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Full Length Research Paper

An application of logistic regression to find outstanding fund managers

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This paper investigates how mutual fund managers' characteristics influence their funds performance. The majority of mutual funds available to Taiwan investors are actively managed. Apparently, investors will expect the active equity fund managers to provide better performance than passive managers do. We apply logistic regression, which adopt the performance of Polaris Taiwan Top 50 Tracker Fund (TTT) as the benchmark, to examine the relationship between fund managers' characteristics and fund performance. The results show that fund size and the fund manager's gender, seniority, and educational background significantly influence fund performance. All else equal, investors can expect higher odds for their fund performance beating TTT if their funds are managed by a female or a senior fund manager, or by a manager graduated from domestic public college or from overseas college.

Key words: Polaris Taiwan top 50 tracker fund, logistic regression, mutual fund performance, mutual fund manager.

INTRODUCTION

Since Taiwan's financial market develops rapidly, increasing amounts of financial and investment products are available for individual investors. However, lack of professional abilities induces the individual investors' demand of assets management. Mutual fund is one of the most popular assets management tools. The popularity of mutual funds is owing to many considerable advantages, such as professional portfolio management, asset liquidity, investment diversification, and lower costs. Up to September in 2008, there were 535 mutual funds and the total assets of various mutual funds were up to NT$1599 billion in Taiwan. Among all types of mutual funds, Taiwan open-end, domestic equity funds have the largest total assets up to NT$315 billion.

In many literatures, their findings indicated that market-related factors, fund features, and a manager's abilities can affect the fund performance. The sample of this study is Taiwan open-end, domestic equity funds so that those funds were operated under the same market conditions.

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About the fund features, Droms and Walker (1994) found that fund performance is not related to expense ratios, asset size, and turnover rates. Conversely, many researchers, including Golec (1996), Carhart (1997), Israelsen (1998), and Berkowitz and Yehuda (2002), claimed that higher expense ratios can reduce fund performance. Dahlquist et al. (2000) used turnover rate to measure the trading activity of funds and found that actively managed equity funds perform better than more passively managed funds. Kallberg et al. (2000) also showed that actively managed funds have higher Jensen's alphas than those passively managed. However, higher turnover rate often implicates higher transaction costs, and Carhart (1997), Israelsen (1998), and Indro et al. (1999) concluded that high turnover rate has negative impact on fund return. Because larger transaction volume has higher discount of brokerage commissions on the execution of trades, larger funds can increase net returns as the size of net assets is growing. In addition, since the administrative and overhead expenses, such as costs of access to data and research support, do not rise in proportion to fund size, growth in fund size can decrease the mean operating costs. Israelsen (1998) and Kallberg et al. (2000) both demonstrated the positive relationship

between fund size and fund performance. In order to cover the acquiring and operating costs, Indro et al. (1999) stated that active management funds have to attain a minimum fund size. But they also mentioned that the marginal returns are diminishing when a mutual fund exceeds its optimal size.

Based on different management strategies, open-end equity funds can be divided into passive and active management equity funds. The passive management equity funds, which include index funds and exchange traded funds (ETFs), are designed to track the benchmark indexes. On the other hand, the purpose of an active management equity fund is to establish a superior portfolio which can beat the market based on the manager's stock-picking ability and market-timing ability. Indeed, many previous researches focused on the manager's professional abilities. For example, Kosowski et al. (2006) found that subgroups of fund managers can earn better returns for which is according to their superior stock-picking abilities not solely to luck. However, Fama and French (2010) who found the contradicting results that few fund managers have sufficient skills which can earn benchmark-adjusted expected returns to cover costs. During the past decade, studies on a fund manager's characteristics also have caught a great deal of attention. The fund manager's characteristics typically include the manager's gender, tenure, seniority, and educational background. Some prior literature mentioned that women are more risk averse than men. For instance, Hinz et al. (1997) confirmed that women tend to invest the pension assets more conservatively than men. Sunden and Surette (1998) concluded that gender significantly affect how individuals allocate their retirement assets. However, Atkinson et al. (2003) examined the fixed-income fund managers and found that gender difference does not exist in fund performance, risk, and other characteristics. Managers' experience with the particular fund may have a positive effect on the improvement of performance. Golec (1996) indicated that investors can expect better risk-adjusted performance from a long-tenured manager. Payne et al. (2000) reported similar result and they indicated that managerial tenure can enhance the fund's risk-adjusted returns. Lee et al. (2008) investigated the interrelationship among manager's tenure, manager's seniority, and fund performance. Their finding showed that the fund manager with longer tenure and shorter seniority can provide better performance. Another issue caused substantial research interest is whether better education of a fund manager is helpful to raise the performance. Golec (1996) found that managers with MBA degrees outperform the managers without MBAs. Chevalier and Ellison (1999) measured the educational quality of the institution from which the manager received the undergraduate degree by using average composite SAT score of the institution. They suggested investors should choose a manager who attended high-SAT undergraduate institution to obtain higher excess returns. Furthermore, Gottesman and Morey (2006) extended the analysis of Chevalier and Ellison (1999) and they adopted the average composite GMAT score to measure the quality of the MBA program of the institution from which the fund manager graduated. In addition, Gottesman and Morey (2006) also considered other educational variables which contain the CFA certification, non-MBA master degree, and Ph. D degree. Their results showed that fund managers with more prestigious MBAs have superior performance than other managers, but other educational benefits are unrelated to fund performance.

The majority of Taiwan open-end, domestic equity funds available to investors are actively managed funds. In order to cover higher costs such as higher transaction costs due to active managed strategies, the management fees of the active managed funds are higher than passive managed ones. For example, the management fees of Taiwan's first ETF, the Polaris Taiwan Top 50 Tracker Fund (TTT)**,** is 0.32%, but most of the actively managed Taiwan open-end, domestic equity funds' management fees are between 1.2 and 1.75%. Investors pay higher management fees, so that they naturally expect an active equity fund manager to generate a positive return, which is at least superior to the market or the ETF. As discussed above, mutual fund performance is highly related to fund features and a fund manager's characteristics.

The purpose of this paper is to find out the characteristics of an outstanding manager who can provide better performance than TTT for investors. We apply logistic regression to examine the relationship between the manager's characteristics and fund performance. All else equal, investors can have higher odds for their fund with performance superior to TTT if their funds are managed by a female or a senior fund manager, or by a manager graduated from domestic public college or from overseas college after controlling for the effect of fund size.

METHODOLOGY

The sample we studied covers a three years period from October, 2005 to September, 2008. It encompasses 96 funds listed in Lipper's Taiwan open-end, equity fund category. The data comes from two sources. For fund features, the data is obtained from the mutual fund database of CMoney–Institutional Investors Investment Decision Supporting System. For fund manager's characteristics, we obtain the data form FundDJ which is the professional finance website providing exhaustive mutual fund information in Taiwan. The notations and definitions of variables are given in Table 1. Note that if there were more than one fund managers manage the same fund during the research period, the fund manager's characteristics of the fund manager with the longest tenure are used as the data.

Data selection and definition of variable

The TWSE Taiwan 50 Index was launched on October 29, 2002 and compiled by Taiwan Stock Exchange Corporation (TWSE) and FTSE group (FTSE). The TWSE Taiwan 50 Index covers the top 50 listed companies in terms of market capitalization and represents

Table 1. Notations and definitions of variables.

Fund features	Variable definitions
Return [a]	The return for a fund from October, 2005 to September, 2008
Standard deviation [a]	Annualized standard deviation for a fund
Management fees [a]	The percentage of NT10,000 assets paid as management fees
Custodial fee [a]	The percentage of NT10,000 assets paid to custodial institution
Fund age [a]	Years of the establishment for a fund up to September, 2008
Fund size [a]	Mean of monthly fund assets under management measured in one billion of New Taiwan dollars
Turnover [a]	Mean of monthly buy and sell rates for a fund
Fund manager's characteristics	**Variable definitions**
Gender [b]	1: Female; 0: Male
Seniority [b]	Months of a fund manager who has managed mutual funds
Tenure [b]	Months of a fund manager who manages a particular fund
MBA [b]	1: with master degree of MBA 0: without master degree of MBA
Finance [b]	1: with master degree of finance 0: without master degree of finance
Private college [b]	1: graduated from domestic private college 0: not graduated from domestic private college
Public college [b]	1:graduated from domestic public college 0: not graduated from domestic public college
Overseas college [b]	1:graduated from overseas college 0: not graduated from overseas college

[a] and [b] denotes the resource of the date. Data of [a] comes from CMoney fund database; data of [b] comes from FundDJ.

nearly 70% of the Taiwanese market. Polaris Taiwan Top 50 Tracker Fund (TTT), the first ETF in Taiwan, was launched by Polaris International Securities Investment Trust Co., Ltd. (PISIT). The underlying index of TTT is the TWSE Taiwan 50 Index so that TTT is highly related to the market. The correlation coefficient of TTT and Taiwan Stock Exchange Capitalization Weighted Stock Index (TAIEX) is 0.970. TTT began trading in Taiwan Stock Exchange on June 30, 2003. In our research period, the average daily trading volume of TTT was 8265 lots (1 lot is equal to1000 shares), which adequately indicates that the investors greatly accept TTT.

Investors give their money and pay higher management fees mainly because they think an active management manager can provide better risk-adjusted return for them compared to passive management manager. Here the risk-adjusted return of a fund is defined as:

$$\text{Return}_{adj} = \frac{\text{Return}}{\text{Standard deviation}}.$$

As other ETFs, TTT is a passively managed fund. Hence, investors naturally expect that the active management funds outperform TTT. In this sample, the risk-adjusted return of TTT is 0.26022 (5.41%/20.79%). Then, we can divide 96 funds into two groups and define the dependent variable as:

$$Y = \begin{cases} 1, \text{superior to TTT}(\text{Return}_{adj} > 0.26022) \\ 0, \text{inferior to TTT}(\text{Return}_{adj} \le 0.26022) \end{cases}, \quad (1)$$

where Y is called the dichotomous dependent variable and Return_{adj} is the risk-adjusted return. In (1), the distribution of Y is Bernoulli distribution with success probability p, which is the probability of a fund with performance superior to TTT. If one has interest to investigate the relationship between p and some independent variables $X_1, X_2, \ldots X_k$, logistic regression is the most commonly used statistical method. In this paper, logistic regression model is defined as

$$\ln\left(\frac{p}{1-p}\right) = \alpha + \sum_{i=1}^{k} \beta_i x_i, \quad (2)$$

where $\ln \bullet$ is natural logarithm function, p is defined below (1), and independent variables $x_1, x_2, \ldots, x_k$ include the variables of fund features (Management fees, Custodial fee, Fund age, Fund size, and Turnover) and the variables of fund manager's characteristics (Gender, Seniority, Tenure, MBA, Finance, Private college, Public college, and Overseas college). Then, we perform the logistic regression analysis which adopts the likelihood ratio approach of backward elimination procedure to find a more parsimonious model. The results will be stated in Section 3.

RESULTS

Logistic regression model and odds ratio analysis

Five independent variables are selected after using backward elimination procedure, that is, fund size, gender, seniority, and educational background in public

Table 2. Summary of logistic regression model.

Variables	Coefficient	Odds ratio	95% Confidence interval for odds ratio
Constant	-20.562(5.969)	0.000	
Fund size	2.011(0.603)	7.648	(2.291, 24.341)
Gender	7.735(2.311)	2287.199	(24.685, 211923.725)
Seniority	0.088(0.029)	1.092	(1.032, 1.155)
Public college	6.407(2.324)	606.027	(6.376, 57603.213)
Overseas college	8.717(2.762)	6104.049	(27.193, 1370187.796)

The standard errors are in the parentheses. All independent variables are significant at the 1% level.

college or overseas college. However, the absolute values of standardized residuals of 6 funds are larger than 1.96. In order to predict more precisely, those 6 funds are excluded and the others analyzed by logistic regression again. Table 2 illustrates the final model and gives the coefficients and standard errors of independent variables, the estimated odd ratios, and 95% confidence intervals for the odds ratios. From Table 2, the final logistic regression model is given below:

$$\begin{aligned} \ln\left(\frac{p}{1-p}\right) &= -20.562 + 2.011 \times \text{Fund size} \\ &+ 7.735 \times \text{Gender} + 0.088 \times \text{Seniority} \\ &+ 6.407 \times \text{Public college} \\ &+ 8.717 \times \text{Overseas college} \end{aligned} \quad (3).$$

To evaluate the model calibration, we perform the Hosmer-Lemeshow goodness-of-fit test. The Hosmer-Lemeshow statistic is 1.159 with p-value 0.997, and it shows that the logistic regression model in (3) can be applied to predict the fund performance. Since smaller Hosmer-Lemeshow statistic indicates smaller discrepancy between the observed and predicted outcomes, this model also has good predictive performance. In addition, because the slope coefficients are significantly different from zero, all independent variables in (3) have influences on fund performance. All else equal, fund size is positively related to the fund performance. After controlling for the effect of fund size, a fund which is managed by a female or a senior fund manager, or by a manager graduated from domestic public college or overseas college has higher odds for its risk-adjusted return superior to TTT.

The estimated odds ratio for an increase of one billion in fund size is 7.648. It indicates that for every increase of one billion in fund size, the odds of a fund with performance superior to TTT increases 7.648 times. The fund sizes are skewly distributed to the right, and 70% (63/90) funds sizes are smaller than NT$2 billion. The operations of a fund may be restricted by small funds size. On the contrary, growth in the size of assets can provide cost advantages and enhance the fund performance. The estimated odds ratio of gender is equal to 2287.199. It estimates that the occurrence of a fund's risk-adjusted return beating TTT is 2287.199 times more likely to occur among female managers than among male ones. Many studies show that female managers trend to hold less risky portfolios as compared to male managers. During global financial crisis from 2007 to 2008, it had led to the female managers outperformed male managers. The estimated odds ratio of a manager's seniority seems the slightly positive influence on a fund's performance. However, manager's seniorities have large difference. The median, minimum, and maximum of the manager's seniorities are 58.5, 12, and 134 months, respectively. One year increase in manager's seniority has a multiplicative effect of 2.875 ($= \exp(0.088 \times 12)$) on the estimated odds for which the fund has better performance than TTT. It indicates that there exist strongly positive relationship between a manager's experience and fund's performance. The academic degree of a fund manager is used to measure the quality of the educational background of a fund manager. The estimated odds ratios between a fund manager graduated from domestic public college (or overseas college) and outstanding fund performance equals 606.027 (or 6104.049). Thus, the educational qualities of domestic public and overseas colleges are both significantly superior to other levels of schools. The knowledge and skills of the fund managers who obtained from domestic public or overseas colleges are helpful to raise the fund performance.

Accuracy of prediction

To evaluate the predictive accuracy of the logistic regression model, an intuitive way is to summarize the observed outcomes for the dependent variable and the predicted values via the classification table. This study uses the risk-adjusted return of TTT as the benchmark. We can separate all the funds into two groups, superior to TTT and inferior to TTT, based on their observed risk-adjusted returns by following definition of the dependent variable in (1). Moreover, the logistic regression model in(3) can be used to predict the value of p, which is the probability of the fund with performance superior to TTT. The estimated probability can be derived from the

Table 3. Classification result of funds.

		Predicted		Rate of correct classification
		Superior to TTT	Inferior to TTT	
Observed	Superior to TTT	22	3	88.0%
	Inferior to TTT	3	62	95.4%
Overall rate of correct classification				93.3%

equation:

$$\hat{p} = \frac{e^a}{1+e^a}, \quad (4)$$

where

$$a = -20.562 + 2.011 \times \text{Fund size} + 7.735 \times \text{Gender} + 0.088 \times \text{Seniority} + 6.407 \times \text{Public college} + 8.717 \times \text{Overseas college}.$$

If the estimated probability exceeds 0.5, then fund performance will be classified as superior to TTT; otherwise it will be classified as inferior to TTT. The results of classifying the observations of fund performances by using the fitted model in (3) are presented in Table 3. From Table 3, 88% (22/25) of the "superior to TTT" group and 95.4% (62/65) of the "inferior to TTT" group are correctly classified, respectively. The overall rate of correct classification is estimated as 93.3% (84/90). Therefore, the logistic regression model in (3) is excellent in classification.

Conclusion

Most Taiwan open-end, domestic equity funds are active management funds. An intuitive concept is that the active management fund's performance is highly related to the fund manager. Since the active fund managers are assumed to beat the market or a passive management fund, they charge higher management fees than passive fund managers do. It induces the question that how to find an excellent fund manager who can provide better risk-adjusted return for investors. We use the Polaris Taiwan Top 50 Tracker Fund (TTT) as the market benchmark. Then, we apply logistic regression to investigate the relationship between fund managers' characteristics and fund performance which is measured by risk-adjusted return. The results suggest investors that they should consider the effects of fund size, fund manager's gender, seniority, and educational background when they select a Taiwan open-end, domestic equity fund. After controlling the fund size, investors can expect higher odds for their fund with performance superior to TTT if their funds are managed by a female or a senior fund manager, or by a manager graduated from domestic public college or from overseas college. The results not only reveal the importance of fund manager's characteristics but also give a selection rule of mutual funds for investors. An investor can use the equation in (4) to calculate the estimated probability of the candidates, and then one should select the fund with the highest estimated probability for which the fund has superior performance.

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