

Inferring Investor Behavior from Fund Flow Patterns of Czech Open-end Mutual Funds

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Abstract

This paper studies two investor behavioral theories – gambler’s fallacy and hot-hand fallacy – using Czech open-end fund data. Weekly net fund flows indicate that investors tend to bring more money into the funds based on their past performance, which can be construed as an indication of hot-hand fallacy. With monthly data there is weak indication that investors in certain sectors tend to reduce the inflow into funds that had superior performance in the past months, which may indicate the gambler’s fallacy. The study indicates two sides of the Czech investor’s behavior. In the short run they are willing to chase the returns, but in the long run show their conservative streak by avoiding return chasing.

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1. Introduction

In efficient markets investors try to maximize their returns and minimize their risk. Their investment decisions are not affected by past performance of an investment, but are based on the anticipated returns and risk. In markets where investors are rational, there should not be any significant correlations between net flows into open-end funds and their past performance. However, if the investors are not fully rational, there may be a tendency for investors to base their investment decisions on the past performance of the funds. Using the fund flow data of Czech open-end mutual fund, this paper tries to identify such investor behavior patterns.

Modern form of collective investment in the Czech Republic was developed in 1991 as a product of specific method of privatization - the voucher privatization. According to Musilek (2002) new privatization investment funds collected points from the holders of investment vouchers, and then they invested them in joint stock companies. Due to an aggressive acquisition strategy, the majority of points were invested through these funds. But some funds exploited the weak security market regulations and embezzled the assets. A sizable number of Czech investors are still disillusioned with collective investment schemes.

There are a number of studies that looked into the fund flow dynamics in the U.S.² All these studies show evidence that past performance has a significant effect on the flow of funds. High performing funds tend to attract new money, while the poor performing funds had higher outflows. What is interesting about these studies is that the investors do not punish the poor performers as much as they reward the good performers.

It is assumed that rational investors will choose a diversified portfolio of assets, which will maximize their risk adjusted return. As pointed out by Sharpe (1992), asset allocation accounts for a large part of the variability in the return on a typical investor's portfolio. In a portfolio allocation model, expected returns and its variance as well as the correlation between the asset returns will determine the weights of each individual asset in the portfolio. Moving funds into an asset category or a particular fund based only on its past returns can thus result in sub-optimal allocation.

One of the theoretical explanations for the relationship between the fund flows and the performance of the fund is provided by Gruber (1996). This study classifies the U.S. investors into "sophisticated" and "disadvantaged clientele." The "sophisticated" investors move their money into funds that are performing well and this explains the increase of flows into those funds. The "disadvantaged clientele" is divided into three groups:

- 1) Unsophisticated investors who move their money partly based on the influence of advertisements and advice from the financial advisors.
- 2) Institutionally disadvantaged investors such as pension accounts where the choice of funds is restricted by the employment contracts.
- 3) Tax disadvantaged investors who are unwilling to sell their holding in one fund and incur the capital gains tax.

The above framework of classifying investors is interesting from the Czech perspective. The mutual funds in this study are open to Czech citizens and non-citizens³ and they are allowed to invest in both Czech and foreign securities. Most of the investors in these funds are retail investors and may not be considered as "sophisticated." Funds spend considerable amount of money on advertisement to attract investors. Since the majority of investments are not tied to

² Chevalier and Ellison (1997), Zheng (1999), Karceski (2002), Nanda, Wang, and Zheng (2004), and Barber, Odean, and Zheng (2005),

³ Since these funds are denominated in Czech koruna, the majority of the investors are Czech citizens.

pension funds they are free to move their money between funds, but are subject to transaction costs. The Czech investment behavior is conditioned by some of the major scandals surrounding the privatization voucher scheme and subsequent acquisitions of these vouchers by mutual funds. One of the biggest scandals involved Viktor Kozney's Harvard Capital and Consulting. This firm promised the investors tenfold return within one year on the privatization vouchers invested with them. The fund moved the money to overseas locations and the founder fled to Azerbaijan, leaving the investors with significant losses (Cohn, 2009). A more general study of the Eastern European markets by Durand and Simon (2008) shows that in the initial years after these markets were created there was behavioral biases such as under reaction and positive feedback trading.

Behavioral finance studies indicate that when faced with complex investment decisions, unsophisticated investors tend to simplify the decision process by devising simple "rules of thumb" (Shefrin, 2000). Behaviorally biased investors generally make poor investment decisions, chase trends, and tend to trade more frequently (Bailey, Kumar, and Ng, 2011). Apart from the economic fundamentals, investor sentiments also play part in determining the aggregate fund flows (Indro, 2004). This paper looks at two behavioral patterns of investors based on the law of small numbers.

The law of small numbers is the behavioral opposite of well-known law of large numbers from probability theory, which describes that the absolutely or proportionally large sample of the total population will be in its characteristics, virtually identical to the characteristics of the total population. In contrast, the law of small numbers describes a situation in which an individual who is subjected to this behavioral law identifies the characteristics of a relatively or absolutely small sample of the total population with the characteristics of the total population. The tendency of investors to generalize from a small sample can lead to the following two behavioral patterns.

Gambler's fallacy: According to this psychological effect an individual is trying to compare the presence of variables in a small sample and their distribution in the general population. A typical example is guessing the side of the coin in case of a higher incidence on one of the sides in the last flip of the coin. For example, after three flips of heads, the individual usually guesses that next will be tails. In fact, the probability of calling tails is still 50/50, however, people tend to favor the side with a lower incidence because according to their intuition the ratio of the two sides in the current sample should reflect the whole population. If investors believe that on the average all mutual fund returns should trend towards a common mean, then a fund that is outperforming others should be risky because it will soon produce low returns so as to get back to the average.

Hot-hand bias: This is a psychological effect based on extrapolating current sample to the future. The most common example is the reaction of investors on the performance of mutual funds. In the event that the fund has succeeded, then investors insert more additional resources than collect from it, and vice versa. In this case the investor is putting too much emphasis on the present course of time series, and neglects the underlying stochastic process.

Rabin and Vayanos (2010) give a theoretical framework to analyze gambler's and hot-hand fallacies. According to this model, individuals holding these beliefs are prone to exaggerate the magnitude of changes in the state, but underestimate their duration. If investors have heterogeneous beliefs, the effects of gambler's fallacy can cancel out the effects of hot-hand fallacy. But if one group dominates the other the fund flows may indicate either one of the characteristics of that particular group. For example, if the investors believe in mean reverting behavior of fund returns, then they will withdraw fund from those mutual funds that exhibited superior performance in the past (gambler's fallacy). On the other hand if they believe in the hot-

hand fallacy, they will put more money into those funds with a string of good performances. This paper studies the fund flow characteristics of Czech mutual fund to determine if any of these behavioral characteristics can be identified.

This study to our knowledge is the first of its kind that looks into the behavioral biases of investors in a transition economy. The results of the analysis indicates that controlling for other factors, on a short-term basis Czech investors tend to bring more money into funds based on their past performance, which can be construed as an indication of the hot-hand fallacy. On the contrary, when the longer term flows are studied, these investors tend to take money out of certain type of funds that had performed well in the past, which may be an indication of the gambler's fallacy.

The rest of the paper is organized as follows. The relevant literature is surveyed in Section 2, Section 3 describes the data, Section 4 outlines the methodology used in this paper. Section 5 analyzes the results and Section 6 concludes the paper.

2. Literature Survey

An investor may use the past performance as a factor in choosing a fund within an asset class. The conventional wisdom is that funds with superior performance will attract funds and inferior performance will result in outflows. There are several studies that examine the relationship between the fund flows and performance of the U.S. mutual fund industry. Ippolito (1992) studied the U.S. mutual funds for the period of 1965 – 84 and found a clear underlying movement of investments in the mutual fund industry toward recent good performers and away from recent poor performers.

The symmetry between the inflows of good performers and outflows of poor performers was studied by Sirri and Tufano (1998) and they found that consumers base their fund purchase decisions on prior performance information, but do so asymmetrically, investing disproportionately more in funds that performed very well the prior period. Goetzmann and Peles (1996) find a significant relation between flows and past returns only for the top quartile of past returns. A theoretical framework for analyzing the asymmetry in fund flows is provided by Lynch and Musto (2003). The explanation for the asymmetry in the flow of funds can be explained by the fact that poor performance of a fund will result in changes in strategies and/or personnel and hence past bad performance may not be relevant to the future performance of the fund.

Del Guercio and Tkac (2002) compared the difference in cash flows of the U.S. mutual funds and pension funds. The results of the study indicated that there is significant difference between the behaviors of the two groups of investors. Pension fund clients move money away from poorly performing funds and do not flock disproportionately towards recent winners. They also use risk measures, such as, Jensen's alpha and tracking error to evaluate the performance of the funds. On the other hand, mutual fund investors tend to direct their cash flows towards recent winners and do not knowingly use risk-adjusted performance measures. Using daily net aggregate fund transfers in the U.S. voluntary retirement contribution funds (401k plan), Agnew and Balduzzi (2012) found that in response to market movements these investors shift funds between equities, cash and bonds. Sialm, Starks, and Zhang (2012) compared the fund flow characteristics of the U.S. defined contribution pension plans and the rest of the mutual funds. The results of this study showed that defined contribution fund flows are more sensitive to superior and inferior performance of the funds.

An investor can obtain the information about a fund from active and passive sources and ratings by independent sources, such as, Morningstar can be an important part of the decision making. The effect of mutual fund ratings by Morningstar on the fund flows is studied by Del Guercio and Tkac (2008). Using a large sample of rating changes by Morningstar from 1996 – 99, this study finds that the rating changes have a significant influence on the investment allocation decisions of retail mutual fund investors. A possible explanation for this relationship is that investors view Morningstar ratings as informative quality measures and use it to channel their investments. The Czech mutual fund industry is still in its early stages of development and there are very few reliable sources of comparison of the fund performance available to the investors. In the absence of reliable performance ratings, Czech investors tend to use informal sources and the advertisements by the funds for making their investment choices.

The behavioral aspects the U.S. discount brokerage investors are studied by Bailey, Kumar, and Ng (2011). Using proxies for the two behavioral biases – disposition effect and narrow framing – they find that behaviorally biased investors make poor decisions about expenses, trading frequency and timing. The choice of investment vehicles by different groups of investors in Australian retirement funds are investigated by Speelman, Clark-Murphy, and Gerrans (2007). The results of this study give an interesting insight into the gender differences in investment choices. Female investors are more risk averse than male investors and young female investors exhibit the highest level of risk aversion. As the investors get older, there is an indication that they tend to become return-chasers.

There are a few studies that looked at the Czech investor behavior during the time of privatization. During the first round of privatization of Czech state owned enterprises, each adult citizen was given an opportunity to buy a booklet of 1000 investment points at a price of approximately US\$35. These points can be used by individuals to bid for shares of enterprises that were privatized. From the beginning of the privatization process, investment funds solicited the individuals to invest their vouchers with them for either cash or fund shares. Two-thirds of the individuals who received the vouchers ended up in exchanging it for fund shares and these funds eventually controlled 72 percent of all investment points (Hingorani, Lehn, and Makhija, 1997).

Even though the investment funds were heavily involved in the privatization scheme, the legal system for monitoring the activities of these funds was not in place in the Czech Republic (Sedlák, 2009). This allowed some of the funds to exploit the loopholes to defraud the investors, which has led to a general distrust of these funds among the Czech investors. A study of investor behavior in 13 East European markets by Durand and Simon (2008) showed that the heuristic driven investment patterns have diminished in the ten year period ending in 2001.

3. Data

Based on the type of assets in which the fund invests, the total sample is divided into the five asset categories. The weekly data covers the period from January 1, 1999 to December 31, 2008 and the monthly data covers the period from January 1, 1999 to December 31, 2011. The details of fund sizes, inflows, outflows and average monthly growths are given in Table 1. Among various categories of funds, the combined bond funds had the highest average size of 45 billion koruna, followed by mixed funds. It is to note that the equity funds had the lowest overall average investment, but had the highest growth rates. This may be an indication that, as the markets are maturing, investors are moving into more risky investments.

**Table I - Summary Statistics of Fund Sizes, Inflows and Outflows
From January 1999 to December 2011 (in millions of Czech koruna)**

Fund type	Bond Funds	Fund of Funds	Equity Funds	Mixed Funds	Money Market Funds
Average monthly fund size	45,635	10,581	7,487	28,547	16,798
Total funds as of Dec. 2011	37,222	17,834	12,904	22,767	7,875
Monthly growth rate of funds	2.22%	0.72%	2.53%	1.21%	1.08%
Average monthly inflows	1,459	379	309	387	974
Average monthly outflows	1,360	307	212	585	921

The return characteristics of fund types are given in Table 2. The money market and bonds funds had positive returns, while the other three categories had negative returns. Equity funds had the lowest return and the highest standard deviation. Part of the reason for the negative returns of equity funds can be explained by the spillover effect of the 2008-2009 financial crisis that affected the major economies of the world.

**Table II – Summary Statistics of Monthly Fund Returns
from January 1999 to December 2011**

Fund type	Bond Funds	Fund of Funds	Equity Funds	Mixed Funds	Money Market Funds
Return	0.17%	-0.14%	-0.20%	-0.07%	0.12%
Std. deviation	1.19%	2.58%	4.63%	2.03%	0.40%
Skewness	-3.3477	-1.0662	-1.4608	-1.5949	1.6248
Kurtosis	19.4044	2.3739	6.9414	4.4151	31.9923
Number of funds	23	31	25	82	15

The individual fund data is arranged in a panel data format for each of the categories. For regression analysis a panel data is created for each individual investment category. To avoid the survivorship bias, funds that were terminated or transferred are included in the dataset, provided

each fund had at least 24 continuous data points. One of the issues that came up in the analysis is the sudden increase or decrease in net flows during a quarter. To eliminate the outliers in the net flows the data for a quarter where the net flows is greater than 0.75 of the funds under management at the beginning of the quarter is dropped.

4. Methodology

A typical mutual fund investment decision involves two steps – first choose an asset category and then select a fund within that asset category. The choice of asset category depends on the investors risk preferences and the choice of the fund may depend on its past performance. Individual investors are thus concerned about the returns and risks involved in investing. There are various agencies that report the performance of the funds and individual fund managers also advertise their performance measures. If investors follow the performance of funds carefully, they will tend to invest more into the funds that perform well in a particular category and withdraw funds from the poor performing funds.

In this analysis the frame work is similar to that of Frino, Heaney and Service (2005). An important factor that can influence the performance of a fund is its size. Chen, Hong, Huang, and Kubik (2004) show that the performance of funds decreases with size and to control for the size effect we use the lagged log size of the fund as a control variable. To adjust for the momentum effect of net flows the lagged value of the inflows and outflows are included as independent variable. The effect of past inflows, outflows, investment returns, size, and overall inflows and outflows into the sector are analyzed using the following fixed effects regression:

$$NCF_{i,t} = \sum_{n=1}^5 \alpha_{1,n} CFI_{i,t-n} + \sum_{n=1}^5 \alpha_{2,n} CFO_{i,t-n} + \alpha_{3,1} RET_{i,1} + \alpha_{3,2} RET_{i,2} + \alpha_{3,3} RET_{i,3} + \alpha_{3,4} RET_{i,4} + \alpha_{3,5} RET_{i,5} + \alpha_4 SIZE_{i,t} + \alpha_5 EIN_{i,t} + \alpha_6 EOUT_{i,t} + \sum_{i=1}^m \beta_i D_i + \varepsilon_{i,t} \quad (1)$$

$CFI_{i,t}$ and $CFO_{i,t}$ are the cash inflows and outflows of i^{th} fund at time t , $RET_{i,1-5}$ are the cumulative weekly or monthly returns for the previous 1 to 5 weeks, and $SIZE_{i,t}$ is the natural logarithm of the assets under management for the fund at time t . The main difference between this model and the Frino, Heaney and Service (2005) is the next two terms of the regression equation. The fund flows into and out of a particular fund is determined by the market conditions prevailing during the week. If there is an overall increase or decrease in the fund flows into the market, it will affect all funds to some extent. To control for this market effect, two control variables are created. These variables are the excess inflows and outflows into a fund compared to the market. These variables are calculated as follows:

$$EIN_{i,t} = \frac{CFI_{i,t}}{SIZE_{i,t-1}} - \frac{\sum_{i=1}^n CFI_{i,t}}{\sum_{i=1}^n SIZE_{i,t}}$$

$$EOUT_{i,t} = \frac{CFO_{i,t}}{SIZE_{i,t-1}} - \frac{\sum_{i=1}^n CFO_{i,t}}{\sum_{i=1}^n SIZE_{i,t}}$$

These two variables are the excess inflows or out flows into a fund as compared to the entire group of funds. The last set of variables in the regression equation is for controlling the fixed effects.

5. Results

The results of the panel regression of monthly net fund flows against the past inflows, outflows, returns, size of the fund and control variables for total flows into the sector are given in Table 3. The past inflows had a significant positive impact on all sectors of the Czech open-end fund market. This momentum of inflows persisted up to three lags in most of the sectors and in the case of money market funds it persisted up to 4 lags. The positive impact of inflows may be due to the fact that many investors have fixed allocation of funds into funds every month. Similarly the past outflows had a significant negative impact on the monthly net flows in all sectors up to a lag length of 3 weeks, except for money market funds. The outflow persistence may be because of investors using these funds for investing their retirement savings and withdraw a certain amount each month to cover their living expenses. This explanation can be further supported by the fact that for bond funds, which are safe investment for retirees, these coefficients are significant in 4 out of 5 of the lags. As evidenced in previous studies, the size of the fund had a significant negative impact on the net fund flows in all sectors, except for mixed funds. The control variable for overall market inflows is significantly positive and the control variable for market outflows is significantly negative in all sectors.

Table III: Fixed Effects Panel Regression of Monthly Net Fund Flows with Past Inflows, Outflows and Returns

Regression equation:

$$NCF_{i,t} = \sum_{n=1}^5 \alpha_{1,n} CFI_{i,t-n} + \sum_{n=1}^5 \alpha_{2,n} CFO_{i,t-n} + \alpha_{3,1} RET_{i,1} + \alpha_{3,2} RET_{i,2} + \alpha_{3,3} RET_{i,3} + \alpha_{3,4} RET_{i,4} + \alpha_{3,5} RET_{i,5} + \alpha_4 SIZE_{i,t} + \alpha_5 EIN_{i,t} + \alpha_6 EOUT_{i,t} + \sum_{i=1}^m \beta_i D_i + \varepsilon_{i,t}$$

$CFI_{i,t}$ and $CFO_{i,t}$ are the cash inflows and outflows of i^{th} fund at time t , $RET_{i,1-5}$ are the cumulative monthly returns for the previous 1 to 5 months, and $SIZE_{i,t}$ is the natural logarithm of the assets under management for the fund at time t . $EIN_{i,t}$ and $EOUT_{i,t}$ are control variables for overall inflows and outflows into all funds for the time period t .

Dependent variable	Bonds Coefficients (t-stat)	Equity Coefficients (t-stat)	Fund of funds Coefficients (t-stat)	Mixed Coefficients (t-stat)	Money Market Coefficients (t-stat)
$CFI_{.1}$	0.0573 (6.7669) ***	0.0334 (5.8083) ***	0.1013 (9.8496) ***	0.0431 (8.3042) ***	0.0578 (3.6887) ***
$CFI_{.2}$	0.0340 (4.0748) ***	0.0317 (5.6904) ***	0.0760 (7.8042) ***	0.0202 (4.2902) ***	-0.0039 (2.3364) **
$CFI_{.3}$	0.0211 (2.0223) **	0.0150 (2.7256) ***	0.0818 (8.8075) ***	0.0018 (1.3836)	-0.0026 (1.9465) *
$CFI_{.4}$	0.0136 (1.5924)	0.0064 (1.2947)	0.0044 (1.1001)	0.0004 (0.8913)	0.0025 (2.0076) **
$CFI_{.5}$	0.0000 (1.6309)	0.0000 (0.0822)	0.0013 (1.7115) *	0.0000 (0.6231)	0.0000 (0.0259)
$CFO_{.1}$	-0.1036 (7.0287) ***	-0.0271 (2.7271) ***	-0.1823 (8.4859) ***	-0.0578 (9.0820) ***	-0.0526 (2.2802) **
$CFO_{.2}$	-0.0161	-0.0057	-0.0789	-0.0166	-0.0166

	(1.2776)	(0.5845)	(3.5468) ^{***}	(2.6678) ^{***}	(0.6608)
<i>CFO</i> _{.3}	-0.0348 (2.8592) ^{***}	-0.0300 (3.0552) ^{***}	-0.1003 (4.6924) ^{***}	-0.0203 (3.4220) ^{***}	-0.0066 (0.2378)
<i>CFO</i> _{.4}	-0.0215 (1.8210) [*]	-0.0035 (0.3563)	-0.0309 (1.4572)	-0.0057 (0.9814)	0.0396 (1.5429)
<i>CFO</i> _{.5}	-0.0268 (2.3877) ^{**}	0.0047 (0.4908)	0.0465 (2.2224) ^{***}	-0.0002 (0.5854)	-0.0686 (2.8684) ^{***}
<i>RET</i> _{.1}	0.0000 (0.1924)	0.0003 (0.4436)	0.0035 (0.1322)	-0.0001 (1.7320) [*]	0.0017 (0.5154)
<i>RET</i> _{.2}	0.0000 (0.0402)	0.0010 (1.3061)	-0.0133 (0.5089)	0.0000 (0.0104)	0.0026 (0.7038)
<i>RET</i> _{.3}	-0.0004 (2.5179) ^{**}	0.0010 (1.2882)	0.0889 (3.3724) ^{***}	0.0000 (0.3258)	0.0000 (0.0042)
<i>RET</i> _{.4}	-0.0001 (0.4843)	0.0006 (0.7560)	0.0236 (0.8723)	-0.0009 (2.1982) ^{**}	-0.0041 (1.1151)
<i>RET</i> _{.5}	-0.0002 (1.0032)	0.0006 (0.8668)	-0.0071 (0.2615)	0.0001 (1.5860)	0.0050 (1.4662)
<i>SIZE</i>	-0.0045 (4.6964) ^{***}	-0.0024 (2.6956) ^{***}	-0.0065 (3.8269) ^{***}	0.0032 (6.9533) ^{***}	-0.0025 (1.5595)
<i>EIN</i>	0.8816 (58.4190) ^{***}	0.5624 (40.7385) ^{***}	-0.0037 (11.7398) ^{***}	0.8654 (82.2961) ^{***}	0.5145 (20.8409) ^{***}
<i>EOUT</i>	-0.8408 (50.6119) ^{***}	-0.5914 (34.4140) ^{***}	-0.3501 (15.6972) ^{***}	-0.7373 (84.7220) ^{***}	-0.4093 (16.9372) ^{***}
Adj R ² (F-stat)	0.8229 (205.25) ^{***}	0.5507 (53.605) ^{***}	0.4948 (34.306) ^{***}	0.7905 (159.47) ^{***}	0.4291 (19.724) ^{***}

*** Significant @1%, ** Significant @5%, * Significant @10%

Controlling for all other variables, there is very little evidence that the past returns had significant effect on the net fund flows. In the case of mixed funds there is weak evidence (significant at 10%) that past one period return had a negative impact on the fund flow, which is an indication of gambler's fallacy. Cumulative returns for three periods had a negative impact on fund flows of bond sector and positive effect on net flows into the fund of funds sector. Since bond funds are the least risky investment, it can be assumed that the investors are weary of keeping their money in funds with high cumulative returns. It is also interesting to note that the return coefficients are significant for the 3 month cumulative returns, which may be an indication that the investors are making their decisions on withdrawal on a quarterly basis. Cumulative 4 month return has a significant negative effect on the net fund flow of mixed funds. Bond funds and mixed funds are the largest asset classes and these two groups of funds are the ones that are showing the negative relationship between past returns and net flows.

The results of panel regression of weekly net fund flows against the past inflows, outflows, returns, size and market control variables are given in Table 4. Past cash inflows had a positive and statistically significant impact on the net flows of bond and fund of funds sectors for up to 2 lags, and up to 3 lags for the equity sector. Inflows had no significant effect on the net flows of mixed and money market sectors. These two groups of funds had the lowest growth rates and this may be the reason that their net flows are not affected by the past inflows. However, this variable is significant for the 5th lag for all sectors, except for the bond sector, which can possibly be explained by the monthly nature of investment inflows. Outflows had negative

impact on the fund flows bonds and fund of funds sectors for 5 and 4 lags respectively and for 1 lag in the case of money market funds. Compared to the monthly flows, the weekly inflows and outflows have relatively less influence on the net fund flows. The effects of size and market control variables are similar to that of monthly regressions.

Table IV: Fixed Effects Panel Regression of Weekly Net Fund Flows with Past Inflows, Outflows and Returns

Regression equation:

$$NCF_{i,t} = \sum_{n=1}^5 \alpha_{1,n} CFI_{i,t-n} + \sum_{n=1}^5 \alpha_{2,n} CFO_{i,t-n} + \alpha_{3,1} RET_{i,1} + \alpha_{3,2} RET_{i,2} + \alpha_{3,3} RET_{i,3} + \alpha_{3,4} RET_{i,4} + \alpha_{3,5} RET_{i,5} + \alpha_4 SIZE_{i,t} + \alpha_5 EIN_{i,t} + \alpha_6 EOUT_{i,t} + \sum_{i=1}^m \beta_i D_i + \varepsilon_{i,t}$$

$CFI_{i,t}$ and $CFO_{i,t}$ are the cash inflows and outflows of i^{th} fund at time t , $RET_{i,1-5}$ are the cumulative monthly returns for the previous 1 to 5 weeks, and $SIZE_{i,t}$ is the natural logarithm of the assets under management for the fund at time t . $EIN_{i,t}$ and $EOUT_{i,t}$ are control variables for overall inflows and outflows into all funds for the time period t .

Dependent variable	Bonds Coefficients (t-stat)	Equity Coefficients (t-stat)	Fund of funds Coefficients (t-stat)	Mixed Coefficients (t-stat)	Money Market Coefficients (t-stat)
$CFI_{.1}$	0.0319 (8.8045) ***	0.0173 (5.6786) ***	0.0043 (2.5565) **	0.0006 (1.0275)	-0.0001 (0.3594)
$CFI_{.2}$	0.0000 (7.2302) ***	0.0134 (4.4288) ***	0.0046 (2.7279) ***	0.0007 (1.4328)	0.0004 (1.1316)
$CFI_{.3}$	0.0000 (0.3269)	0.0163 (5.8057) ***	0.0005 (0.8520)	0.0008 (1.6423)	0.0006 (1.6623) *
$CFI_{.4}$	0.0000 (0.3502)	0.0004 (0.9263)	0.0006 (1.1846)	0.0008 (1.6317)	0.0010 (1.0770)
$CFI_{.5}$	0.0000 (0.3221)	0.0082 (6.9670) ***	0.0054 (3.8310) ***	0.0002 (1.8368) *	-0.0028 (2.9695) ***
$CFO_{.1}$	-0.0299 (6.1990) ***	-0.0010 (0.1392)	-0.0389 (3.4927) ***	-0.0035 (1.1707)	-0.0140 (4.3285) ***
$CFO_{.2}$	-0.0192 (3.7805) ***	-0.0069 (0.9918)	-0.0811 (6.9790) ***	-0.0008 (0.2795)	0.0011 (0.3433)
$CFO_{.3}$	-0.0121 (2.5178) ***	-0.0075 (1.0846)	-0.0907 (8.3534) ***	-0.0015 (0.5260)	0.0026 (0.7690)
$CFO_{.4}$	-0.0262 (4.4444) ***	-0.0057 (0.8241)	-0.0228 (2.0954) **	-0.0271 (9.3629) ***	-0.0066 (1.8822) *
$CFO_{.5}$	-0.0085 (1.7819) *	0.0153 (2.2493) **	0.0102 (0.9104)	-0.0049 (1.8351) *	0.0049 (1.3977)
$RET_{.1}$	0.0049 (1.8898) *	0.0098 (3.5886) ***	0.0643 (5.1719) ***	0.0052 (3.8229) ***	0.0244 (3.4663) ***
$RET_{.2}$	0.0054 (2.2337) *	0.0016 (0.5917)	0.0235 (1.9002) *	0.0001 (0.1087)	0.0156 (1.8522) *
$RET_{.3}$	0.0066	0.0021	0.0423	0.0022	0.0066

	(2.7365)***	(0.7804)	(3.4056)***	(1.6000)	(0.8269)
<i>RET</i> ₄	0.0063 (2.6223)***	0.0047 (1.7184)*	0.0441 (3.5788)***	0.0026 (1.8757)*	0.0011 (0.1334)
<i>RET</i> ₅	0.0051 (1.9909)**	0.0081 (2.9669)***	0.0230 (1.7827)*	0.0022 (1.6314)	-0.0114 (1.3409)
<i>SIZE</i>	-0.0034 (18.9796)***	-0.0005 (2.2334)**	-0.0030 (8.0511)***	0.0007 (7.6020)***	-0.0009 (2.7707)***
<i>EIN</i>	0.8607 (127.5319)***	0.7339 (103.6226)**	0.8797 (84.5456)***	0.9938 (236.2836)***	0.6819 (58.7047)***
<i>EOUT</i>	-0.8950 (108.7528)***	-0.7963 (95.2144)***	-0.6210 (50.2075)***	-0.8496 (232.9746)***	-0.6238 (51.8955)***
Adj R ² (F-stat)	0.8446 (803.36)***	0.6935 (364.38)***	0.7293 (248.67)***	0.8721 (1029.98)***	0.6149 (153.62)***

*** Significant @1%, ** Significant @5%, * Significant @10%

The effect of past returns is positive and significant for 1 lag for all sectors and significant for 5 lags for bond and fund of funds sectors, indicating a possible presence of hot-hand fallacy among the investors of these two sectors. Assuming that these two sectors are relatively less risky, investors may be basing their investment decisions mostly on the past performance of the funds. In the case of equity sector, the cumulative returns for 4 and 5 weeks are significant and positive, which indicates that the investors are possibly having the hot-hand fallacy, but with a delay of two weeks. Money market and funds and mixed funds did not show the same level of persistent effect of past returns on net flows.

6. Conclusions

This paper attempts to study the investor behavior in Czech open-end fund market using a panel regression framework. Results indicate that in the short run, investors exhibit the hot-hand fallacy by investing in funds that had high returns. Using the monthly data, there is weak indication that in some sectors investors may be exhibiting the gambler's fallacy by withdrawing funds from the funds that performed well in the past. The difference in results indicates that there may be investors who may be monitoring the performance of funds on a continuous basis and these investors may be prone to the hot-hand fallacy. On the other hand, the monthly data shows that in the long run, there is no indication of hot-hand fallacy, but maybe there is a weak indication of gambler's fallacy. A possible reason for this tendency to fall into the trap of gambler's fallacy may be due to the general attitude of the Czech population towards the costs associated with the freedom that came with the democratic institutions. A survey of Czech population's perceptions of the changes in society since 1989 showed that only 33 percent of the population is satisfied with the changes (Klicperová-Baker, 2009). The source of dissatisfaction that came to surface in this survey is the worsening of human relations including the way the businesses are conducted. The effects of bitter experiences of early days of liberalization are still lingering in the minds of Czech investors.

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