Measuring Perceived Risk of Securities Investment Based on Disposition Effect

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Abstract—Under the frame of behavioral finance, this article established a model of perceived risk based on the disposition effect. Simulations indicate the opposite correlation between perceived risk and the disposition effect index. This conclusion is same to the real market perceived risk.

Keywords: securities investment risk, perceived risk, disposition effect

I. INTRODUCTION

The securities investment risk is the core of the financial theory research. There are many famous models such as variance model, β index and VaR model ect. But behavioral finance point out that the risk measure should reflect the psychological of investors but not depend on the history data only. Perceived risk is a kind of securities investment risk including the cognitive biases psychology. Shefrin and Statman(1994) established a asset pricing model based on the β index. Yang Chunpeng(2004) gave a perceived risk measure model based on the overconfidence. The disposition effect is one of the the cognitive biases psychology from Shefrin(2000).And Odean(1998) found that there was strong disposition effect in American. Grinblatt(2002) build a stock price fluctuation model including the disposition effect.

This article established a model of perceived risk based on the disposition effect using the loss probability and the expected loss under the frame of behavioral finance. From the simulations result, we can say that the model can expand the perceived risk measure method and has some certain reality significance.

II. PERCEIVED RISK MODEL BASED ON THE DISPOSITION EFFECT

A. Hypothesis

Based on the model of Grinblatt, we hypothesis that there is only one risky assets in the Market and its quantity is 1.Differently, there are only two types traders in the market: disposition effect traders whose proportion is \( \mu \); rational and liquidity traders whose proportion is \( 1-\mu \). The linear demand function from disposition effect traders is:

\[
D_t^d = 1 + b[(F_t - P_t) + \lambda(R_t - P_t)]
\]  

there \( F_t \) is the basic value; \( P_t \) is the market price; \( R_t \) is the reference price. \( \lambda \) is the disposition effect index and it can describe the stronger disposition effect when it is bigger. \( b \) is a constant. For disposition effect traders, \( \lambda \neq 0 \), they prone to sale stock when they profit but hold the stock when they deficit. For the other traders, \( \lambda = 0 \), they will buy the stock when the market price is below the basic value.

The non-disposition effect traders depend on the exogenous condition to choose the transaction. If \( \epsilon_t \sim (0,1), \) i.i.d, the demand function is:

\[
D_t^k = D_{t-1}^k + b\epsilon_{t-1}
\]

B. Balance price of stock

The traders will adjust the reference price when they want to buy stock and will not when they want to sell. So \( R_t \) is the average weight price:

\[
R_{t+1} = \begin{cases} (D_t^d - D_{t-1}^d)P_t + D_{t-1}^d R_t & D_t^d > D_{t-1}^d \\ R_t & D_t^d \leq D_{t-1}^d \end{cases}
\]

The value of stock \( F_t \) is the logarithmic normal distribution:

\[
F_t = F_i \exp\{(u - 1/2\sigma^2)(T-t) + \sigma\sqrt{T-t}\}
\]

there \( \theta \sim N(0,1) \); \( u \) is the daily profit rate; \( \sigma \) is the daily volatility.

From “Supple=Demand”, we can calculate the balance price of the stock:

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\[
P_t = \frac{\mu F_t + \mu \lambda R_t + (1 - \mu) \sum_{j=1}^{t-1} e_{t,j}}{\mu(1 + \lambda)}
\]  (5)

C. Perceived risk measure

We will research the relationship between the perceived risk and the disposition effect from the loss probability and the expected loss. Commonly, the perceived risk is bigger when the loss probability and the expected loss are bigger respectively.

The loss probability is the probability that the balance price less than the reference price:

\[
p = P(P_t < R_t)
\]  (6)

The expected loss is the average loss of the investors:

\[
V = E[\max(0, R_t - P_t)] = E(R_t - P_t)_-
\]  (7)

III. DATA AND SIMULATION

A. Parameter and initial value

From experience, we give the annual profit rate and the volatility are 10% and 40% respectively. According to \( F_{t+1} = F_t \exp\{\mu - 1/2\sigma^2\} + \sigma\theta \), we can get the stock value sequence \( p_t, \mu = 0.7 \), namely that there are 70% traders have the disposition effect. The basic value of the stock and reference price in the start are all 10 Yuan; \( b=0.05 \) and start demand of the non-disposition effect traders is \( D^*_t = 1 \).

B. Simulation results

For different \( \lambda \), we can get different stock value sequence using the Matlab Procedure. There is the statistical property of log-return of \( p_t \) in the table1. We can see that \( \ln(P_t / P_{t-1}) \) are all negative-skewed when \( \lambda \leq 1 \) and the kurtosis are commonly small.

<table>
<thead>
<tr>
<th>( \lambda )</th>
<th>skewness</th>
<th>kurtosis</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>0.0182</td>
<td>3.1101</td>
<td>0.5968</td>
</tr>
<tr>
<td>20</td>
<td>0.0154</td>
<td>3.0997</td>
<td>0.6052</td>
</tr>
<tr>
<td>6</td>
<td>0.0106</td>
<td>3.0546</td>
<td>0.6742</td>
</tr>
<tr>
<td>3</td>
<td>0.0047</td>
<td>3.0199</td>
<td>0.7411</td>
</tr>
<tr>
<td>1</td>
<td>-0.0081</td>
<td>3.0128</td>
<td>0.8095</td>
</tr>
<tr>
<td>0.5</td>
<td>-0.0196</td>
<td>2.9954</td>
<td>0.9401</td>
</tr>
<tr>
<td>0</td>
<td>-0.0285</td>
<td>2.9907</td>
<td>0.7820</td>
</tr>
</tbody>
</table>

Compare to conclusion in southeast Asia market and Chinese market from So(1997) and pay more attention to the reference price from themselves but not the basic value of the stock. Gu Lan(2001), \( \lambda \) should bigger than 1 because of the “acute peak and thick tail” phenomenon”. That is to say, the investors From Figure1 below, we can point out the relationship between the volatility and the disposition effect: the volatility of price is subdued than the value because of the disposition effect and the price volatility is smaller when the disposition effect index is bigger. That is because that under the disposition effect, the investors are willing to sell the stock when the price goes up. This phenomenon decrease that the demand of the stock and lead to relieve the going up of the stock.
IV. CONCLUSION

Under the frame of behavioral finance, this article established a model of perceived risk based on the stock price fluctuation model including the disposition effect of Grinblatt(2002). According to the “acute peak and thick tail” phenomenon, we can point out the range of $\lambda$. Simulations indicate the opposite correlation between perceived risk based on disposition effect and the disposition effect index. That is to say the perceived risk is bigger when the disposition effect is bigger. This conclusion is same to the real market perceived risk. In the future, we’ll pay some attention to the non-linear demand function of the traders and verify our conclusion in the real stock market.