Inflation Level and Equity Mutual Fund Flows in Aggregate

Miss Boontarikar Dangsritham

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อัตราเงินเฟ้อและกระแสเงินลงทุนสุทธิในกองทุนรวมตราสารทุน

น.ส.บุณฑริกา แดงศรีธรรม

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INDEPENDENT STUDY COMMITTEE

..... Chairman

()

..... Advisor

(Assistant Professor ANIRUT PISEDTASALASAI, Ph.D.)

..... Examiner

(Assistant Professor BOONLERT JITMANEEROJ, Ph.D.)

..... Examiner

(JANANYA STHIENCHOAK, Ph.D.)

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This paper investigates the relationship of inflation level and aggregate equity mutual fund flows using Thai evidence. Sample period covered from 2006 to 2020. For the first objective, we investigate the relationship between realized inflation and net flow of money into equity mutual fund. Next, since investors are forward-looking, we extend the analysis to investigate the same relationship using forecasted inflation instead. Lastly, money supply is increasing since 2008 because of the first launch of QE. Also, inflation trend becomes lower since then. Our further exploration is whether there is a change in the relationship between inflation and aggregate equity mutual fund flow between pre-post 2008 period.

We find a strongly negative relationship between equity flows and realized inflation. When inflation is high, economic stability will be worsened and nominal interest rate is going up. As a result, there are outflows from equity. However, the same relationship is not founded using inflation expectation. Net equity mutual fund flows tend to move with the realized inflation rather than the forecasted. Furthermore, our findings show that there is a significant amount of fund flows into equity mutual fund since 2008 onwards, but we cannot detect any significant change in the relationship between inflation and aggregate equity mutual fund flows.

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Boontarikar Dangsritham

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1. INTRODUCTION

Mutual funds play an important role as an investment vehicle in financial market. Many practitioners consider mutual fund flows as a measure of investor sentiment. According to Association of Investment Management Companies (AIMC), NAV of Thai mutual funds in 2019 is accounting for 45.84% of GDP. [1] Also, mutual fund NAV grew at 7.19% 5-Y CAGR[2] while 5-Y CAGR of Thai GDP is only 3%. Thai mutual fund industry will likely continue to grow in the future.

Previous studies on the factors, especially the macroeconomic data, that drives mutual fund flows are widely documented. (Ederington & Golubeva, 2010) find that the aggregate movements of equity funds are positively correlated with term spread but negatively correlated with VIX. These results are consistent with (Cohen, 2003). (Chalmers et al., 2013) also find that when economic is performing well, there will be following by a significant fund inflow to equity mutual funds. However, I observed that the linking between inflation and aggregate mutual fund flows are not very well-studied. Overall economic well-being can be reflected through inflation rate. (Fama, 1981) found that the higher inflation causes higher general price level which causes a reduction in real economic activities. It would result in lower the corporate profit in the future. Hence, stock price decreases. Therefore, the rate of inflation also has an impact to asset allocation decisions of investors.

According to the Fisher Effect, real interest rate equals the nominal interest rate minus the expected inflation rate. This economic theory is used to calculate financial return which an investor gets for every asset classes. When there is a change in the rate of inflation, it affects the real yield of investment assets. However, (Modigliani & Cohn, 1979) provide evidences that bond market investors and stock market investors incorporate the change in inflation rate differently and unparallelly. For bond market investors, they would adjust nominal interest rate in the same direction and magnitude with the change in inflation. Then, that adjusted nominal rate will be used as a discount rate for stocks market. However, (Modigliani & Cohn, 1979) and (Campbell & Vuolteenaho, 2004) claim that stock market participants usually fail to adjust a change in inflation

to the nominal growth rate of future cashflows. To illustrate, when inflation goes up, investor might correctly revise the nominal discount rate up, but they do not revise up the estimation of nominal cashflows to reflect the inflation. As a result, the intrinsic values of stock tend to be undervalued when inflation is high and seem to be overvalued when inflation is low. Therefore, it could affect the equity fund flow as well. Moreover, these empirical works that are referred in this paper are mostly limited to developed market. Most of them are studied in U.S. and Europe while the evidence in emerging markets is not well-studied.

In this paper, we investigate the relationship between inflation level and flow of money into equity mutual fund in aggregate level using Thai data. we studies equity mutual fund flow in economic-wide level. So, when investors reallocate money from one to another equity mutual funds, it will be net out at the aggregate level. I use monthly data over the period June 2004 until November 2020 to find an evidence in Thailand. There are some reasons of using Thai data. First, Thailand is one of the lowest inflation countries in ASEAN and in Asia. Also, the size of Thai mutual fund is accounting for 45.84% of Thai GDP at the end of 2019[1] with 7.19% 5-Y CARG, while 5-Y CAGR of Thai GDP is only 3.15%. It can imply that mutual fund industry in Thailand is still expanding. Also, in this study, SET TRI return, SET TRI volatility, term spread, and USD/THB movement will be control as well. The details of control variables will be elaborated further in section 3. As (Fama & Schwert, 1977) find, high inflation is associated with lower stock returns. When inflation is high, economic stability will be worsened. This result is consistent with (Bodie, 1976) and (Lintner, 1975)'s evidences. As a result, stock price will decline. Therefore, we hypothesize that investors will respond to low inflation by moving their asset allocation towards equity, leading to an inflow to equity mutual funds. In other words, there should be a negative relationship between inflation and aggregate equity mutual fund flows.

Secondly, in the prior empirical research about the impact of inflation to stock returns or fund flows, they usually use actual and lagged inflation data to examine the relationship. However, according to (e Cunha et al., 2006), they find that individual investors are used to strategize their

investment plans using foresight. (Amsteus, 2008) also conclude that individuals tend to interpret all uncertainties that they are facing at. Hence, the inflation expectation should also impact asset allocation decision as well. So, we want to examine the implication from the forecasted inflation in the upcoming period to current equity mutual fund flows. We hypothesize that there should be a negative correlation between forecasted inflation and equity mutual fund flows in aggregate as well. The forecasted inflation data will be calculated from autoregressive moving average (ARMA) time series models**.** Moreover, as far as I know, no researchers have ever considered the forecasted rate of inflation to examine relationship with equity mutual fund flow in the current period.

Lastly, since the U.S. subprime mortgage crisis in 2008, Federal Reserve responses to this crisis by supporting market liquidity through monetary policy. They decided to print money to increase money supply in the market to help facilitate an economic recovery. Theoretically, this response of Fed would create inflationary pressure to go up. Base on the quantity theory of money, where MV=PQ, a change in money supply (M) causes an equal change in general price level (P) in the economy, ceteris paribus. Increasing the money supply (M) faster than the growth in real output (Q) will cause inflation (P). However, the U.S. economy experienced low inflation rate since 2008 despite the various rounds of QE. The common reason for this phenomenon is because a sluggish of aggregate business and consumer demand for loans. So, banks must hold significant amounts of money at the Fed rather than lend into an economy. However, (Pham, 2018) document the alternative reason of U.S. economic paradox after the 2008 financial crisis (money expansion without inflation increase) mainly due to a constant increase in GDP and a decrease in unemployment rate since 2009. This is also called pent-up demand effect. Growth in real output (Q) increase faster than money supply (M) in economy. So, inflation tend to stable or decrease since then. Therefore, I would like to investigate a change in the relationship between inflation and aggregate equity mutual fund flow if it is conditional on time or not. Dummy variable will be created to test the significance of the structural break between pre-post 2008 period. Since there is a lot of money from QE floating in economy after 2008 while inflation level still low, I suspect to see a higher amount of fund flows into equity asset class. I, therefore, hypothesize that after

2008, degree of relationship between these two variables becomes stronger, compare to pre-2008 period.

This study is different from the previous studies in the following issues. First, most of the empirical works are limited to developed countries while emerging markets are still lagged of evidence. Also, according to the World Bank[3], Thailand inflation is relatively low comparing to the western countries, reaction of investors to a change in inflation rate might be different from what we observed in developed countries. Therefore, this study would give us a clearer picture about the relationship that we are going to observe in Thailand with the evidence which are well-documented in developed markets. Secondly, we extend the first objective of this paper by testing the significance of the structural break in order to take into account the new normal of inflation level. If pre- and post-2008 give the different results, it implies that relationship between inflation and aggregate equity fund flows is also conditional on time as well. Also, the relationship that is observed in the first objective could be driven from the difference time spans. Finally, because investors are forward looking, they tend to use foresight view to strategize their long-term investment plans. So, the forecasted inflation should be considered as another explanatory variable for equity mutual fund flows. To the best of my knowledge, no academic research has taken the inflation expectation as independent variable to see how it affect the concurrent equity mutual fund flow. This paper will be the first study examining this relationship.

The rest of the paper is organized as follows. Section 2 reviews some theoretical issues involved and relevant studies in literature. Section 3 describes the data. Section 4 discusses the methodology of my empirical analysis. Section 5 summarizes key empirical findings. Section 6 finally concludes.

2. LITERATURE REVIEW

2.1 Determinants of mutual fund flows

In the prior study, (Warther, 1995) use U.S. monthly fund flows data from 1984-1993 and finds that stock returns are positively related with mutual fund flows. This result also in line with (Edelen & Warner, 2001), using daily flow data from 1998-1999. This paper identifies the positive relationship between overall market returns and aggregate U.S. equity mutual fund flow. They also find the lagged response of aggregate flow to market return by one day. Expanding to emerging market, (Fong et al., 2018) recently use evidence in Hong Kong to identify the key determinants of mutual fund flows invested in HK equities. They find that mutual funds' portfolio rebalancing highly determines mutual fund flow. Besides, the return-chasing behaviors of investors is the main reason for high volatility of fund flows in Hong Kong as well.

The relationship between macroeconomic data and equity fund flows has been well-studied in the previous literatures. (Ederington & Golubeva, 2010) use aggregate monthly fund flows from 1988 to 2008 in U.S. and find that the aggregate movements of equity funds are positively correlated with and term spread but show negative correlation with VIX index (measurement of stock market uncertainty). It gives the same result as (Cohen, 2003) which shows that individual investors tend to reduce their equity holding during trough economic cycle (when the term spread is high). (Chalmers et al., 2013) also examined whether aggregate asset allocations of U.S. mutual fund investors depend on economic conditions. They use monthly data between February 1991 and March 2008. The proxies of economic conditions that they test include activity index, term spread, default spread, the change in short-term interest rate, and stock market volatility. Their evidence shows that when economic is in a good shape, there is a significant fund inflow to equity mutual funds. It indicates that economic conditions have an impact to asset allocation decisions of individual investors.

2.2 Inflation and stock returns

There are many empirical findings about the effect of inflation on stock prices or stock returns. (Fama & Schwert, 1977) use U.S. data during 1953-1971 to estimate which asset class was a hedge against inflation and found the highly negative relationship between inflation rate and common stocks returns. Other asset classes give them the mixed results. This conclusion is also consistent with (Bodie, 1976) and (Lintner, 1975)'s evidences. The reasons for this relationship have been well-documented as well. For example, (Fama, 1981) found that the higher inflation causes higher general price level. A reduction in real economic activities result in lower the corporate profit in the future. Hence, stock price decreases. Moreover, (Geske & Roll, 1983)'s finding is consistent with (Fama, 1981) but they also considered fiscal aspect into this negative relationship. The reduction in real economic activities will reduce revenue to the government as well. The link between inflation and stock returns also can be found in a behavioral model. (Brandt & Wang, 2003) test whether aggregate risk aversion is affected by inflation news. They conclude that degree of risk aversion is in response to the news of inflation. When inflation is expected to rise, investors become more anxious or higher risk aversion, and thus lower stock prices. Hence, the negative relationship between inflation and stock returns can impact the net flow of equity funds as well.

Interesting point here, (Campbell & Vuolteenaho, 2004) find that 80% of stock mispricing comes from the level of inflation. They use the loglinear dynamic valuation framework and a vector autoregression (VAR) to do the empirical test. To elaborate their paperwork, according to the Gordon Growth Model (Gordon & Shapiro, 1956), it can be expressed as D_t/P_t=R-G, where R is long-term discount rate and G is long-term growth rate of dividends. The R comes from the nominal bond yield plus risk premium. However, the key driver of long-term nominal interest rate is the expected long-term rate of inflation. So, the factor that cause real and nominal interest rate do not move closely is the rate of inflation. When there is a change in inflation rate, we would expect that it would also move nominal G (long-term dividend growth rate). Then, the impact would be offset with the same effect on nominal R (long-term discount rate). So, there would be no net effect on the discount rate on GGM when doing stock valuation. However, what researchers found is that, for the long-term discount rate (R), it is perfectly adjusted with the change of inflation. But

stock market investors usually fail to adjust the long-term dividend growth rate (G) with the change in inflation. Therefore, it comes to their conclusion that inflation is highly correlated with a mispricing of stock prices which is supporting (Modigliani & Cohn, 1979) view. This effect is called "Inflation illusion".

Most closely related to my special project, (Krishnamurthy et al., 2018) test whether inflation level in U.S. has an impact on asset allocation decisions of mutual fund investors. Their sample period is in quarterly level from 1976:Q4 to 2013:Q4. They also extend their analysis to see whether the relationship shown in the first hypothesis comes from the mispricing or inflation illusion or not. They find that aggregate equity mutual fund flows are negatively related to both inflation level and the mispricing induced by inflation illusion. These results are statistically and economically significance.

3. DATA

3.1 Sample

In this paper, we study the evidence in Thailand. Data is collected in monthly frequency. The sample period is between June 2004 and November 2020, consists of 198 data points. Even though equity mutual fund in Thailand has been started since November 1993, but the number of equity mutual funds which was established prior to year 2000 are very small. So, we decided to use equity mutual fund flow since 2004 onwards.

3.2 Variables

In order to understand the relationship between inflation level and aggregate equity mutual fund flows, we relate equity mutual fund flows with current and forecasted rate of inflation, SET TRI return, SET TRI volatility, term spread, and USD/THB movement.

3.2.1 Aggregate equity mutual fund flows

Dependent variable for this entire paper is the aggregate equity mutual fund flows ($Flow_t$). This data is available in Morningstar database. Morningstar provides monthly estimated net flow data. It is computed using the following formulars.

$$Flow_{i,t} = \left(\frac{TNA_{i,t}/TNA_{i,t-1}}{1+TR_{i,t}}\right) - 1 \quad (1)$$

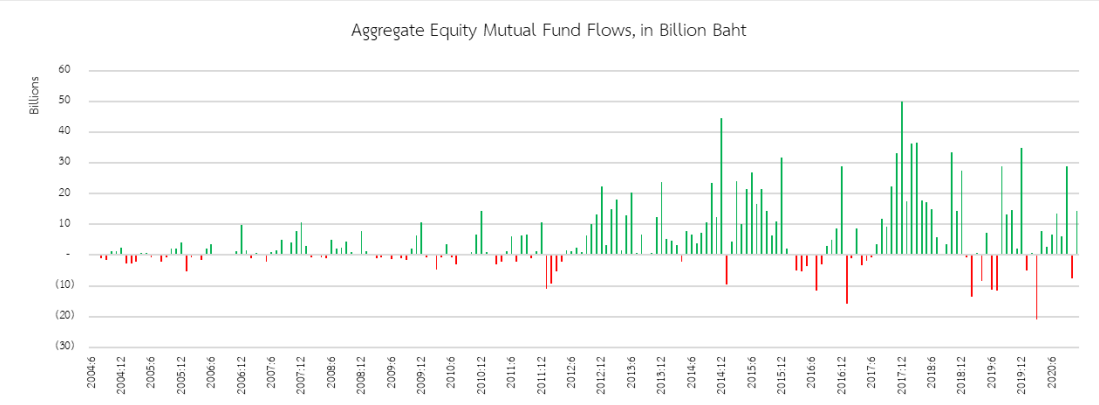
$$Flow_t = \sum_i Flow_{i,t} \quad (2)$$

where $TNA_{i,t-1}$ is the beginning and $TNA_{i,t}$ is the ending monthly total net assets of each equity fund. Morningstar tries to separate out the impact from monthly total return ($TR_{i,t}$) out of total net asset to get the net flow of fund into each fund ($Flow_{i,t}$). Then, in equation (2), net flows of each individual fund will be summed up to get the aggregate equity mutual fund flows in each month ($Flow_t$). The results are in the figure (1). Moreover, to make aggregate mutual fund flow data to be stationary, we scale net fund flow by the nominal Thai GDP. Therefore, in our empirical analysis, we use the scaled monthly flow to equity funds as the dependent variable. Noted that the portion of tax saving mutual fund flow is around 16% of the net equity mutual fund flow in

each month. Therefore, the empirical result would not be affected by this type of mutual fund significantly.

Fig (1): Raw data of aggregate equity mutual fund flows during sample period (in Billion Baht).

This figure shows raw data of aggregate equity mutual fund flow in each month from June 2004 to November 2020. Unit is in billion baht. Obviously, in Thailand, fund inflows dominate outflows. Moreover, the magnitude of flows becomes significant since 2012 onwards. Although flows become sluggish in 2016-2017 but fund inflows continuously increase in late 2017. This graph reassures that Thailand mutual fund industry is still expanding.



3.2.2 Inflation

In this paper, we use two different types of inflation rate; realized inflation and forecasted inflation. For the realized inflation which is used to examine the relationship with aggregate equity fund flow, we collect CPI data which is monthly announced by the Bureau of Trade and Economic Indices, Ministry of Commerce. Inflation data that we use is calculated from the change in CPI month-on-month. Also, since we did not exclude food and fuel items, our inflation data is the headline inflation.

For the forecasted inflation, it will be calculated from autoregressive moving average (ARMA) time series models. It does not assume any structural relationships or other value attributes to model. The forecasting needs information only from past values plus previous error terms. According to (Stockton & Glassman, 1987) , ARMA model is relatively robust when generating short-run forecasting ability. So, our model will step forward one month at a time and forecast one month ahead.

3.2.3 Other control variables

Since equity fund flows are determined by many factors, market return is one of the key variables that should be considered (Edelen & Warner, 2001; Warther, 1995). It is calculated from monthly return on SET total return index with continuously compounded. We also include volatility of equity market using trailing 12-month standard deviation of SET TRI (Cohen, 2003; Ederington & Golubeva, 2010). Another macroeconomic indicator is term spread. When the term spread is small, there is high level of uncertainty about the economy, resulting in outflows from risky asset classes. It can imply current economic health, which lead to equity market condition. So, it is calculated from using 10-year government bond minus 3-month treasury bill for another control variable in my model. The weakening of Thai Baht against U.S. dollar can reduce fund flows out of Thailand as well (Li et al., 2018). Hence, we include a change in spot exchange rate of USD/THB which can be obtained from Bloomberg. (Chalmers et al., 2013)

Table (1): Definition of variables in summary.

The units are in percentage, except for the dummy variable.

Variable	Definition
Flow	Aggregate net equity mutual fund flows (scaled by GDP)
Inf	Inflation Rate
SET	SET TRI Returns captures stock market return which can correlate with equity fund flows.
σ	SET TRI Volatility captures stock market uncertainty which discourages investment into equities asset class
Term	Term spread (10Y-3M yield) captures current economic health and uncertainty about the economy
FX	Change in spot exchange rate of USD/THB captures co-movement between funds flows and THB rate
CRISIS	Dummy variable taking value 1 if year is in 2008 onwards

3.3 Data Descriptive

Table (2): Descriptive statistics of all variables

This table reports the summary statistics for the variables during the 2004-2020 study period. All variable definitions are provided in Table 1. Data in this table are shown in percentage. FX represents the rate of change in spot exchange rate of USD/THB. Noted that the methodology of forecasted inflation ($E(Inf_{t+1})_t$) will be elaborated in section 5.1.

(Monthly)	Obs	Mean(%)	Std. Dev.(%)	Min(%)	Max(%)
$Flow_t$	198	.055	.108	-.191	.488
Inf_t	198	.158	.538	-2.938	2.257
$Flow_{t-1}$	197	.054	.108	-.191	.488
SET_t	198	.708	5.788	-35.805	16.542
σ_t	198	5.083	2.472	1.371	13.897
$Term_t$	198	.106	.068	-.005	.338
FX_t	198	-.143	1.707	-5.107	5.093
$E(Inf_{t+1})_t$	198	.157	.197	-1.01	.907

Table (3): Correlation matrix

This table reports the correlation matrix among each variable. Here, significance levels are indicated as * p < .05, ** p < .01, *** p < .001.

	$Flow_t$	Inf_t	$Flow_{t-1}$	SET_t	σ_t	$Term_t$	FX_t	$E(Inf_{t+1})$
$Flow_t$	1							
Inf_t	-0.194**	1						
$Flow_{t-1}$	0.356***	-0.129	1					
SET_t	-0.176*	0.068	-0.086	1				
σ_t	-0.275***	-0.038	-0.283***	0.073	1			
$Term_t$	-0.081	0.206**	-0.093	0.112	0.296***	1		
FX_t	0.035	0.149*	0.023	-0.168*	-0.081	-0.032	1	
$E(Inf_{t+1})$	-0.085	0.395***	-0.193**	-0.014	-0.039	0.227**	0.070	1

From table 2, during 2004-2020, the mean of aggregate equity fund flows is around 0.06% of annual GDP. The average inflation in the past 16 years is at 1.8% annually. For SET TRI return and volatility, the means are 8.5% and 5% respectively. However, the gap between MAX and MIN value of SET TRI is very wide because high volatility during the Subprime Mortgage Crisis in 2008. Also, MAX value of SET TRI volatility, which reached 13.9% standard deviation, occurred during the crisis as well.

From table 3, it reports correlation coefficient among each of variables. Base on this table, aggregate equity mutual fund flows show a negative relationship with inflation, SET TRI return, SET

TRI volatility, term spread, and forecasted inflation while it shows a positive relationship with its own lag and USD/THB movement.

Fig (2): Plotted raw data of inflation rates and aggregate equity mutual fund flows

This figure represents the visual raw data of three main variables. Realized inflation and forecasted inflation are represented in the left-hand-side axis. Aggregate equity mutual fund flow is represented in right-hand-side axis. All are in percentage point.

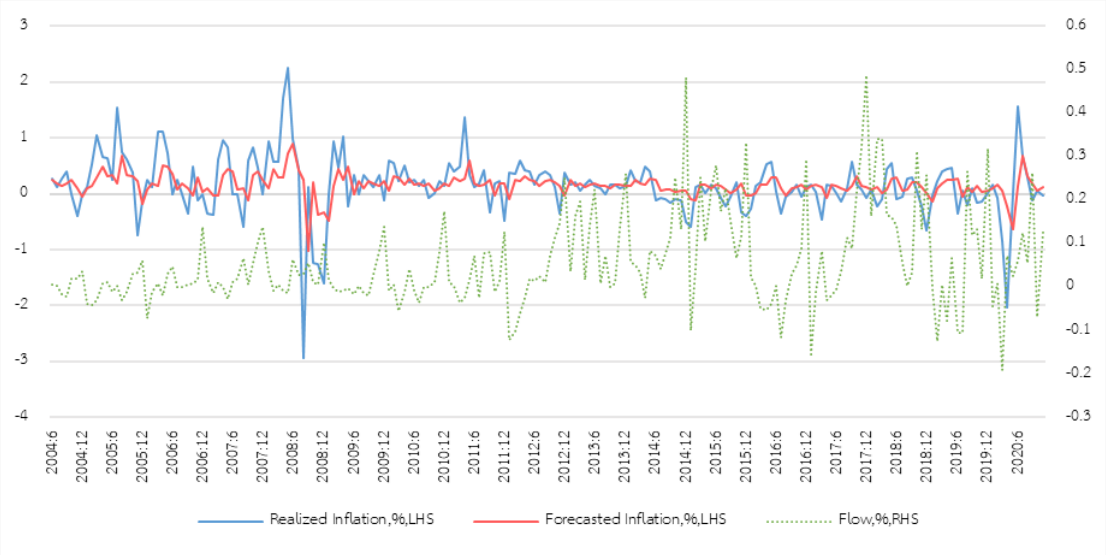


Figure (2) represents the visual raw data of three main variables, including dependent variable which is net equity mutual fund flows, and the main explanatory variables which are realized inflation and forecasted inflation. You can see that since 2008 onwards, inflation trend seems lower and less volatile than pre-2008. Moreover, the level of net equity mutual fund flows seems higher and more volatile than pre-2008.

4. METHODOLOGY

Measuring forecasted inflation using ARMA time-series model

We predict a given day of inflation base only on the previous values and error terms with no other value attributes. Also, the change in CPI M-o-M is already stationary. Therefore, we employ ARMA model to forecast inflation. It is generally denoted as ARMA (*p,q*). The model is stated in equation (3).

$$E(Inf)_t = c + \sum_{i=1}^{p} \rho_i Inf_{t-i} + \sum_{i=1}^{q} \alpha_i e_{t-i} + e_t \quad \textbf{(3)}$$

where *E(Inf)* denotes the forecasted inflation, *Inf* denotes the actual inflation, ρ_i denotes the coefficient of the i lag of inflation, *p* denotes the number of time lags of AR terms, *e* denotes the white noise error term, α_i denotes corresponding coefficient of white noise term, and *q* denotes the number of time lags of MA terms. For model identification, we use the penalty function criteria to identify the optimal number of lags. The lowest Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC) is preferred. However, many researchers favor the BIC over the AIC because BIC is more consistent whereas AIC will usually tend to suggest the highest number of lags and give less weight to parsimony. After these procedures have been done, using ARMA models for forecasting is relatively straightforward. The coefficient terms from ARMA process will be used for the forecasted inflation.

4.1 Measuring impact of inflation on equity mutual fund flows in aggregate

According to (Bodie, 1976; Fama & Schwert, 1977; Lintner, 1975)'s evidences, high inflation is associated with lower stock returns, which can lead to an outflow to equity mutual funds. Hence, to investigate the relationship between inflation level and aggregate equity mutual fund flows, we employ a multivariate linear regression model to test significance of these two variables. Other control variables are also included to capture the relationships which are not primary interest. The regression model for the first objective is as following.

$$Flow_t = \beta_o + \beta_1 Inf_t + \beta_2 Flow_{t-1} + \beta_3 SET_t + \beta_4 \sigma_t + \beta_5 Term_t + \beta_6 FX_t + \varepsilon_t \quad (4)$$

where *Flow, Inf, SET,* σ*, Term, FX* represent aggregate net equity mutual fund flows, actual inflation rate, SET total return, SET volatility, term spread, and change in spot exchange rate of USD/THB, respectively. β_i is the coefficient of independent variables and ε_t is the residual value of the model. From equation (4), for the control variables, β_2 to β_6 capture the relationships which also affect $Flow_t$. Autoregressive model is an important model for time-series data analysis. The upcoming value depends linearly on its own previous values. Therefore, we include the previous lag term of $Flow_{t-1}$ as a control variable and β_2 captures that AR relationship. Also, β_3 captures the relationships from stock returns because (Edelen & Warner, 2001; Warther, 1995) find that overall market returns are positively related with mutual fund flows. (Chalmers et al., 2013) indicates that economic conditions have an impact to asset allocation decisions of individual investors. Therefore, the proxies of economic condition that we test include stock market volatility, term spread, and USD/THB exchange rate movement and the relationships are shown in β_4 to β_7, respectively. Importantly, according to our first hypothesis, which stated that there is a negative relationship between actual inflation and aggregate equity mutual fund flows using Thai data, β_1 captures the relationship between the main explanatory variable (Inf_t) and dependent variable ($Flow_t$). We test whether β_1 is significantly different from zero or not. If β_1 is significantly negative, it can be concluded that high inflation causes outflows from equity mutual funds. It would be consistent

with the evidences found in developed markets by (Bodie, 1976; Fama & Schwert, 1977; Lintner, 1975).

4.2 Measuring impact of forecasted inflation on equity mutual fund flows in aggregate

(Amsteus, 2008; e Cunha et al., 2006) have documented about investors' foresight. Since investors tends to interpret all uncertainties they are facing at and strategize their investments plans using forward-looking aspect, the forecasted inflation should also impact their decisions to move their money towards equity funds. The regression model is as follows.

$$Flow_t = \beta_o + \beta_1 E(Inf_{t+1})_t + \beta_2 Flow_{t-1} + \beta_3 SET_t + \beta_4 \sigma_t + \beta_6 Term_t + \beta_6 FX_t + \varepsilon_t \quad \textbf{(5)}$$

where *Flow, E(Inf), SET,* σ*, Term, FX* represent aggregate net equity mutual fund flows, forecasted inflation, SET total return, SET volatility, term spread, and change in spot exchange rate of USD/THB, respectively. β_i is the coefficient of independent variables and ε_t is the residual value of the model. From equation (5), for the control variables, β_2 to β_6 capture the relationships which also affect $Flow_t$, apart from our main explanatory variable ($E(Inf_{t+1})$). Base on second hypothesis, which stated that forecasted inflation also has significant negative impact to the current equity mutual fund flow, we want to test whether β_1 is significantly different from zero. If β_1 becomes significant, it can be concluded that not only the actual inflation that causes a shift of flows to equity mutual funds, but the forecasted inflation is also contribute to the aggregate equity mutual fund flows as well.

4.3 Measuring the significance of the structural break between pre-post 2008 on the relationship between inflation and equity mutual fund flow in aggregate

4.3.1 The change in relationship between realized inflation and equity mutual fund flow in aggregate between pre-post 2008

Quantitative Easing policy (QE) is first introduced to the world economy in 2008 so, money supply is increasing since then. Also, inflation trend becomes lower since 2008. Our further

exploration is whether there is a change in the relationship between inflation and aggregate equity mutual fund flow between pre-post 2008 period. We introduce dummy variable *(CRISIS$_t$)* to capture the different sample span. Moreover, since we believe that the structural break would cause some change across time in relationship between inflation and aggregate mutual fund flows, we also create interaction term. Then, we add dummy variable and interaction terms in equation (4) to get equation (6).

$$Flow_t = \beta_o + \beta_1 Inf_t + \gamma_0 CRISIS_t + \gamma_1 CRISIS_t \times Inf_t + \beta_2 Flow_{t-1} + \beta_3 SET_t + \beta_4 \sigma_t + \beta_5 Term_t + \beta_6 FX_t + \varepsilon_t \quad \textbf{(6)}$$

where *Flow, Inf, CRISIS, SET,* σ*, Term, FX* represent aggregate net equity mutual fund flows, realized inflation, dummy variable taking value 1 if year is in 2008 onwards, SET TRI return, SET TRI volatility, term spread, and change in spot exchange rate of USD/THB, respectively. β_i is the coefficient of independent variables and ε_t is the residual value of the model. For the control variables, β_2 to β_6 capture the relationships which also affect *Flow*$_t$. In addition, γ_i is the coefficient of dummy variable. We test equation (6) whether there is a shift in intercept and slope. γ_0 capture the difference between aggregate equity fund flow of pre- and post-2008 period. If γ_0 is significantly different from zero, it can be concluded that there is a shift of net equity fund flows level in post-2008. Moreover, the coefficient in the interaction term, or γ_1, capture difference of the relationship of realized inflation on aggregate equity fund flows between the pre-post 2008. If γ_1 turns negative and statistically significant, it means that the observed relationship is conditional on time.

4.3.2 The change in relationship between inflation expectation and equity mutual fund flow in aggregate between pre-post 2008

To compare either the actual inflation or the expected inflation has more impact to the equity mutual fund flows, we develop another regression model to test the change in the relationship of pre- and post-2008 between dependent variable, or $Flow_t$, and the forecasted inflation, instead of realized inflation. Equation (6) and (7) are similar, except for the main explanatory variable, which are the realized and forecasted inflation, respectively.

$$Flow_t = \beta_o + \beta_1 E(Inf_{t+1})_t + \gamma_0 CRISIS_t + \gamma_1 CRISIS_t \times E(Inf_{t+1})_t + \beta_2 Flow_{t-1} + \beta_3 SET_t + \beta_4 \sigma_t + \beta_5 Term_t + \beta_6 FX_t + \varepsilon_t \quad (7)$$

where *Flow, E(Inf), CRISIS, SET,* σ*, Term, FX* represent aggregate net equity mutual fund flows, forecasted inflation, dummy variable taking value 1 if year is in 2008 onwards, SET TRI return, SET TRI volatility, term spread, and change in spot exchange rate of USD/THB, respectively. β_i is the coefficient of independent variables and ε_t is the residual value of the model. For the control variables, β_2 to β_6 capture the relationships which also affect $Flow_t$. In addition, γ_i is the coefficient of dummy variable. We test equation (7) whether there is a shift in intercept and slope. γ_0 capture the difference between aggregate equity fund flow of pre- and post-2008 period. If γ_0 is significantly different from zero, it can be concluded that there is a shift of net equity fund flows level in post-2008. Moreover, the coefficient in the interaction term, or γ_1, capture difference of the relationship of forecasted inflation on aggregate equity fund flows between the pre-post 2008. If γ_1 turns negative and statistically significant, it means that the structural break has a significant implication on the observed relationship.

5. EMPIRICAL RESULTS

To analyze the relationship between inflation rate and equity mutual fund flows, there are four main experiments to conduct.

5.1 Forecasting the inflation rate using ARMA model

For model selection, informational criterions are used to identify the number of lags. The model with the lowest value of Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC or BIC) is preferred. Since AIC will usually tend to suggest the highest number of lags in the model, so in this paper, the lowest BIC will be chosen. The ARMA(1,1) is eventually selected because it provides the lowest BIC (BIC=347.883).

To ensure the validity of the selected model, Breusch–Godfrey test is also conducted to test the serial correlation problem of error terms. The result suggests that there is no serial correlation in the model. Therefore, it can be concluded that ARMA(1,1) process is well-specified.

Table (4): ARMA(1,1) regression result

This table shows regression result using equation (3) $E(Inf)_t = c + \sum_{i=1}^{p} \rho_i Inf_{t-i} + \sum_{i=1}^{q} \alpha_i e_{t-i} + e_t$ where *E(Inf), Inf* ρ_i, *p, e,* α_i, *q* represent the forecasted inflation, the actual inflation, the coefficient of the i lag of inflation, the number of time lags of AR terms, the white noise error term, the coefficient of white noise term, the number of time lags of MA terms. Significance levels are indicated as * p<0.1, ** p<0.05, *** p<0.01.

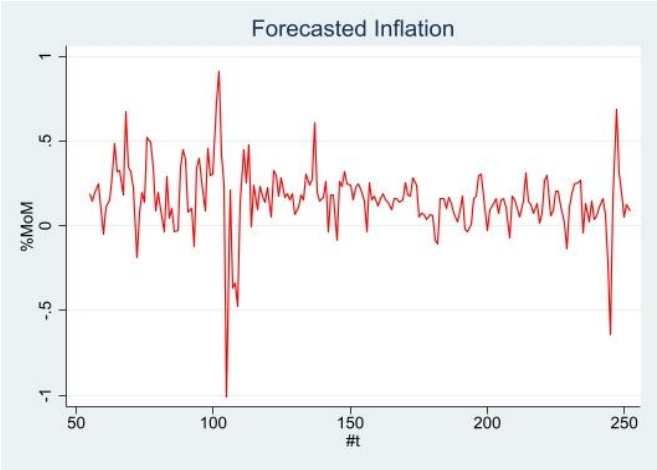
	Coef.	t-value	p-value
Inf			
Constant	.156	3.22***	.001
ARMA			
Inf_{t-1}	.312	3.40***	.001
e_{t-1}	.063	0.69	.488
sigma	.462	51.17***	0

$$E(Inf)_t = 0.156 + 0.312Inf_{t-1} + 0.063e_{t-1} + e_t \quad (8)$$

From ARMA(1,1) regression result in table (4), we get constant term *(c)* at 0.156. The coefficient of the 1st lag of inflation (ρ_1) is equal to 0.312 with 1% significance level. The coefficient of the 1st lag of white noise error term (α_i) is equal to 0.063. Therefore, the estimated model which will be used to forecast inflation as another explanatory variable in hypothesis 2 is written in equation (8).

Fig (3): Plotted values of the forecasted inflation rates

This figure graphically shows the time-series of forecasted inflation rates on monthly basis. The mean value of our forecasted inflation during sample period (June 2004 to Nov 2020) is equal to 0.157% per month. This number is already reported in table (2) in section 3.3 Data descriptive.



5.2 Impact of actual inflation level on equity mutual fund flows in aggregate

Turning to each hypothesis in this paper, we begin with measuring the impact of inflation on equity mutual fund flows in aggregate. As documented in Table (3) in the correlation matrix section, it shows a significantly negative correlation between actual inflation and equity mutual fund flow at current period. There are significant outflows form equity mutual funds during high inflationary period. Therefore, the multivariate analysis is conducted to test the first hypothesis *(there is a negative relationship between realized inflation and aggregate equity mutual fund flows)*. The result is shown in table (5)

Table (5): Impacts of actual inflation on aggregate equity mutual fund flows

Regression result using equation (4) $Flow_t = \beta_o + \beta_1 Inf_t + \beta_2 Flow_{t-1} + \beta_3 SET_t + \beta_4 \sigma_t + \beta_5 Term_t + \beta_6 FX_t + \varepsilon_t$

where *Flow, Inf, SET, σ, Term, FX* represent aggregate net equity mutual fund flows, realized inflation, SET total return, SET volatility, term spread, and change in spot exchange rate of USD/THB, respectively. All variables base on monthly basis, starting from June 2004 to Nov 2020. T-statistics are in the parentheses. Significance levels are indicated as * p<0.1, ** p<0.05, *** p<0.01.

	Eq (4)
	$Flow_t$
Constant	0.083***
	(4.35)
Inf_t	-0.034**
	(-2.52)
$Flow_{t-1}$	0.269***
	(3.93)
SET_t	-0.002*
	(-1.97)
σ_t	-0.008***
	(-2.89)
$Term_t$	0.086
	(0.76)
FX_t	0.001
	(0.27)
Observations	197
R-squared	0.205

For the control variables, the coefficient of SET total return is negative with statistically significant at 10% (t=-1.97). It means there is an outflow from equity funds when SET TRI is positive. This behavior is consistent with the finding from (Barber & Odean, 2013) that the retail investors are contrarians. They tend to buy stocks when most other investors are selling and sell stocks when others are buying. Also, the retail investors dominate mutual fund industry in Thailand at around 28% in 2010 (Nathaphan & Chunhachinda, 2012). This might be the reason why we see the negative coefficient of SET TRI return. We include the lagged monthly net equity mutual fund flows to capture the possibility of investor's momentum chasing behavior (Grinblatt et al., 1995). The coefficient is strongly significant (t=3.93). Moreover, SET TRI volatility is another control variable which is also strongly significant (t=-2.89). The coefficient is negative, meaning that there is an outflow from equity fund when the volatility of the market becomes higher. This finding might not

be consistent with the evidence in developed market by (Gervais & Odean, 2001), which documented that individual investors buy stocks more aggressively during high-volatility market. However, we do not find this relationship using equity mutual fund flows as the dependent variable using Thai data. Thai mutual fund investors tend to migrate their asset allocation away from equity asset class during volatile market. To conclude for the control variable part, one-lagged of monthly net equity mutual fund flows and SET index volatility can highly capture the variation in aggregate equity mutual fund flows.

Importantly, the main explanatory variable is the actual inflation rate. The result shows the coefficient is at -0.034 with almost 1% significant level., suggesting that the actual inflation is significantly negatively related to the net equity mutual fund flows (t=-2.52). The result is consistent with the evidence from (Modigliani & Cohn, 1979) and (Campbell & Vuolteenaho, 2004) that during high inflationary period, there are outflows from equity funds. Stated differently, the outflow of equity funds can be explained by inflation illusion effect where intrinsic value of stocks tends to be undervalued during high inflation period. Therefore, it confirms our hypothesis (1) that there is a negative relationship between inflation level and aggregate equity mutual fund flows using evidence in Thailand.

5.3 Impact of forecasted inflation on equity mutual fund flows in aggregate

Next, I test the second hypothesis, which states that besides the actual inflation, the forecasted inflation is also contribute to the aggregate equity mutual fund flows as well.

Table (6): Impacts of forecasted inflation on aggregate equity mutual fund flows

Regression result using equation (5) $Flow_t = \beta_o + \beta_1 E(Inf_{t+1})_t + \beta_2 Flow_{t-1} + \beta_3 SET_t + \beta_4 \sigma_t + \beta_5 Term_t + \beta_6 FX_t + \varepsilon_t$ where *Flow, E(Inf), SET,* σ*, Term, FX* represent aggregate net equity mutual fund flows, forecasted inflation, SET total return, SET volatility, term spread, and change in spot exchange rate of USD/THB, respectively. The forecasted inflation rates in time-series are estimated using ARMA(1,1) model. All variables base on monthly basis, starting from June 2004 to Nov 2020. T-statistics are in the parentheses. Significance levels are indicated as * p<0.1, ** p<0.05, *** p<0.01.

	Eq (5)
	$Flow_t$
Constant	0.082***
	(4.03)
$E(Inf_{t+1})_t$	-0.024
	(-0.64)
$Flow_{t-1}$	0.283***
	(4.03)
SET_t	-0.003**
	(-2.16)
σ_t	-0.008**
	(-2.59)
$Term_t$	0.041
	(0.35)
FX_t	-0.000
	(-0.09)
Observations	197
R-squared	0.180

From the result in table (6), the coefficient of lagged net equity mutual fund flows is strongly significant (t=4.027). For SET total return and volatility, the coefficients are both negative with t=-2.161 and -2.59. Again, it can be summarized that they can control the variation of net equity mutual fund flows with marginally significant.

The main explanatory variable of interest is the forecasted inflation. We find that the coefficient of forecasted inflation is negative but not significant (t=-0.641). The result suggested that equation (5) which we try to replicate equation (4), except that the actual inflation is replaced by

the forecasted inflation does not provide additional contribution from what we observed from the previous regression result. We interpret this finding as being not consistent with the findings from (Amsteus, 2008; e Cunha et al., 2006), which documented that investors tend to interpret all uncertainties that they are facing at. According to our second hypothesis, the inflation expectation does not show any statistically significant impact to equity mutual fund flows. Stated differently, the net equity mutual fund flows in Thailand tends to move with the realized inflation rather than the expected inflation.

5.4 The significance of the structural break between pre-post 2008 on the relationship between inflation rate and equity mutual fund flow in aggregate

Table (7): Change in relationship of pre- and post-2008 between inflation rate (both realized and forecasted inflation) and equity mutual fund flows in aggregate.

The results using eq (6) $Flow_t = \beta_o + \beta_1 Inf_t + \gamma_0 CRISIS_t + \gamma_1 CRISIS_t \times Inf_t + \beta_2 Flow_{t-1} + \beta_3 SET_t + \beta_4 \sigma_t + \beta_5 Term_t + \beta_6 FX_t + \varepsilon_t$

and eq (7) $Flow_t = \beta_o + \beta_1 E(Inf_{t+1})_t + \gamma_0 CRISIS_t + \gamma_1 CRISIS_t \times E(Inf_{t+1})_t + \beta_2 Flow_{t-1} + \beta_3 SET_t + \beta_4 \sigma_t + \beta_5 Term_t + \beta_6 FX_t + \varepsilon_t$

where *Flow, Inf, E(Inf), CRISIS, SET,* $\boldsymbol{\sigma}$*, Term, FX* represent aggregate net equity mutual fund flows, realized inflation, forecasted inflation, dummy variable taking value 1 if year is in 2008 onwards, SET total return, SET volatility, term spread, and change in spot exchange rate of USD/THB, respectively. All variables base on monthly basis, starting from June 2004 to Nov 2020. T-statistics are in the parentheses. Significance levels are indicated as * p<0.1, ** p<0.05, *** p<0.01.

	Eq (6)	*Eq (7)*
	$Flow_t$	$Flow_t$
Constant	0.049*	0.05*
	(1.95)	(1.70)
Inf_t	-0.023	
	(-0.75)	
$E(Inf_{t+1})_t$		-0.028
		(-0.33)
CRISIS	0.044**	0.042
	(2.19)	(1.61)
CRISIS x Inf_t	-0.012	
	(-0.34)	
CRISIS x $E(Inf_{t+1})_t$		0.009
		(0.09)
$Flow_{t-1}$	0.232***	0.244***
	(3.34)	(3.40)
SET_t	-0.003**	-0.003**
	(-2.08)	(-2.26)
$\boldsymbol{\sigma}_t$	-0.01***	-0.009***
	(-3.27)	(-3.02)
$Term_t$	0.148	0.105
	(1.29)	(0.89)
FX_t	-0.000	-0.002
	(-0.05)	(-0.39)
Observations	197	197
R-squared	0.226	0.204

Moving to our last hypothesis, we developed additional two models to see whether there is a sign of structure break in 2008 or not. Equation (6) and (7) in table (7) are similar, except for the main explanatory variable, which are the realized and forecasted inflation, respectively. The control variables are the same as the first two models. First lagged of monthly net equity mutual

fund flows, SET TRI return, and SET TRI volatility can highly capture the variation in aggregate equity mutual fund flows.

Base on the regression results in table (7), it shows that coefficient of dummy variable (CRISIS) is positive at 0.04 for both models but it is marginally significant only for equation (6) (t=2.19). The reason might link to the result in table (6) which shows that the forecasted inflation has not statistically significant on flows. This result provides support for the third hypothesis that the net equity mutual fund flows become higher in post-2008 period. However, the coefficients of interaction terms ($CRISIS\ x\ Inf_t$, and $CRISIS\ x\ E(Inf_{t+1})_t$) do not give a statistically significant number (t=-0.34 and 0.09). The relationship between dependent variable and explanatory variable does not significantly change that much between pre- and post-2008. The possible reason that we do not find a stronger degree of relationship in post-2008 is because the negative relationship between equity flows and inflation might be offset by the positive relationship between money supply and inflation from the quantity theory of money, where MV=PQ, a change in money supply (M) causes an equal change in general price level (P), ceteris paribus. However, increasing money supply (M) faster than the growth in real output (Q) can cause inflation (P) to jump up as well.

To be summed up, these results show that even though the level of net equity fund flows after 2008 might be significantly higher comparing to pre-2008, but the relationship between inflation and net equity mutual fund flow is not conditional on time. New normal inflation, or super-low inflation trend, does not change any relationship. Moreover, this result is consistent with plotted raw data of inflation rates and aggregate equity mutual fund flows which is shown is figure (2) in the data section. You can see that since 2008 onwards, there are a higher amount of fund flows into equity. However, the relationships between flows and inflation level do not change whether it is in pre- or post- 2008.

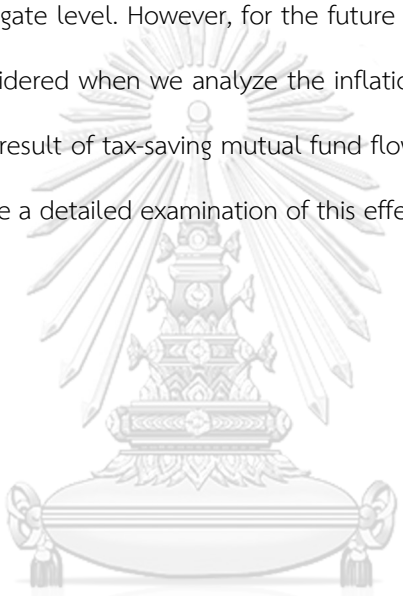
6. CONCLUSION

In this paper, we divided our research question into three main objectives. First, we use monthly data to examines the relationship between aggregate equity mutual fund flows and inflation level using evidence in Thailand. Our empirical analysis reveals that the aggregate equity mutual fund flows are negatively correlated with realized inflation. Investors will respond to low inflation by moving their asset allocation towards equity, leading to an inflow to equity mutual funds. It is also consistent with inflation illusion effect, which stated that stocked tend to be undervalued during inflationary period.

These results raise interesting questions whether the forecasted inflation also gives the consistent result with the realized inflation or not. Since mutual fund investors are forward-looking, we extend the first analysis to investigate the same relationship using forecasted inflation instead. Our forecasted inflation in our model is estimated by using ARMA(1,1) process. The result shows that it has not statistically significant on flows. The aggregate equity mutual fund flows in Thailand tends to move with the realized inflation rather than the expected inflation.

The interesting question for further exploration is whether the observed relationship between inflation rate and net equity mutual fund flows shows sign of structural break during pre- and post-2008, when QE is first introduced to the economy. Also, inflation trend in the world becomes lower since 2008. So, we divide this test into two sub-models by the main explanatory variables (realized and forecasted inflation). For the structural break of realized inflation and flows, the results suggest that since 2008 onwards, there is a significant amount of fund flows into equity mutual fund in Thailand. However, the relationship of those two does not change whether it is in pre- or post-2008. For the structural break of forecasted inflation and flows, this paper cannot detect any significant change in interception or slope in the model. One possible explanation for that is might be linked with the finding from hypothesis 2, which there is no relationship between inflation expectation and equity mutual fund flows in the first place. Therefore, there would be no additional contribution further from these two variables.

To be concluded, these results point up the need for a better understanding of the movement of equity fund flows at the macro level. Reallocation from equity funds is negatively related with actual inflation level in that period, not with the inflation expectation. We interpret these findings as being consistent with (Bodie, 1976; Fama & Schwert, 1977; Krishnamurthy et al., 2018; Lintner, 1975; Modigliani & Cohn, 1979). Also, relationship of flows and inflation level does not conditional on time. The new normal of inflation level does not impact those relationship. We present preliminary evidence that there is a negative relationship between inflation and equity mutual fund flows in aggregate level. However, for the future research, the volatility of food and fuel prices should be considered when we analyze the inflation rate as well. Also, it would be a good idea to separate the result of tax-saving mutual fund flow out of the sample of the normal mutual fund flow. We leave a detailed examination of this effect to future research.



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VITA

NAME	BOONTARIKAR DANGSRITHAM
DATE OF BIRTH	24 March 1994
PLACE OF BIRTH	Bangkok
INSTITUTIONS ATTENDED	- Bachelor of Business Administration, Major of Banking and Finance, First-Class Honors, Faculty of Commerce and Accountancy, Chulalongkorn University - Master of Science in Finance, Faculty of Commerce and Accountancy, Chulalongkorn University
HOME ADDRESS	748/190 Pruksa Village19, Bangna-Trad Road, Bangphli-Yai, Bangphli, Samutprakarn 10540