Backtesting with Financial Leverage Situation

A3: Individual Paper

Algorithmic Trading in R

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This paper is an extension of my team project that is to build an algorithmic trading model of Red Hat stock. It will focus on backtesting of the model, which is the part that I did, and simulate the situation with financial leverage to see the difference in the result. My objective is to build a strategy that can be applied to the different types of investor in terms of risk acceptance.

Backtesting is the way for us to prove that our model works or not by running it in the past and then compare results with the actual data. However, we can only put the information available prior to that day in the past because we based on the assumption that we cannot see what will happen in the future. We did backtesting by using the bt package in Python.

For the strategy, I used the predicted return as a signal to determine whether to long or short the stock. I split the signal into five types and assigned the target weight for each type. As the following table.

Weight Type	Signal Strength	Target Weight
WeightStrongLong	More than 2%	1.0
WeightMediumLong	Between 1% and 2%	0.5
WeightWeak	Between -1% and 1%	0.0
WeightMediumShort	Between -2% and -1%	-0.5
WeightStrongShort	Less than -2%	-1.0

Figure 1: Target weight before financial leverage

I also put LimitDeltas algorithm to limit the change in the portfolio for only 10 percent per day. This will help reduce the maximum drawdown and also reflex more in real-world trading. Moreover, I shift the predicted return to have a 1-day lag because the predicted return relied on the closing price of that day and we cannot know that data before the day end. This helped us reduced the look-ahead bias that happened in our model. In this backtesting, I assume that we will have one million dollars in investment capital and one percent of commission fee.

After running the backtesting for the last 3 quarters of 2018, this strategy had -1.46% in total return, -0.22 in the Sharpe ratio, and -7.05% in max drawdown.

	Total Return	Sharpe Ratio	Sortino Ratio	CAGR	Max Drawdown
LimitDeltas & 1-day lag	-1.46%	-0.22	-0.31	-1.96%	-7.05%

Figure 2: Result from backtesting before financial leverage

Assume that we want to bet more in our signal, we can go long or short more than one hundred percent. For example, you can get more money by borrowing money from the bank. This is called financial leverage and it may give us more return. However, we will also have more risk. To illustrate, assume that we will put 2.5 as a weight target in the strong signal and 1.5 in the medium signal. As the following table.

Weight Type	Signal Strength	Target Weight
WeightStrongLong	More than 2%	2.5
WeightMediumLong	Between 1% and 2%	1.5
WeightWeak	Between -1% and 1%	0.0
WeightMediumShort	Between -2% and -1%	-1.5
WeightStrongShort	Less than -2%	-2.5

Figure 3: Target weight after having financial leverage

This time it turned out that we got a total return of 6.62% and the Sharpe ratio of 0.54 that is more than the previous one. However, the number in max drawdown is -9.03% that is worse than the previous one.

	Total Return	Sharpe Ratio	Sortino Ratio	CAGR	Max Drawdown
LimitDeltas & 1-day lag	6.62%	0.54	1.08	9.03%	-9.03%

Figure 4: Result of backtesting after having financial leverage

This is the tradeoff between return and risk as we can see from the Modern Portfolio Theory Graph. By borrowing more money to invest, we can get a higher return but trading with more risk. This method depends on a different kind of investor. For example, the investor who willing to accept more risk and get more return such as working professionals who have income in many ways. In the other hand, some investors are better with the lower risk such as people who are already retired and have no income.

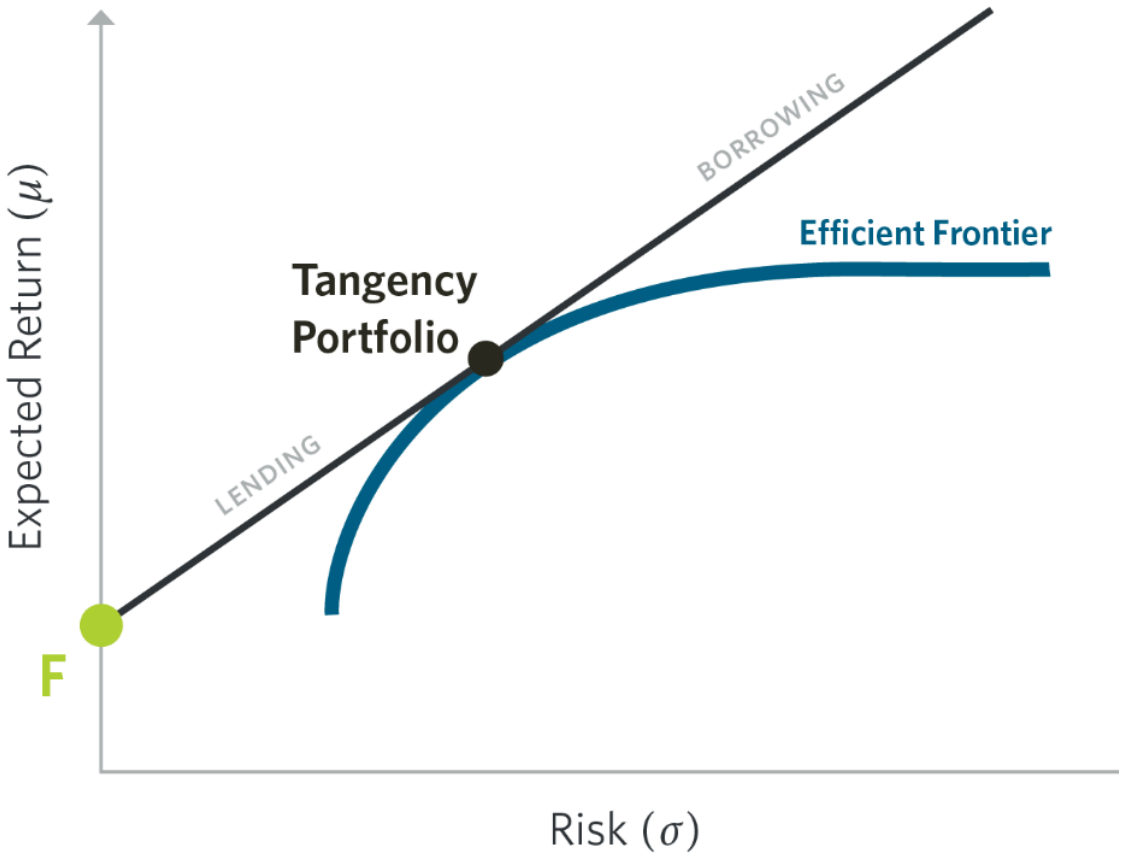

Figure 5: Modern Portfolio Theory Graph

In conclusion, a trading strategy is an important part of the model to get the desired level of return and risk. By having more financial leverage, we can have more return, but we also have more risk. Investors should find the right strategy to get the appropriate level of return and risk that match with their conditions.