

Publisher: Asian Economic and Social Society

ISSN: 2225-4226

Volume 3 No. 3 March 2013.

Journal of Asian Business Strategy



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Citation: Joe-Ming Lee (2013). Evidence from Business Strategy of Mutual Fund Managers after the Financial Crisis - Panel Smooth Transition Regression Model. Journal of Asian Business Strategy, Vol. 3, No. 3, pp. 48-58.



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Abstract

This study applies by the panel transition regression (PSTR) model to investigate the nonlinear dynamic relationship between equity fund flow and investment volatility in Taiwan. Our empirical results show that the equity fund managers will be different business strategy under the volatility threshold value and the control variables of asset of funds, management fee and Turnover indicator. After the financial crisis, the threshold of volatility will be an important index to different business strategy of equity fund managers. Belong to low-risk equity funds, the equity fund managers tend to attract investors to increase fund performance, efforts to expand the fund size, and the better the performance of the fund, but charge lower management fee, increased investors purchase fund incentives, as well as reduce the turnover rate, the pursuit of fund performance. Conversely, belong to high-risk equity funds, the equity fund managers to increase fund performance, efforts to expand the fund size, and the better the fund performance of the funds charge higher management fees, increased operating income, and the use of the high turnover rate, the pursuit of fund performance. Finally, the equity fund managers in order to restore investor confidence, for different risk bearing capacity of the investors, the use of different business strategies to meet the investment demands of investors, as well as trying to make a loss of investors to reflux, and efforts to reach stable company revenue goals.

Keywords: Equity fund, PSTR model, volatility, fund performance.

Introduction

The financial crisis of 2007–2008, also known as the global financial crisis and 2008 financial crisis, is considered by many economists to be the worst financial crisis since the Great Depression of the 1930s. It resulted in the threat of total collapse of large financial institutions, the bailout of banks by national governments, and downturns in stock markets around the world. In many areas, the housing

market also suffered, resulting in evictions, foreclosures and prolonged unemployment.

Due to the impact from the global financial crisis, one of the major challenges faced by the mutual fund industry is gradually seeing greater market risk under declining interest rates in recent years. For operating in a highly competitive environment, it is necessary that fund companies continuously launch many kinds of funds to attract investors with

different risk preferences and various investment demands.

However, it is not easy for an investor confronted by so many confusing options to choose appropriate funds and superior fund managers due to limited knowledge and information. Therefore, after the financial crisis, the investment for mutual funds lack of confidence, in order to restore the confidence of investors, the business strategy of the mutual fund managers, will affect the attitude of the investor's investment.

For the mutual fund, there are several explanations for the asymmetric performance–flow relation, such as the asymmetric relation implying that the market rewards high-performance funds, but does not discipline poor performers as much. Chevalier and Ellison (1997) showed this asymmetric performance–flow relation gives a fund management company an incentive to increase the riskiness of its portfolios given that management fees are proportional to fund size. If the fund performance is high, then the fund grows and total fee revenue increases, while if the fund performance is low, then the fund does not lose assets and fees as much. Thus, fund companies have an incentive to increase the riskiness of the portfolios, hoping to benefit from any increase in returns that would bring in more inflows and fee revenues.

Yeh *et al.* (2000) investigated mutual fund managers' discretionary behaviors, which are hidden in their ordinary investment decisions but may conflict with the interests of fund investors. Empirical results show those managers who are losers in the first 6 months of a year tend to increase their portfolio risks in the second half of the year. These changes in portfolio risks have negative impacts on funds' performance in our sample period. On the other hand, they did not find significant correlation between funds' turnover ratios and their performances. Based on press reports and corresponding portfolio holding data, they document 75 funds' investments that exhibit potential agency problems.

Shu *et al.* (2002) investigated the investment flow of open-end equity mutual funds. With unique data from Taiwan, they found that most investors in large mutual funds are small-amount investors, while those that invest in small funds invest a much larger amount. These small-amount investors in large funds tend to chase past winners and redeem shares once fund performance improves. Investors are more likely to avoid actively managed funds with high turnover. On the other hand, the large-amount investors in small funds appear to be dispassionate buyers whose purchases are not remarkably affected by short-term performance. They are more likely to keep performance-improving funds, redeem the losers, and pay higher management fees.

Lee and Lee (2012) use the threshold autoregressive model to investigate the relationship between equity funds' Fund performance and investment risk in Taiwan. Their empirical findings show that equity funds' investors are concerned about the investment return and neglect the investment risk. In particular, when expanding the size of the equity funds, fund investors believe that the fund cannot lose any money on investment products. In order to satisfy investors, equity fund managers only target short-term returns so as to attract investors, while ignoring the risk. Thus, the paper reminds investors to pay attention to risk, and fund managers should look to fulfill their obligations in addition to the pursuit of profit. Finally, equity funds should have risk management professionals help run the funds.

Mutual funds in Taiwan are very popular investment products. In particular, equity funds are the largest types of domestic mutual funds in which the fund managers offer investors the advantages of diversification and professional risk assessment risk on stock investment. Taiwanese investors of equity funds are generally concerned with the performance that will affect their motivation for investing in the funds.

However, most economic variables change regimes in a smooth manner, with transition from one regime to another taking some time. Follow Shu *et al.* (2002), it is thus interesting

to evaluate the influence and nonlinear dynamic relationship that asset, management fee and turnover rate have on fund's performance according to volatility. This study applies Panel Smooth Threshold Regression (PSTR) model, which was recently developed by Gonzalez *et al.* (2005) to set volatility as threshold variables, and determine the relative influence of variables on the linkage of fund's Fund performance. The objectives of study are threefold: The objectives of study are two folds: (1) Use PSTR to prove nonlinear relationship of volatility and fund's Fund performance. (2) Set control variables of asset, Turnover ratio and fee to explore the relationship between volatility and equity's Fund performance according to different range of volatility.

Our empirical study's dataset consists of monthly fund performance, Asset, Management fee, Turnover ratio, Fund standard deviation(i.e Volatility). The sample period for the study covers four years, from January 2009 to June 2012, containing a total of 79 equity funds. We find that there is strong evidence of the non-linear dynamic relationship between equity's Fund performance and volatility. What is more, the different risk attributes of equity funds produce completely different business strategy. After the financial crisis, the equity fund managers in order to restore investor confidence, investment risk tolerance, the use of different business strategies to meet the investment

demands of investors, as well as trying to make a loss of investors to reflux, and efforts to reach stable company revenue goals.

The remainder of the paper is organized as follows. Section 2 takes a brief review of the PSTR model. Section 3 provides the empirical results. Section 4 is conclusion and remarks.

Brief review of the Panel Smooth Transition Regression model

We follow Shu *et al.* (2002) and use the panel data model to estimate the mutual fund flows, where the dependent variable is Fund performance monthly of each fund. We take natural logarithms of Fund performance. To explain the relation between Fund performance relation, we use several important variables as independent variables, include, fund size (Asset), management fee ratio (Fee) , standard deviation of fund returns (Volatility) and the turnover_ ratio (Turnover). The regression model is as follows :

$$Fund\ Performance_{i,t} = \beta_0 + \beta_1 Asset_{i,t} + \beta_2 Fee_{i,t} + \beta_3 Volatitlity_{i,t} + \beta_4 Turnover_{i,t} + e_{i,t} \tag{1}$$

Panel Smooth Threshold Regression Model

We will first briefly review the Panel Smooth Threshold Regression (PSTR) model¹. The

¹ For more detail, see González *et al.* (2005) and Colletaz and Hurlin (2006).

basic PSTR model with two extreme regimes is defined as follows:

$$y_{it} = \mu_i + \beta_0 x_{it} + \beta_1 x_{it} g(q_{it}; \gamma, c) + u_{it} \tag{2}$$

for $i = 1, \dots, N$, and $t = 1, \dots, T$, where N and T denote the cross-section and time dimensions of the panel, respectively. The dependent variable y_{it} is a scalar, x_{it} is a k -dimensional vector of time-varying exogenous variables, μ_i represents the fixed individual effect, and u_{it} are the errors. Transition

function $g(q_{it}; \gamma, c)$ is a continuous function of the observable variable q_{it} and is normalized to be bounded between 0 and 1, and these extreme values are associated with regression coefficients β_0 and $\beta_0 + \beta_1$. More generally, the value of q_{it} determines the value of $g(q_{it}; \gamma, c)$ and thus the effective regression coefficients $\beta_0 + \beta_1 g(q_{it}; \gamma, c)$ for individual i at time t . The widely used transition function is a logistic specification as in equation (3)

$$g(q_{it}; \gamma, c) = \left(1 + \exp \left(-\gamma \prod_{j=1}^m (q_{it} - c_j) \right) \right)^{-1} \tag{3}$$

with $\gamma > 0$ and $c_1 \leq c_2 \leq \dots \leq c_m$

where $c = (c_1, \dots, c_m)'$ is an m -dimensional vector of location parameters and the slope parameter γ determines the smoothness of the transitions. The restrictions $\gamma > 0$ and $c_1 \leq \dots \leq c_m$ are imposed for identification purposes. In practice it is usually sufficient to consider m

= 1 or $m = 2$, as these values allow for commonly encountered types of variation in the parameters. For $m = 1$, the model implies that the two extreme regimes are associated with low and high values of q_{it} with a single monotonic transition of the coefficients from β_0 to $\beta_0 + \beta_1$ as q_{it} increases, where the change is centered around c_1 . When $\gamma \rightarrow \infty$, $g(q_{it}; \gamma, c)$ becomes an indicator function $I[q_{it} > c_1]$, defined as $I[A] = 1$ when the event A occurs and 0 otherwise. In that case the PSTR model in equation (1) reduces to the two-regime panel threshold model of Hansen (1999). For $m = 2$, the transition function has its minimum at $(c_1 + c_2)/2$ and attains the value 1 both at low and high values of q_{it} . When $\gamma \rightarrow \infty$, the model becomes a three-regime threshold model whose outer regimes are identical and different from the middle regime. In general, when $m > 1$ and $\gamma \rightarrow \infty$, the number of distinct regimes remains two, with the transition function switching back and forth between zero and one at c_1, \dots, c_m . Finally, for any value of m the transition function becomes constant when $\gamma \rightarrow 0$, in which case the model collapses into a homogenous or linear panel regression model with fixed effects.

A generalization of the PSTR model to allow for more than two different regimes is the additive model

$$y_{it} = \mu_i + \beta_0' x_{it} + \sum_{j=1}^r \beta_j' x_{it} g_j(q_{it}^{(j)}; \gamma_j, c_j) + u_{it} \quad (4)$$

Where the transition functions $g_j(q_{it}^{(j)}; \gamma_j, c_j)$, $j=1, \dots, r$, are of the logistic type. If $m = 1$, $q_{it}^{(j)} = q_{it}$ and $\gamma_j \rightarrow \infty$, for all $j = 1, \dots, r$, the model in equation (3) becomes a PTR model with $r + 1$ regimes. Consequently, the additive PSTR model can be viewed as a generalization of the multiple regime panel threshold model in Hansen (1999). Additionally, when the largest model that one is willing to consider is a two-regime PSTR model with $r = 1$ and $m = 1$ or $m = 2$, equation (3) plays an important role in the evaluation of the estimated model. In particular, the multiple regime equation (4) is an obvious alternative in diagnostic tests of no remaining heterogeneity.

The building procedure of PSTR model consists of specification, estimation and evaluation stages. Specification includes testing homogeneity, selecting the transition variable y_{it} and, if homogeneity is rejected, determining the appropriate form of the transition function, that is, choosing the proper value of m in equation (2). Statistically, the PSTR model is not identified if the data-generating process is homogenous, and a homogeneity test is necessary to avoid the estimation of unidentified models. As to the

estimation of parameters $\theta = (\beta_0', \beta_1', \gamma, c')$ in the PSTR model is a relatively straightforward application of the fixed effects estimator and nonlinear least squares. Whereas evaluation of an estimated PSTR model is an essential part of the model building procedure, including the tests of parameter constancy over time and of no remaining nonlinearity.

Empirical result analysis

The dataset consists of equity funds that were issued in Taiwan. For the purpose of comparison, the sample period for the study covers ten years, from January 2009 to June 2012, containing a total of 79 equity funds. The data were obtained from the Taiwan Economic Journal (TEJ) database.

Table 1 reports the descriptive statistics of the average ratios of database, including Fund performance, Asset, Fee, Volatility and

Turnover of equity fund. The Fund performance between -17.812% to 31.808 % and the mean is 1.1827%, which shows that Fund performance has great changes in trading patterns. We see the Asset is 0.233 (NT\$ million) between 91,353(NT\$ million), which means that the multivariate scale equity funds available to investors choose to invest funds. Here, the Fee is 0.0430% between 0.7880%, which explains that different equity funds use different cost mechanism to provide property investors choose funds. Whereas the Volatility is 8.4502% between 60.843%, which means that the fund company issued a high-or low-risk fund, hoping to attract different investors. The Turnover is 0% between 200.22 %, and its mean is 22.979%, which explains that a great difference between the high and low indicators, Implied overall equity funds operating performance have a big gap. In addition, all of the Jarque-Berra (J-B) statistics reject the null hypotheses of normality distribution.

Table 1: Summary Statistics of Equity Funds' Performances

	Fund performance (%)	Asset (NT\$ million)	Fee (%)	Volatility (%)	Turnover (%)
Mean	1.1827	26,702	0.12723	24.328	22.979
Std	0.296	17,558	0.009	8.0002	17.197
Max	31.808	91,353	0.7880	60.843	200.22
Min	-17.812	0.233	0.0430	8.4502	0.000
Skewness	0.32156	0.617	11.047	0.75559	1.5174
Kurtosis	0.36015	2.702	235.64	0.26778	5.2139
J-B	85.8226***	16684.7***	8.847***	372.147***	5748.85***

Note: P-value is the probability that the data come from the normal distribution, according to the Jarque -Berra normality test.

In empirical design, we set the volatility as threshold variable and control variables include Asset, Turnover and Fee. The table 3 presents the test of linearity results between the volatility and the Fund performance. The LM, Fisher and LRT linearity tests clearly lead to the rejection of the null hypothesis of linearity for the model. This result implies that there is strong evidence of the relationship between volatility and Fund performance is non-linear.

Furthermore, we apply the sequence of tests to determine the order m of the logistic function. In practice, it is usually sufficient to consider $m = 1$ (monotonically increasing with two regimes) or $m=2$ (symmetric or exponential with three regimes) transition function, as these values allow for commonly encountered types of variation in the parameters. The results of the specification test sequence, shown in Table 4, we will select $m = 1$ if the rejection of H_{02} is the strongest one. We find that the monotonically increasing in Figure 1.

Table 2: Test of linearity

H_0: linear model against H_1:PSTR model with at least one threshold variable ($r \geq 1$)		
	Statistics	P-value
Wald Tests (LM)	240.231	0.000*
Fisher Tests (LMF)	83.645	0.000*
LRT Tests (LRT)	248.180	0.000*

Note: *denote significant at 5% significance level. The LM and pseudo LRT statistics have a chi-square distribution with mK degrees of freedom, whereas the F statistics has a $F(mK; TN - N - K(m + r + 1))$ distribution. LM_F is its F-version. Pseudo LRT can be computed according to the same definitions by adjusting the number of degree of freedom. For detail, see also Colletaz and Hurlin (2006).

Table 3: Sequence of homogeneity tests for selecting m

Select $m=2$ if the rejection of H_{02} is the strongest one, otherwise select $m=1$.		
	Statistics	P-value
$H_{03}:B3=0$	$F3 = 0.878$	0.569
$H_{02}:B2=0 B3=0$	$F2 = 4.483$	0.000*
$H_{01}:B1=0 B2=B3=0$	$F1 = 9.295$	0.000*

Final model $m=1$

The next step is to determine the number of transitions in the model. Table 5 testing for non remaining nonlinearity consists of checking whether there is one transition function ($H_0 : r = 1$) or whether there are at

least two transition functions ($H_1 : r = 2$), the testing results show that the reasonable numbers of threshold $r =1$, which means that there are one regions. Each region has two regimes.

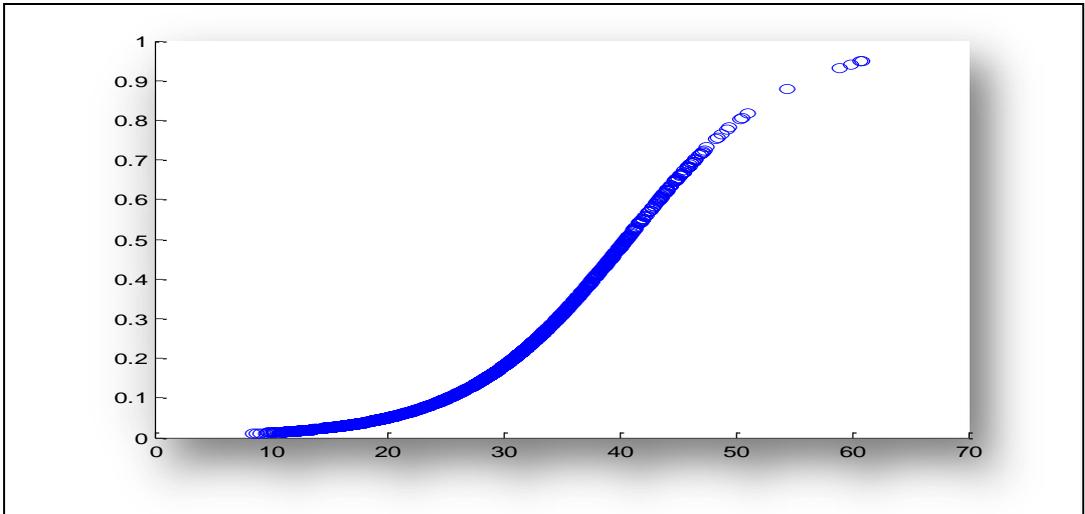


Figure 1: Transition Function with $m = 1$

Given the choices of $r_{max} = 5$ and $m = 1$, the OPTIMAL (LMF criterion) NUMBER OF THRESHOLD FUNCTIONS is $r = 1$

Table 4: Testing the Number of Regimes: Tests of no Remaining non-linearity

H0: PSTR with $r = 1$ against H1: PSTR with at least $r = 2$		
	Statistics	P-value
Wald Tests (LM)	2.025	0.567
Fisher Tests (LMF)	0.660	0.577
LRT Tests (LRT)	2.026	0.567

Note. 1. * denote significant at 5% significance level.

2. max $r=5$, $m=1$, the reasonable numbers of threshold $r=1$.

Table 5 shows the parameters estimate results of PSTR models. The transition function is logistic specification ($m=1$ with two regimes), C is location parameters, in the region, the value are 36.3372, respectively. The above result shows that there are structure changes at the point (see also Figure 2). The transition function is logistic specification. With regard to the control parameters, we observe that the Asset is positive (0.0011), Fee is negative (-41.5965), Turnover is negative (-0.0037) and if no any structure change for Volatility. The explanations for this region are that when the Volatility is below 40.6059, the asset scale

increase then the Fund performance will increase, the Turnover that the value decrease will increase the Fund performance. However, the Fee increase, the Fund performance will decrease. Whereas the Volatility is greater than 40.6059, the asset scale increase then the Fund performance will also increase, that is no any trade-off between Asset and Volatility. The Turnover that the ratio increase will increase the fund performance. The Fee increase will increase the Fund performance. The above statement is based on the PSTR model of $m=1$, $r=2$ is given. Equation (1) shows the full PSTR model for model 5.

$$Fund_Performance_{it} = \mu_i + 0.0011Asset_{it} - 41.5965Management_fee - 0.0037Turnover_rate + \beta_1 g(volatility_{it}, 0.1435, 40.6059)(0.0015Asset_{it} + 96.1133Management_fee + 0.4723Turnover_rate) + \varepsilon$$

(5)

Table 5: Parameter Estimation Results for PSTR Model

	β_0	$\beta_0 + \beta_1$
Asset	0.0011 *** (0.0000)	0.0015*** (0.0000)
Fee	-41.5965*** (14.6709)	96.1133*** (17.2683)
Turnover	-0.0037*** (0.0099)	0.4723*** (0.0564)
(C1)	(40.6059)	
(γ1)	(0.1435)	
SSE	146357.494	

Note. 1. ***, **, * denote significant at 1% ,5%, 10% significance levels, respectively.

2. C is location parameters , γ is slope parameter (smooth parameter or transition speed).

3. Threshold variable: volatility; control variables: asset, Turnover and management fee .

Conclusion and remarks

In this article, we used the PSTR model to re-examine the nonlinear dynamic relationships between Taiwan’s equity fund performance and volatility after the financial crisis. We found that strong evidence of the relationship between volatility and fund performance is non-linear and the trade off correlation between these ratios and the fund performance.

Our empirical results the equity fund managers will be different business strategy under the Volatility threshold value and the control variables of asset of funds, management fee and turnover ratio.

As to the business strategy of equity fund managers, we conclude that belong to low-risk equity funds (volatility is less than 40.6059) the equity fund managers tend to attract investors to increase fund performance, efforts to expand the fund size, and the better the performance of the fund, but charge lower management fee, increased investors purchase fund incentives, as well as reduce the turnover rate, the pursuit of fund performance. Conversely, the equity fund managers to increase fund performance, efforts to expand the fund size, the better the performance of the funds charge higher management fees, increased operating income, and the use of the high turnover rate, the pursuit of fund

performance (volatility is greater than 40.6059).

As mentioned above, after the financial crisis, the equity fund managers in order to restore investor confidence, for different risk bearing capacity of the investors, the use of different business strategies to meet the investment demands of investors, as well as trying to make a loss of investors to reflux, and efforts to reach stable company revenue goals.

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