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Shouldn't all eggs be putted in one basket? A portfolio model based on investor sentiment and inertial thinking

Jun Xie [a,*], Chunpeng Yang [b]

[a] College of Mathematics and Information Sciences, Guangxi University, Guangxi, China
[b] School of Economics and Commerce, South China University of Technology, Guangzhou, China

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ABSTRACT

In the portfolio choice literatures and the financial market, diversification and concentration are the focus of debate of philosophers. In this paper, we develop a model of portfolio choice to integrate the diversification strategy and the concentration strategy. Our model relies on the concepts of investor sentiment and inertial thinking. The results show that: Generally, when the level of sentiment is relatively low, an investor who is affected by sentiment and inertial thinking may do a well-diversified investment the same as the rational investor. When the level of sentiment is high enough, the investment strategies including diversification and concentration are complex and volatile. Quantitative results for either diversification or concentration investment are given for all cases in the paper.

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1. Introduction

Shouldn't investor put all his (her) eggs in one basket? According to this question, there are two contrasting answers concerning the process of portfolio selection: Consent and contra. In fact, this is the debate about diversification and concentration in the field of portfolio choice.

On the one hand, investment diversification almost has been accepted as one of the most fundamental tenets of modern financial economics since Markowitz posed the mean-variance framework. Markowitz (1952) argues that an investor should diversify across a large number of stocks, and it is inefficient to put a large holding in just a few stocks. And lots of researches, such as Fama (1991), Tyrrell and Stanislav (2002) and Jacobs and Levy (2012), support investment diversification by the analysis of standard financial theory which assumes that the investor is rational. Taking into account that the impact of standard financial theory is so strong, we assume that the investor should give priority to rational investment strategy.

On the other hand, because of the lack of an analytical characterization, the academic literature has so far paid relatively little attention to concentration investment. There are few theories and models that can describe the concentrated investment. But, in the finance market, lack of diversification has been confirmed by a number of empirical researches. Blume and Friend (1975) find that the average number of stocks in the investor portfolio is only 3.41 from the Federal Reserve Board's 1962 Survey of the Financial Characteristics of Consumers. Subsequently, Kelly (1995), Barber and Odean (2000), and Goetzman and Kumar (2008) also show that there are a very small number of stocks in the majority of investor's portfolio. Sporadic interpretations of concentrated investment are due to the overconfidence (De bondt, 1998; Odean, 1998), familiarity (Huberman, 2001), loyalty (Cohen, 2009), educational levels, financial knowledge, and information (Abreu and Mendes, 2010).

The paper is not against one of the investment strategies: Diversification and concentration. Our goal in the paper is to construct a bridge that contracts diversification with concentration. Boyle et al. (2012) try to do the similarity by the analysis of ambiguity aversion. However, ambiguity aversion is difficult to suit the general circumstance, because it is only one of the behavioral biases of the investor. In fact, the investment decision-making process is often affected by investor sentiment and inertial thinking. And a variety of behavioral biases can be considered as the effect of sentiment, such as: Familiarity (Huberman, 2001) and loyalty (Cohen, 2009) are considered as the effect of optimistic sentiment; Ambiguity aversion is considered as the effect of pessimistic sentiment. Different with Boyle et al., we propose a portfolio model based on investor sentiment and inertial thinking, which can answer the questions: Under what condition does investor diversify his (her) investment? And under what condition does investor concentrate his (her) investment?

In particular, our framework combines the impacts of investor sentiment and inertial thinking to discuss optimal portfolio both qualitatively and quantitatively. Investor sentiment is a hot point in recent behavioral finance studies and is a belief which is formed by the anticipation of the cash flows and the investment risk (Baker and Wurgler,

* Corresponding author. Tel.: +86 7713232084.
E-mail address: gxaone@163.com (J. Xie).

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2006). The concept of sentiment defined by Baker and Wurgler is related to the whole market. Different with the sentiment concept defined by Baker and Wurgler, we model investor sentiment as the individual investor's emotion which is defined as (Antoniou et al., 2013): Sentiment, broadly defined, refers to whether an individual, for whatever extraneous reason, feels excessively optimistic or pessimistic about a situation. The recent researches on the effect of investor sentiment generally discuss the macroeconomic performance, where sentiment is defined by Baker and Wurgler (see for example, Stambaugha et al, 2012; Garcia, 2013; Yang and Zhang, 2013). But our framework analyzes the microscopic mechanism of the individual investor sentiment. To isolate the effect of investor sentiment on portfolio selection, an economy with identical assets is considered. The assets differ only in the degree of uncertainty the investor exhibits toward the expected returns of each asset. And in the paper, we operationalize the concept of investor sentiment as the size of the confidence interval each investor has for the statistical estimate of the mean of each asset return.

Another foundation of our model is inertial thinking. Rational investor and diversification of the investment portfolio have been almost accepted as the most fundamental tenets of modern financial economics. These theories have profound impact to the investor, and lead to inertial thinking: The investor who is affected by irrational factors should give priority to diversification strategy the same as the rational investor, but with the deepening impact of irrational factors, when diversification strategy can't achieve optimal, the investor should finally choose the concentration strategy. Similarly with inertial behavior, inertial thinking can also arise from a variety of sources, including endowment effects (Kahneman et al., 1991; Thaler, 1980), a tendency to procrastinate in decision making (Akerlof, 1991; O'Donoghue and Rabin, 1999), and the cognitive fixed costs associated with reevaluating and re-optimizing an existing portfolio. In this paper, all assets have the same positive risk premium, common volatility and the common correlation across assets. Obviously, rational investor should take the long position in all assets. So in this economy, the investor with inertial thinking should give priority to take long positions in all assets, and take zero positions in some assets or with all assets as a final option.

In summary, we build a portfolio model based on investor sentiment and inertial thinking, to discuss if the investor shouldn't always put all eggs in one basket. Our results are useful in understanding the investment behaviors which include the diversification strategy and concentration strategy. The contribution of this paper is: first, to provide a framework that analyzes the role of investor sentiment and the role of inertial thinking in the portfolio choice. Second, to give a theory that integrates the diversification strategy and the concentration strategy. Finally, to show quantitative results for either diversification or concentration.

The remainder of this article is organized as follows. Section 2 discusses the assumptions of the model and proposes an empirically-motivated measure of investor sentiment. Section 3 constructs a framework that allows us to analyze the tradeoff among return, risk and investor sentiment. Section 4 gives the optimal portfolio weights for different levels of sentiment, which give the quantitative weights for either diversification or concentration. Section 5 concludes. The appendix contains the derivation of the model solution based on inertial thinking.

2. The model assumptions

Under the influence of inertial thinking, to isolate the role of investor sentiment on the assets choices, we consider an economy with one risk-free asset and n identical risky assets. And the length of time is considered to be the same for all assets, when the investor tries to estimate any parameters. Let σ denote the common volatility of the risky assets (standard deviation), $\rho \geq 0$ denote the common correlation coefficient across assets and μ denote the expected return in excess of the risk-free rate. And let $\sum \in R^{n\times n}$ denote the covariance matrix. Then because the covariance between any two assets $\text{cov} = \rho\sigma^2$, we have

$$\Sigma = \begin{pmatrix} \sigma^2 & \rho\sigma^2 & \cdots & \rho\sigma^2 \\ \rho\sigma^2 & \sigma^2 & \cdots & \rho\sigma^2 \\ \vdots & \vdots & \ddots & \vdots \\ \rho\sigma^2 & \rho\sigma^2 & \cdots & \sigma^2 \end{pmatrix}.$$

Furthermore, let $\boldsymbol{\pi} = (\pi_1, \pi_2, \cdots \pi_n)'$ denote the column vector of portfolio weights, for the available n risky assets. Where π_i is the weight of the asset i.[1] And let $\boldsymbol{\mu} = (\mu, \cdots, \mu)'$ is the column vector of risk premium about the n risky assets. γ is the coefficient of risk aversion. Then the classical mean-variance portfolio model (Markowitz, 1952) about this economy is

$$\max_{\mathbf{w}} \quad \boldsymbol{\pi}\boldsymbol{\mu}' - \frac{\gamma}{2}\boldsymbol{\pi}\Sigma\boldsymbol{\pi}'. \tag{1}$$

Obviously, the solution to the mean-variance model is

$$\boldsymbol{\pi} = \frac{1}{\gamma}\Sigma^{-1}\boldsymbol{\mu} = \frac{1}{\gamma}\left(\frac{\mu}{\sigma^2(1+\rho(n-1))}\right)\mathbf{1}_n, \tag{2}$$

where $\mathbf{1}_n = (1, 1, \cdots 1)'_{1\tilde{n}n}$. Eq. (2) implies that a rational investor should have an average allocation of his (her) investment funds in all n assets. In fact, the investor may estimate the standard deviation σ, correlation coefficient ρ easily and perfectly. But it's different to estimate the expected return μ accurately (Best and Grauer, 1991; Demiguel et al., 2009; Merton, 1980). So we assume that the investor has known the standard deviation σ and correlation coefficient ρ perfectly, but the estimation of the expected return μ is affected by investor sentiment. We consider the confidence interval for the estimator of the expected returns which are influenced by the investor sentiment. Let $\widehat{\mu}_i$ denote the estimated value of the mean return of asset i by using a return time series of length t, and $\sigma_{\widehat{\mu}_i} = \sqrt{\sigma_i^2/t}$ is the standard deviation of the estimate $\widehat{\mu}_i$. Then the confidence interval α_i for the expected return μ_i is defined by

$$\alpha_i = \left\{ \mu_i : \quad \frac{(\mu_i - \widehat{\mu}_i)^2}{\sigma^2_{\widehat{\mu}_i}} \leq \alpha_i^2 \right\}. \tag{3}$$

Obviously, $-\alpha_i\sigma_{\widehat{\mu}_i} \cdot \text{sign}(\pi_i) \leq \mu_i - \widehat{\mu}_i \leq \alpha_i\sigma_{\widehat{\mu}_i} \cdot \text{sign}(\pi_i)$. Where $\alpha_i \geq 0$ is the critical value determining the level of the confidence, and can be directly interpreted as a measure of the extent of investor sentiment about the estimate of the expected return on the asset i. And $\text{sign}(\pi_i)$ is the sign function about the weight π_i: (1) $\text{sign}(\pi_i) = -1$, when the investor short sells the asset i; (2) $\text{sign}(\pi_i) = 0$, when the weight $\pi_i = 0$; (3) $\text{sign}(\pi_i) = 1$, when the investor has a long position in the asset i.

Generally, the investor should make the optimistic decision under the influence of optimism, and make the pessimistic decision under the influence of pessimism (Arkes et al, 1988; Bower, 1981; Wright and Bower, 1992). Let α_i^- denote a measure of the extent about investor pessimistic sentiment for asset i, $\alpha_i^- < 0$. Let α_i^+ denote a measure of the extent about investor optimistic sentiment for asset i, $\alpha_i^+ > 0$. On the one hand, we consider that the investor has a long position in asset i. If the investor is pessimistic about asset i, he (she) should underestimate the expected return of asset i. So we know that $\alpha_i^-\sigma_{\widehat{\mu}_i} \cdot \text{sign}(\pi_i) \leq \mu_i - \widehat{\mu}_i < 0$ in this case. If the investor is optimistic about asset i, then he (she) should overestimate the expected return of asset i. So we know that $0 < \mu_i - \widehat{\mu}_i \leq \alpha_i^+\sigma_{\widehat{\mu}_i} \cdot \text{sign}(\pi_i)$ in this case. On the other hand, we consider that the investor sells short the asset i. In the case of

[1] π_i is the weight of the asset i, the relative weight of asset i is $\pi_i / \sum_{i=1}^{n} \pi_i$.

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