98% of the cases, there is an average maximum increase of 5.9% within three days, but the drawdown is very low, with a maximum drawdown of only 3%, significantly lower than the situation when the underlying stock hits the upper limit.
Therefore, it appears that the convertible bond market has a strong enthusiasm for chasing gains while exhibiting relatively low panic during sell-offs. The reversal effect is particularly significant when the underlying stock experiences a substantial decline.

2.2.1 Robustness Testing

Observe the price changes of the entire market within the backtesting period for Robustness Testing.
The average price change across the entire market is relatively balanced, with the average maximum return over 3 days reaching up to 2.5%, and the maximum drawdown approximately 1.9%. Note that here, 3D_up_pct refers to the maximum return over the next 3 days, which is calculated as the highest bond price over the next 3 days divided by today's opening price; 3D_down_pct refers to the maximum drawdown over the next 3 days, calculated as the lowest bond price over the next 3 days divided by today's opening price.
Therefore, the factor does have a significant effect.

2.3 Impact of Opening Day After the Underlying Stock Hits the Upper or Lower Limit

Further hypothesis: If the next day is the opening day after the underlying stock hits the upper or lower limit, will it have different effects?
Compared to the previous conditions, the maximum return slightly decreases, while the maximum drawdown also decreases. Notably, under the condition of "the underlying stock hitting the lower limit two days ago and opening the board the previous day," the probability of the convertible bond rising increases from 97.7% to 98.4%. This may indicate that the opening price on the day following "the underlying

stock hitting the upper limit two days ago and opening the board the previous day" is likely to be lower than the opening price from the previous day.

2.3.1 Signal Fading Speed

But could this be due to the fading enthusiasm after a day?
In fact, if we ignore whether the limit is opened but consider the situation of convertible bonds when the underlying stock hit its limit two days ago and any situation yesterday, we can find that the results are almost the same as when the underlying stock hit its limit two days ago and was opened yesterday. This indicates that whether the limit is opened or not does not affect the market movements in the following three days.

2.4 Hypothesis

Thus, we focus on the following aspects:

1. Whether buying at the close on the day the underlying stock hits its limit and selling at the close in the following days yields significant returns.
2. Whether buying at the close on the day the underlying stock hits its limit and selling at the open in the following days yields significant returns.
3. Whether the opening price on the day after the underlying stock hits its limit is generally higher than the opening price on the third day.

After validation these hypothesis, we can construct strategies.

3 Strategy

3.1 Buy at the close on day 0, Sell at the close/open at day 1

Further observation of the net value trend of this strategy reveals that "buying the convertible bond at the close on the day the underlying stock hits its limit down and selling at the close the next day" can achieve an annualized return of 16.5%. However, during mid-2023, the drawdown reached nearly 40%. In comparison, "buying the convertible bond at the close on the day the underlying stock hits its limit down and selling at the open the next day" is more robust. Apart from the drawdown in mid-2023, the drawdowns are generally small, and the annualized return is also 12.2
The drawdown in mid-2023 was primarily due to the mandatory delisting of Landun Convertible Bond (123015.SZ). The situation regarding this convertible bond can be briefly illustrated by the screenshot the author found on Baidu. This suggests that we should avoid trading convertible bonds of ST (Special Treatment) stocks.
After removing this "first strong delisting" stock, the strategy's net value performance became very stable. For example, using the strategy of "buying the convertible bond at close on the day of the underlying stock's limit down and selling it at open the next day," the maximum drawdown was only 8.4%, with a Sharpe ratio as high as 2. However, the strategy performed average from 2023 to 2024, which may be due to differing signal performances in different bull and bear cycles. Further research could explore the impact of stock and bond market sentiment on the effectiveness of strategy signals.


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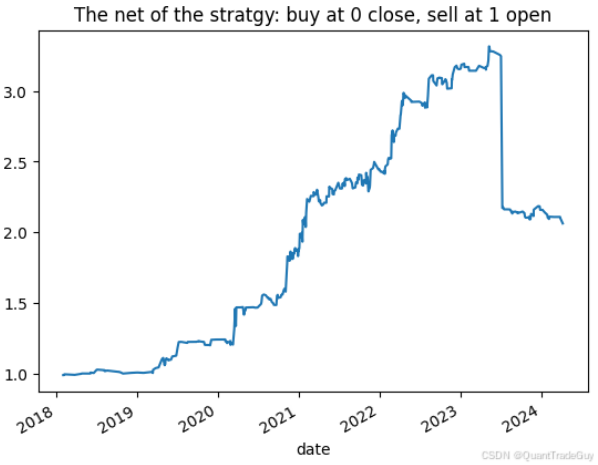
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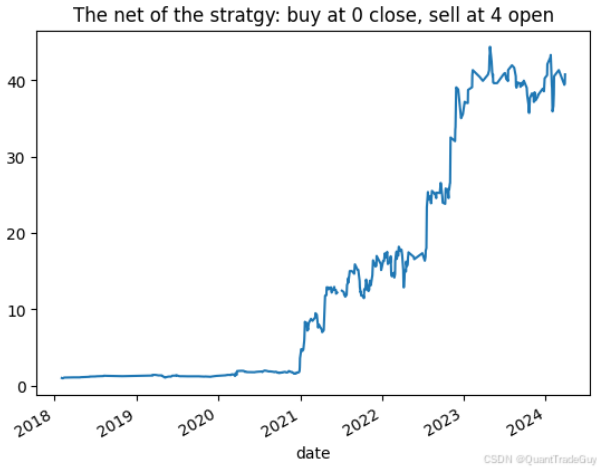

3.2 Buy at the close on day 0, Sell at the close/open at day 4

Buying at close on the day of the underlying stock's limit down and selling at open on the fourth day yields impressive results. Given that the "4-day open/0-day close" strategy previously exhibited the highest average return, the strategy of "buying at close on the day of the underlying stock's limit down (Day 0) and selling at open on Day 4" performed exceptionally well—achieving a 40-fold return with a maximum drawdown of 29.3%.
However, the "4-day close/0-day close" strategy performed relatively poorly, with a maximum drawdown reaching 38.9%.

3.3 Buy at the close on day 0, Sell at the open at day 1

Due to the negative average returns in all other cases of limit up, it is essentially impossible to develop effective strategies from them. Therefore, we will only consider the strategy of "buying at close on the day of the underlying stock's limit up and selling at open the next day."
This strategy exhibits a maximum drawdown of 19.7%, with an annualized return as high as 70% and a Sharpe ratio of 3.6. Furthermore, the strategy signals are consistently stable and effective, making it an

exceptionally strong strategy. It could even be considered the best among the five strategies analyzed.