Herding Behavior ,Case of Listed Companies in Thailand

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พฤติกรรมแห่ตามกันกรณีศึกษาบริษัทจดทะเบียนในตลาดหลักทรัพย์แห่งประเทศไทย

นายปฏิพล ประวังสุข

สารนิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
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ปฏิพล ประวังสุข : พฤติกรรมแห่ตามกันกรณีศึกษาบริษัทจดทะเบียนในตลาดหลักทรัพย์แห่งประเทศไทย. (Herding Behavior ,Case of Listed Companies in Thailand) อ.ที่ปรึกษาหลัก : ผศ. ดร.นาถฤดี ศุภกิจจารักษ์

งานวิจัยนี้ได้ทำการตรวจสอบพฤติกรรมแห่ตามกันในตลาดหลักทรัพย์แห่งประเทศไทยในเงื่อนไขต่างๆอาทิเช่น ในช่วงที่ตลาดขึ้นและลง ในระดับอุตสาหกรรม และ ในแต่ประเภทของนักลงทุน นอกจากนี้เรายังตรวจสอบพฤติกรรมแห่ตามกันในช่วงที่มีการแพร่ระบาดโรคโควิด 19 และสุดท้ายเราได้พัฒนาตัวแปรด้านความเสี่ยงตัวใหม่ที่ช่วยอธิบายผลตอบแทนของหุ้น โดยผลการวิจัยพบพฤติกรรมแห่ตามกันในตลาดหลักทรัพย์แห่งประเทศไทย โดยช่วงตลาดขึ้นและลงให้ผลที่แตกต่างกัน เรายังพบพฤติกรรมแห่ตามกันใน 20 อุตสาหกรรมจากทั้งหมด 26 อุตสาหกรรม นอกจากนี้ผลการวิจัยยังระบุว่าพฤติกรรมแห่ตามกันในหุ้นขนาดเล็กมีความรุนแรงมากกว่าหุ้นขนาดใหญ่ ในช่วงที่มีการระบาดของโรคโควิด 19 พบกว่าพฤติกรรมแห่ตามกันทวีความรุนแรงขึ้น สุดท้ายตัวแปรความเสี่ยงที่เราพัฒนาขึ้นสามารถอธิบายผลตอบแทนของหุ้นได้บนโมเดลสี่ตัวแปร

สาขาวิชา การเงิน ลายมือชื่อนิสิต .....

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We examine herding behavior in the Thailand stock market under different market conditions, industries, firm sizes, and investor types. We also study herding behavior during the Covid19 period. Lastly, we further develop a new factor that is a qualified price-risk element for stock return. The results show evidence of herding behavior in the Thailand stock market during the extreme positive and negative markets condition. And the herding behavior exists in twenty sectors out of twenty-six. The small-cap portfolio shows a greater magnitude of herding behavior compares with a large-cap portfolio. During the covid19 period, the result indicates herding behavior is more severe than usual. We further suggest the new risk factor in the Carhart four-factor model.

Field of Study:	Finance	Student's Signature .....
Academic Year:	2020	Advisor's Signature .....

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Introduction

Herding behavior refers to the collective behavior of individuals in a group acting without central direction. It can occur in both animals and humans in a variety of contexts. In finance, herding refers to a proclivity of an individual or organization to follow the other's action because of their interactive observation of one another's actions (Hirshleifer and Hong, 2003). Herding behavior is a critical issue because it impacts financial market participants such as fund managers and investors by reducing the diversification benefit due to the correlated trade pattern, securities mispricing, and uncertainty in the stock market. It also decreases the effectiveness of trade regulations imposed by financial regulators, resulting in a detrimental effect on social welfare and market destabilization. If the herding is more extreme enough, it could lead to potential bubbles or a financial crisis. (Chang, Cheng, and Knorana 2000; Chiang and Zheng 2010; Tan et al. 2008).

In recent decades, Thailand's stock market has developed into one of Asia's fast-growing developing markets, drawing foreign investors looking for profitable investment likelihoods. The characteristics of emerging markets are unique and different from a mature market, with vital volatility and the potential of critical price declines (Bekaert and Harvey 1997; Patel and Sarkar 1998). These have the potential to influence the investor's behavior. They are more willing to repress their views to conform to the market's expectations during times of high uncertainty and volatility and periods of severe market decline. Moreover, according to Barkoulas and Travlos (1998), Thailand's stock exchange is inefficient and relatively risky for numerous reasons, including a low level of data disclosures, a lack of educated and well-

informed investors, illiquidity, inadequate security laws, and weak trading regulatory law obligation. Finally, over the last five years, Thailand's stock markets have been impacted by political crises and epidemics, which have increased volatility and uncertainty in the market. Herding behaviors in Thailand may occur due to these failures (Chang, Cheng, and Knorana 2000; Demirer and Kutan 2006).

Most studies of herding behavior in Thailand determine cross-sectional return dispersion as a proxy of herding. And study herding at the aggregate market level and industry level. Therefore, we extend our study to examine the evidence of herding behavior in different firm sizes and during the Covid19 epidemic. And we further integrate what we find with the Fama-French and Carhart four-factor model to develop the new risk factor.

The purpose of this study is to find whether herding behavior exists in Thailand between 2015 to 2020. We test herding in different levels such as aggregate market, sectors, and firm size. We also study the covid19 epidemic to find how the epidemic impacts herding behavior. We extend the study to investigate herding among investor types and their performance since the researchers view individual investors are behavioral-based trading and some paper suggest that foreign investors do not have information as much as domestic investors, so we investigate herding behavior among these investors and the performance. Lastly, we extend our study to develop new risk factor by subtract herding behavior and integrate with Fama-French and Carhart's (1997) four factors model to determine whether this new factor can explain the portfolio return.

Hypothesis development

Herding behavior is the behavior that investor suppresses their analysis and follow market consensus. It likely occurred during extreme market movement. And the presence of herding implies an inefficient market. Nowadays, most of the trading volume in the Thailand stock market comes from individual investors. As we mentioned before, the literature suggests that individuals are behavior-based trading, and Thailand has a low degree of information disclosure. These are all the factors that cause herding behavior. Thus, our first hypothesis is Thai investors form herding behavior. Next, Investors react differently in the different market conditions. The bull and bear market affect the market participant behavior. In the downtrend, the market is influenced by fear, and investors tend to follow the market consensus to avoid loss. These could affect herding behavior to more extreme in the bearish trend. So, the second hypothesis is herding behavior in a downward market is more significant than in an upward market. Herding may exist only at the aggregate market level but not at the sector level, and in the investor may form herding behavior in some sectors. We test this suspect in hypothesis three and hypothesis four. Next, Since the small-cap and large-cap are different in liquidity and information visibility. Moreover, Institutional investors prefer the stock with high visibility and without liquidity constraint. Furthermore, the literature suggests that institutional do herding each other (Chang, Cheng, and Khorana 2000). Thus, we develop hypothesis five to test the asymmetry of herding in different firm sizes.

Chang, Cheng, and Knorana (2000) find the herding behavior exists in times of the extreme market. Furthermore, they suggest that investors' confidence is lower

during the crisis, and herding behavior is more severe. The Covid19 epidemic is one of the events creating market stress and increasing market volatility during 2019-2020. We test the effect of the event in hypothesis six. We extend to study herding among the investor groups. As we mentioned before, the one factor that causes herding behavior is asymmetry information. Since the researcher views each investor differently in information efficiency, foreigners and institutional investors are information-based trading, and individuals are psychological biases. Thus, the trading pattern and performance should not be the same. We test these in hypothesis seven. To find which types of investors form herding and how are their performance. Lastly, we develop a new risk factor that exclude herding behavior. Since the herding behavior causes the stock mispricing and reduce diversification benefits, if herding behavior extreme enough, it could lead to a bubble and financial crisis. Thus, many reasons support herding behavior is terrible and could affect the portfolio return. So, this new factor that subtracts herding behavior could help to explain the portfolio return.

Literature Review

Many researchers study the herding behavior in the different markets around the world. Hirshleifer and Hong, 2003 define herding behavior as individuals' behavior in a group collaborating without centralized direction and may occur in animals and humans in several contexts. In finance, herding behavior is the propensity of individuals (or organizations) to imitate others' actions after observing each other's actions. The practice of herding assumes that people obey the actions of others with disregard for their private signals or prevailing market fundamentals (Erdenetsogt and Kallinterakis 2016)

Christie and Huang (1995) examine the herding behavior by using a CSSD model. They suggest that the dispersion degree of individual portfolio returns is uniquely sensitive to the market return by forecasting the increase of the absolute value of the market return. When herd behavior exists, the average cross-section standard deviation of market return decreases, as the spread between stock and market returns is not large.

Chang et al. (2000) develop the Christie and Huang (1995) methodology and use cross-sectional absolute deviation (CSAD) to measure return dispersion. They suggest that according to rational asset pricing models, the market return and return dispersion are increasing linear relation. If the herding behavior exists, this relation will be non-linear. Thus, the dispersion could be increasing or even decreasing during the presence of herding behavior. They suggest that herding behavior mainly occurs during extreme market movement. As a result, they exhibit herding in developing

markets such as Taiwan and South Korea and find no evidence of herding in the developed market such as the US market.

Some literature investigates the herding of a specific group of investors; Wermers (1999) finds evidence of herding in mutual funds and correlates with the past return; Kamesaka, Nofsinger, Kawakita 2003 investigated the trading pattern and performance of different investor types by using the Var model, and they found that foreign investors and institutional investors perform better than individual investors. Even foreign and individuals investors are momentum investors. It verified evidence consistent with information-based models (foreign investors) and behavioral-based models (individual investors). Gwangheon Hong (2011) found foreigners and institutional investors tend to drive the Korean market, and their trade is information-driven. In contrast, the opposite sides are individuals, and their performance is lower than foreigners and institutional investor

Many researchers try to explain the role of market frictions such as transaction cost, taxes, and volatility, as estimators of stock return. The fundamental reason is that a further significant number of trade frictions mean a greater level of risk, which drives investors to require a greater return. For example, Amihud and Mendelson (1986) suggest that the Bid-ask Spread significantly increases the expected return. Then, Numerous subsequent researchers elaborate on the significance of liquidity as an expected return predictor. Herding behavior disrupts investors' rational views and results in asset mispricing under rational asset pricing models. So, expected returns and risk factors are misread, causing the asset's price to differ from its equilibrium value (Hwang &Salmon, 2004).

The Carhart (1997) four-factor model suggest that the sensitivity of a portfolio's returns to four factors explains its expected return over and above the risk-free rate. These are the excess market return over the risk-free rate (R_m- R_f), the difference between the returns on a small-cap stock portfolio and a large-cap stock portfolio (SMB), and the difference between the returns on a high book-to-market-value stock portfolio and a low book-to-market-value stock portfolio (HML) (Fatma & French, 1996) and a momentum factor (WML). These variables have been included to account for anomalies that cannot be attributed to market returns.

Data

Christie and Huang (1995) suggest that herding behavior usually occurs in the short term and can be captured with high-frequency data. And according to Tan et al. (2008), who analyze herding behavior in the Chinese stock market suggest that the level of herding becomes more visible with daily data than other longer time horizons. Thus, we will use the daily stock return to examine herding behavior in the Thailand equity market.

We collect data on stock prices and market capitalization for listed firms on the SET from the DataStream from January 01, 2015 to December 31, 2020. Furthermore, we collect the trading value of four investor types (Local Institutions, Proprietary Trading, Foreign Investors, Local Individuals) from SET SMART.

Methodology

Herding behavior in SET index (H1)

We adopt Chang et al. (2000), utilizing a cross-sectional absolute deviation return dispersion model to detect the herding behavior. According to the asset pricing model, the absolute market return and return dispersion are a linear combination. Thus, when the absolute market return increase, the return dispersion increase. However, when the market participants form herding behavior, the absolute market return and return dispersion correlation will be non-linear. The cross-sectional return dispersion (RD) measure as follows:

$$RD_t = \frac{\sum_{i=}^{n} |R_{i,t} - R_{m,t}|}{n} \quad (1)$$

$$RD_t = \alpha_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \varepsilon_t \quad (2)$$

Where R_i is the logarithm daily return on the stock of individual firm i at time t which determine as $R_i = \ln\left(\frac{P_t}{P_{t-1}}\right) \times 100$, P_t , P_{t-1} is the stock price and $R_{m,t}$is market portfolio return at time t

Chang et al. (2000) suggest that, under the capital asset pricing model (CAPM) assumptions, the RD of individual stock returns and market returns should be linear. Conversely, suppose there is evidence of a non-linear relationship between the RD, and market returns or the coefficient β_2 is significantly negative. In that case, this implies evidence of herding behavior. It also means that if stock market returns are extreme, the cross-sectional absolute deviation can decrease or increase at a

decreasing rate. Additionally, positive β_2 indicates that as market returns increase, RD increases as well, indicating the absence of herding in financial markets.

$H_0: \beta_2 = 0$ There is no herding behavior in SET.

$H_1: \beta_2 < 0$ There is herding behavior in SET.

Herding behavior during different market condition (H2)

Numerous empirical studies demonstrate unsymmetrical return behavior (Ball and Korthari, 1989; Conrad and Nonallergen, 1991; Bekeart and Wu, 2000), and according to Chang, Cheng, and Knorana (2000), Market return direction may affect investors' behavior. When the market is bearish, the dip effect is more pronounce since investors will seek to follow the market consensus to avoid the displeasure of losing. Investigating the relationship between up days and down days would be worth doing. We test these hypotheses by the following using the regression equation.

$$RD_t = \alpha_0 + \beta_1(1-D)\left|R_{m,t}^{Down}\right| + \beta_2(D)\left|R_{m,t}^{UP}\right| + \beta_3(1-D){R_{m,t}^{Down}}^2 + \beta_4 D{R_{m,t}^{UP}}^2 + \varepsilon_t \quad (3)$$

Where D=0 when the market goes down Rm <0 and D=1 when the market goes up Rm>=0 The negative β_3 and $\beta_4$imply the presence of herding behavior and the coefficient hypothesis test to see whether up and down-market condition, herding are significantly different.

$H_0: \beta_3 - \beta_4 \leq 0$ Herding with the downward market condition is greater.

$H_1: \beta_3 - \beta_4 > 0$ Herding with the upward market condition is greater.

Rm <0 D=0; $$RD_t = \alpha_0 + \beta_1 \left|R_{m,t}^{Down}\right| + \beta_3 R_{m,t}^{Down^2} + \varepsilon_t \quad (4)$$

$H_0: \beta_3 = 0$ There is no herding behavior in SET when the market decrease.

$H_1: \beta_3 < 0$ There is herding behavior in SET when the market decrease.

Rm >0 D=1; $$RD_t = \alpha_0 + \beta_2 \left|R_{m,t}^{UP}\right| + \beta_4 R_{m,t}^{UP^2} + \varepsilon_t \quad (5)$$

$H_0: \beta_4 = 0$ There is no herding behavior in SET when the market increase.

$H_1: \beta_4 < 0$ There is herding behavior in SET when the market increase.

Herding of sector portfolio towards the market (H3)

We also study herding behavior at the sector level. To find whether herding exists between the 26 sectors portfolio and the market portfolio, we calculate the logarithm daily return on the 26 sectors portfolio and calculate cross-sectional return dispersion as equation (1). We run the regression as equation below. The significant negative implies a non-linear relationship between the RD, and sector portfolio return during rising and decreasing market; this could be evidence of herding behavior.

$$RD_t = \alpha_0 + \beta_1(1-D)\left|R_{m,t}^{Down}\right| + \beta_2(D)\left|R_{m,t}^{UP}\right| + \beta_3(1-D)R_{m,t}^{Down^2} + \beta_4 D R_{m,t}^{UP^2} + \varepsilon_t \quad (6)$$

$H_0: \beta_3 - \beta_4 \leq 0$ Herding with the downward market condition is greater.

$H_1: \beta_3 - \beta_4 > 0$ Herding with the upward market condition is greater.

If $R_m < 0$ D=0; $$RD_t = \alpha_0 + \beta_1 \left|R_{m,t}^{Down}\right| + \beta_3 R_{m,t}^{Down^2} + \varepsilon_t \quad (7)$$

$H_0 : \beta_3 = 0$ There is no herding behavior in sectors portfolio when the market decrease.

$H_1 : \beta_3 < 0$ There is herding behavior in sectors portfolio when the market decrease.

If Rm > 0 D=1; $$RD_t = \alpha_0 + \beta_2 \left|R_{m,t}^{UP}\right| + \beta_4 R_{m,t}^{UP\ 2} + \varepsilon_t \quad (8)$$

$H_0 : \beta_4 = 0$ There is no herding behavior in sectors portfolio when the market increase.

$H_1 : \beta_4 < 0$ There is herding behavior in sectors portfolio when the market increase.

Herding of firms with sectors portfolio (H4)

We do a deeper analysis of the sector level. To find which sector that herding activity exists, we calculate the daily 26 sector's portfolio return and the cross-sectional return dispersion. Then, we run the regression as equation below. If there is evidence of a non-linear relationship between the CSAD and stock in the sector portfolio, this implies herding behavior.

$$RD_t = \alpha_0 + \beta_1(1-D)\left|R_{s,t}^{Down}\right| + \beta_2(D)\left|R_{s,t}^{UP}\right| + \beta_3(1-D)R_{s,t}^{Down^2} + \beta_4 D R_{s,t}^{UP^2} + \varepsilon_t \quad (9)$$

Where R_{in} is a daily return of the aggregate sector portfolio and dummy (D) equal to 1 when R_{in} greater than 0 and zero otherwise.

The negative β_3 and β_4 imply herding behavior, and the coefficient hypothesis test to see whether up and down-market condition, herding is significantly different. If we can reject the null hypothesis, it implies herding during the upward market is more severe. On the other hand, if we cannot reject the null hypothesis, herding in the bear market condition is greater.

H_0: $\beta_3 - \beta_4 \leq 0$ Herding with the downward market condition is greater.

H_1: $\beta_3 - \beta_4 > 0$ Herding with the upward market condition is greater.

If R_{in} <0 D=0; $$RD_t = \alpha_0 + \beta_1 \left| R_{s,t}^{Down} \right| + \beta_3 R_{s,t}^{Down^2} + \varepsilon_t \quad (10)$$

H_0 : $\beta_3 = 0$ There is no herding behavior in sectors portfolio when the market decrease.

H_1: $\beta_3 < 0$ There is herding behavior in sectors portfolio when the market decrease.

If R_{in} >0 D=1; $$RD_t = \alpha_0 + \beta_2 \left| R_{s,t}^{UP} \right| + \beta_4 R_{s,t}^{UP^2} + \varepsilon_t \quad (11)$$

H_0 : $\beta_4 = 0$ There is no herding behavior in sectors portfolio when the market increase.

H1 : $\beta_4 < 0$ There is herding behavior in sectors portfolio when the market increase.

Size-based portfolio tests (H5)

According to Chang, Cheng, and Khorana (2000), Institutional investors are well-known for forming herding behavior, and Falkenstein (1996) suggests that mutual funds strongly prefer high visibility stocks. While small and large firms differ significantly based on visibility; thus, we expect that herding behavior will differ among small and large firms. Then, we group the stocks in SET as small to large firms based on capitalization at the end of the year before the measure year. Each year, we reconstructed the portfolio to reflect any changes in individual stocks' market capitalization in the aggregate portfolio. We define the 20 percentiles as a small firm's portfolio and the 80 percentiles as a large firm's portfolio.

$$RD_t = \alpha_0 + \beta_1(1-D)\left|R_{m,t}^{Down}\right| + \beta_2(D)\left|R_{m,t}^{UP}\right| + \beta_3(1-D){R_{m,t}^{Down}}^2 + \beta_4 D{R_{m,t}^{UP}}^2 + \varepsilon_t \quad (12)$$

The negative β_3 and β_4 indicate herding behavior, and the coefficient hypothesis test to see whether up and down-market condition, herding is significantly different. If we can reject the null hypothesis, it implies herding during the upward market is more severe. On the other hand, if we cannot reject the null hypothesis, herding in the bear market condition is greater.

H_0: $\beta_3 - \beta_4 \leq 0$ Herding with the downward market condition is greater.

H_1: $\beta_3 - \beta_4 > 0$ Herding with the upward market condition is greater.

Rm <0 D=0; $$RD_t = \alpha_0 + \beta_1 \left|R_{m,t}^{Down}\right| + \beta_3 R_{m,t}^{Down^2} + \varepsilon_t \quad (13)$$

$H_0 : \beta_3 = 0$ There is no herding behavior in size portfolio when the market decrease.

$H_1 : \beta_3 < 0$ There is herding behavior in size portfolio when the market decrease.

Rm >0 D=1; $$RD_t = \alpha_0 + \beta_2 \left|R_{m,t}^{UP}\right| + \beta_4 R_{m,t}^{UP^2} + \varepsilon_t \quad (14)$$

$H_0 : \beta_4 = 0$ There is no herding behavior in size portfolio when the market increase.

$H_1 : \beta_4 < 0$ There is herding behavior in size portfolio when the market increase

Herding behavior during the crisis period (H6)

Herding behavior has historically been more prevalent in times of extreme returns, which are periods of heightened market stress (Christie and Huang 1995; Chang, Cheng, and Knorana 2000). Recent evidence shows that market declines correspond with crises. Market volatility during the crisis reduces investors' confidence to a deficient level. Thus, the more outstanding herding behavior should appear during the crisis. The Covid19 epidemic is one of the events creating market stress and increasing market volatility during 2019-2020. We define the crisis dummy (CD) for the covid19 period to capture the epidemic's impact.

$$RD_t = \alpha_0 + \beta_1(1-D)\left|R_{m,t}^{Down}\right| + \beta_2(D)\left|R_{m,t}^{UP}\right| + \beta_3(1-D)R_{m,t}^{Down^2} + \beta_4 D R_{m,t}^{UP^2} + \beta_5(CD)\left|R_{m,t}^{Down}\right| + \beta_6(CD)\left|R_{m,t}^{UP}\right| + \beta_7(CD)R_{m,t}^{Down^2} + \beta_8(CD)R_{m,t}^{UP^2} + \varepsilon_t \quad (15)$$

IF Rm <0 D=0; $RD_t = \alpha_0 + \beta_1 \left|R_{m,t}^{Down}\right| + \beta_3 R_{m,t}^{Down^2} + \beta_5 (CD) \left|R_{m,t}^{Down}\right| +$

$\beta_7 CD * R_{m,t}^{Down^2} + \varepsilon_t$ (16)

$H_0 : \beta_5 = 0$ Covid19 does not affect herding behavior during decreasing market

$H_1 : \beta_5 < 0$ Covid19 affect herding behavior during decreasing market

IF Rm >0 D=1; $RD_t = \alpha_0 + \beta_2 \left|R_{m,t}^{UP}\right| + \beta_4 R_{m,t}^{UP^2} + \beta_6 (CD) \left|R_{m,t}^{UP}\right| +$

$\beta_8 CD * R_{m,t}^{UP^2} + \varepsilon_t$ (17)

$H_0 : \beta_6 = 0$ Covid19 does not affect herding behavior during rising market

$H_1 : \beta_6 < 0$ Covid19 affect herding behavior during rising market

Herding among investor types and their performance (H7)

Since the researchers view individual investors are behavioral-based trading and some literature suggest that foreign investors do not have information as much as domestic investors, so we expect to see herding behavior from these investors and expect the performance is underperform informed investors. To examine herding between investor types, we adopt Gwangheon Hong's (2011) 's method using buy and sell value from SET SMART period 2015-2020 calculate the NET investment flow of each investor (NIF) and do VAR analysis.

$$\text{NIF} = \frac{\text{Buying Value} - \text{Selling Value}}{\text{Buy Value} + \text{Sell Value}} \quad (18)$$

NIF will be positive when the buy value is greater than sell value. And negative when the buy value less than sell value. Then, we do VAR analysis as equation below.

$$\text{NIF}_{J_t} = \alpha + \sum_{i=1}^{p} \beta_i \, R_{m,T-i} + \sum_{i=1}^{p} \beta_{1j} \, \text{NIF}_{ID_{t-i}} + \sum_{i=1}^{p} \beta_{2j} \text{NIF\_F}_{t-i} +$$

$$\sum_{i=1}^{p} \beta_{3j} \, \text{NIF\_IT}_{t-i} + \sum_{i=1}^{p} \beta_{4j} \, \text{NIF\_P}_{t-i} + \varepsilon_{i,t} \quad (19)$$

Where $R_{m,t-i}$ is daily SET index return at time t-i ,

NIF_J can be net inflow of any investors. (NIF_ID, NIF_F, NIF_IT or NIF_P)

NIF_ID_{t-i} is net inflow of individual investors at time t-i

NIF_F_{T-i} is net inflow of foreign investors at time t-i

NIF_IT_{t-i} is net inflow of institutional investors at time t-i

NIF_P_{t-i} is net inflow Proprietary investor at time t-i

H_0; lagged coefficients are all zero

H_1; lagged coefficients are all zero

Implication

β_i is a feedback trading, It implies the investor trading pattern. If the coefficient β_i is positive mean this investor are momentum trading while β_i is negative for contrarian investing We group herding detection into two groups which are self-herding and herding among investors.The positive coefficient $\beta_1, \beta_2, \beta_3$ and β_4 indicate herding behavior.

Performance of each investor type

We adopt Kamesaka (2003) method to present each investor types of cumulative return in the period 2015-2020.

$$\text{Cumulative Return} = \sum_{t=1}^{T}(Buy_{i,t-1} - Sell_{i,t-1}) \text{ x } R_{m,t} \quad (20)$$

Herding behavior and augmented four-factors Fama French model (H8)

Under the rational asset pricing models, herding disturbed investors' rational beliefs, and mispricing the assets (Hwang &Salmon, 2004). Herding also reduces the benefit of diversification due to the investors act in the same way. If herding behavior extreme enough, it could lead to a bubble and financial crisis. Thus, many reasons support herding behavior is terrible and could affect the portfolio return. Since the CSAD is a proxy of herding behavior, the error term is a part of CSAD that has no relation with the market return. Thus, we use the error term as a new risk factor that excludes herding behavior and integrate with the four-factors model by Fama-French and Carhart (1997) to find whether this new factor can explain the return.

$$R_{p,t} = \propto + \beta_1 RMRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \beta_5 NRF_t + e_t \quad (21)$$

Rp,t is the return on large and small portfolios at time t, RMRF is an excess return of the market portfolio, SMB is a return of small firms minus large firms' portfolios at time t. HML is a value stock factor, the spread of value and growth stock at time t. MOM is a momentum factor that spreads between winner stocks and loser stock in the portfolio. NRF is the new risk factor which is the error term obtained from the CSAD equation model.

Empirical Result

We calculate CSAD and apply the CSAD return dispersion model to test hypotheses 1- 6 to investigate the herding behavior in the Thailand stock exchange market. By definition, when individual stock returns move in perfect with the market portfolio, the CSAD equal to zero. Whereas when the stock return deviates from the market returns the CASD increase.

Table 1 exhibits the descriptive statistics of returns dispersions and market returns for the Thailand stock exchange market. The average daily return is -0.032%. The highest and lowest return are 5.953 % and -9.678 %, respectively.

Table 1Descriptive statistics of CSAD.
The table shows the descriptive statistics for equally weighted market portfolio returns.

	Average	Max	Min	Std
Daily Return	-0.032	5.953	-9.678	0.832
CSAD	1.490	5.060	0.839	0.422

1. Herding behavior in Thailand stock market

We use equation (2) to test the first hypothesis. A statistically significant negative coefficient β_2 means the presence of herding behavior in the Thai equity market, And β_1 is positive, implying that the return dispersion $CSAD_t$ and $|R_{m,t}|$ have a linear relationship.

As shown in Table 2, the estimates of β_2 are -0.01166 and the empirical evidence does reject the null hypothesis, implying that the Thailand stock market exhibits

significant herding behavior. Furthermore, β_1 are positive and significant. Thus, There is a significant positive linear relationship between $CSAD_t$ and $|R_{m,t}|$. Additionally, it demonstrates that the combined herding effect and linear relationship between $CSAD_t$ and |Rm, t| explain 49.51% of the variation in $CSAD_t$.

Table 2 Estimates of herding behavior in the sample stock market (Full sample).

The table presents the coefficient estimate of equation (2): $RD_t = \alpha_0 + \beta_1|R_{m,t}| + \beta_2 R_{m,t}^2 + \varepsilon_t$ where RD_tindicate the measure of CSAD for equal weight market portfolio. $|R_{m,t}|$ is a daily absolute equal weight market return and $R_{m,t}^2$ a square of daily equal weight market return.

Market	Constant	$\lvert R_{m,t}\rvert$	$R_{m,t}^2$	Adj. R^2
SET	1.2357***	0.50779***	-0.01166**	0.4951
	(102.6)	(23.11)	(-2.89)	

***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

2. Herding behavior during up and down market

Table 3 display the empirical results of herding activities when the market experiences an extreme movement. It shows β_3 is negative and statistically significant during a declining market, thereby implying there is herding behavior with the downward market condition. Whereas, in the bull market we find insignificantly negative β_4, Furthermore, for the coefficient testing, we find the P-Value is 0.4639, then we fail to reject the null hypothesis $H_0 : \beta_3 - \beta_4 \leq 0$, so herding in a bear market is greater than a bull market.

Table 3 Estimate of herding behavior under upward and downward market conditions.

Regression estimates under baseline equation (3):

$RD_t = \alpha_0 + \beta_1(1-D)\left|R_{m,t}^{Down}\right| + \beta_2(D)\left|R_{m,t}^{UP}\right| + \beta_3(1-D){R_{m,t}^{Down}}^2 + \beta_4 D{R_{m,t}^{UP}}^2 + \varepsilon_t$ In the equation, RD_t indicate the measure of CSAD for equal weight market portfolio. $\left|R_{m,t}\right|$ is a daily absolute equal weight market return and $R_{m,t}^2$ a square of daily equal weight market return. The model is specified as $RD_t = \alpha_0 + \beta_1\left|R_{m,t}^{Down}\right| + \beta_3{R_{m,t}^{Down}}^2 + \varepsilon_t$ if $R_{m,t} < 0$ and $RD_t = \alpha_0 + \beta_2\left|R_{m,t}^{UP}\right| + \beta_4{R_{m,t}^{UP}}^2 + \varepsilon_t$ if $R_{m,t} > 0$.

$***$, $**$, and $*$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Constant	$\left\|R_{m,t}\right\|_{down}$	$\left\|R_{m,t}\right\|_{up}$	${R^2_{m,t}}_{down}$	${R^2_{m,t}}_{up}$	Adj. R^2	p-value of F-test
1.2351***	0.4917***	0.5243***	-0.0099**	-0.00903	0.4944	0.46
(98.93)	(20.55)	(15.80)	(-2.37)	(-0.87)		

3. Herding of sector portfolio toward market portfolio|

Table 4 exhibits the estimates of β_3 and β_4 are significantly negative at the 1% and 5% levels, respectively. These imply that there is significant herding behavior in sector portfolios during increasing and decreasing market conditions. And the null hypothesis of $\beta_3 - \beta_4 \leq 0$ cannot be rejected, thus herding is more prevailing in rapidly decreasing market conditions.

Table 4 Sector portfolio toward market portfolio

This table reports the estimate result from equation(6): $RD_t = \alpha_0 + \beta_1(1-D)\left|R_{m,t}^{Down}\right| + \beta_2(D)\left|R_{m,t}^{UP}\right| + \beta_3(1-D){R_{m,t}^{Down}}^2 + \beta_4 D{R_{m,t}^{UP}}^2 + \varepsilon_t$In the equation, RD_t indicate the measure of CSAD for equal weight sector portfolio. $\left|R_{m,t}\right|$ is a daily absolute equal weight market return and $R_{m,t}^2$ a square of daily equal weight market return. The model is specified as $RD_t = \alpha_0 + \beta_1\left|R_{m,t}^{Down}\right| + \beta_3{R_{m,t}^{Down}}^2 + \varepsilon_t$ if $R_{m,t} < 0$ and $RD_t = \alpha_0 + \beta_2\left|R_{m,t}^{UP}\right| + \beta_4{R_{m,t}^{UP}}^2 + \varepsilon_t$ if $R_{m,t} > 0$. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Constant	$\left\|R_{m,t}\right\|_{down}$	$\left\|R_{m,t}\right\|_{up}$	$R_{m,t_{down}}^2$	$R_{m,t_{up}}^2$	Adj. R^2	p-value of F-test
0.464***	0.241***	0.274***	-0.011*	-0.0062**	0.356	0.78
(59.17)	(15.54)	(16.40)	(-1.76)	(-2.14)		

4. Herding behavior in 26 sectors

We find herding behavior in 20 sectors which are Automotive, Banking, Electronic Components, Health Care Services, Home & Office Products, Industrial Materials & Machinery, Tourism & Leisure, Transport & Logistics, Construction Materials, Consumer Products, Energy & Utilities, Fashion, Financials, Food & Beverage, Info. & Communication, Insurance, Media & Publishing, Property Fund& REITs, Property Development, Steel. And we find no evidence of herding in 6 sectors: Agribusiness, Commerce, Personal Products & Pharmaceutical, Petrochemicals & Chemicals, Packaging, Professional Services. The result is consistent with our expectations, especially herding in financials and Property Development, which are the cause of the financial crisis in the year 1997. And some sectors which experience high uncertainty, such as the Tourism sector, get the direct impact from the Covid19—furthermore, sectors like Steel and Energy, which the earning involves with the commodity price. On the other hand, we do not expect to see herding in commerce sectors because this sector is popular among informed

investors such as mutual fund and value investors. Furthermore, we are surprised by finding no herding behavior in Petrochemicals & Chemicals because the earning of this sector is volatile due to the product spread price.

Table 5 reports the coefficients of β3 and β4 in different sectors. Coefficients of β3 for across sectors are significant negative, indicating that dispersion in these sectors during downward market movements is low and investors follow other investors instead of their own investment decisions. These sectors include Construction Materials, Energy & Utilities, Electronic Components, Financials, Food & Beverage, Health Care Services, Home & Office Products, Info. & Communication, Industrial Materials & Machinery, Insurance, Property Fund& REITs, Property Development, Tourism & Leisure, and Transport & Logistics.

The sectors have significant negative coefficient of β4 are Automotive, Banking, Construction Materials, Consumer Products, Electronic Components, Fashion, Financials, Health Care Services, Home & Office Products, Insurance, Property Fund& REITs, Steel, Tourism & Leisure, and Transport & Logistics. The coefficient imply the exist of herding behavior during upward market condition.

To see asymmetry, we do the F-test for the sectors having significant negative β3 or β4. The F-test reject null hypothesis for Automotive, Banking, Electronic Components, Health Care Services, Home & Office Products, Industrial Materials & Machinery, Tourism &Leisure, and Transport & Logistics which imply herding during upward market condition is more severe for these sectors, Whereas the F-test cannot reject the hypothesis for Construction Materials, Consumer Products, Energy & Utilities, Fashion, Financials, Food & Beverage, Info. & Communication,

Insurance, Media & Publishing, Property Fund& REITs, Property Development and Steel which imply herding behavior during bull market condition is more severe for these sectors. On the other hand, if the coefficients of β_3 and β_4 are positive indicating higher dispersion and the sector do not form herds. From the table 4 Agribusiness, Automotive, Commerce, Consumer Products, Home & Office Products, Info. & Communication, Insurance, Media & Publishing, Personal Products & Pharmaceutical, Property Fund & REITs, Packaging, Professional Services, the coefficients β_3 of these sectors are positive, thus the investors do not form herd in these sectors during the decreasing market. For the coefficient β_4, Agribusiness, Commerce, Home & Office Products, Info. & Communication, Industrial Materials & Machinery, Insurance, Personal Products & Pharmaceutical, Petrochemicals & Chemicals, Packaging, Professional Services have positive β_4, so investors do not form herds during the bull market in these sectors.

To summarize, investor do herds only rising market condition in Automotive, Banking, Consumer Products, Fashion, Steel and Media & Publishing. And they do herds only downward market in Food & Beverage, Tourism & Leisure, Energy & Utilities, Info. & Communication, Industrial Materials & Machinery. Whereas the sectors that found herding in both market condition are Construction Materials, Electronic Components, Financials, Health Care Services, Home & Office Products, Insurance, Property Fund& REITs, Property Development, Transport & Logistics. Lastly, there are no evidence of herding behavior for Agribusiness, Commerce, Personal Products & Pharmaceutical, Petrochemicals & Chemicals, Packaging, Professional Services

Table 5 Herding behavior in 26 sectors

Regression estimates from the equation(9): $RD_t = \alpha_0 + \beta_1(1-D)\left|R_{s,t}^{Down}\right| + \beta_2(D)\left|R_{s,t}^{UP}\right| + \beta_3(1-D)R_{s,t}^{Down^2} + \beta_4 D R_{s,t}^{UP^2} + \varepsilon_t$ In the equation, RD_t indicates the measure of CSAD for each equal weight sector portfolios. $\left|R_{s,t}\right|$ is a daily absolute equal weight sector portfolio return and $R_{m,t}^2$ a square of daily equal weight sector portfolio return. The model is specified as $RD_t = \alpha_0 + \beta_1\left|R_{s,t}^{Down}\right| + \beta_3 R_{s,t}^{Down^2} + \varepsilon_t$ if $R_{s,t} < 0$ and $RD_t = \alpha_0 + \beta_2\left|R_{s,t}^{UP}\right| + \beta_4 R_{s,t}^{UP^2} + \varepsilon_t$ if $R_{s,t} > 0$. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Sector	Constant	$\left\|R_{s,t}^{Down}\right\|$	$\left\|R_{s,t}^{UP}\right\|$	$R_{s,t}^{Down^2}$	$R_{s,t}^{UP^2}$	Adj. R^2	P-value of F-test
Agribusiness	0.1555***	0.6812***	0.7365***	0.0239***	0.0061**	0.9103	0.0000***
	(14.35)	(37.68)	(46.61)	(5.69)	(2.26)		
Automotive	1.061***	0.2581***	0.7459***	0.0962***	-0.0263*	0.5301	0.0000***
	(45.94)	(6.84)	(15.50)	(14.53)	(-1.74)		
Banking	0.7071***	0.2267***	0.3430***	-0.0026	-0.0127***	0.2731	0.0242**
	(45.85)	(10.29)	(13.73)	(-0.93)	(-2.63)		
Commerce	1.2519***	0.2611***	0.0637**	0.00826**	0.1378***	0.7016	1.0000
	(63.95)	(9.33)	(2.20)	(2.02)	(34.85)		
Construction Materials	1.0578***	0.3738***	0.7035***	-0.0078*	-0.0478***	0.341	0.9998
	(52.39)	(12.70)	(18.01)	(-1.66)	(-4.46)		
Consumer Products	1.1901***	0.2587***	0.44817***	0.00222	-0.0192**	0.2858	0.9949
	(53.92)	(10.98)	(12.98)	(0.78)	(-2.31)		
Energy & Utilities	1.0642***	0.4225***	0.40279***	-0.0073*	-0.00057	0.3666	0.2320
	(59.64)	(15.77)	(11.59)	(-1.92)	(-0.06)		
Electronic Components	1.070***	0.8387***	1.097***	-0.0199*	-0.074***	0.4358	0.0002***
	(24.21)	(15.36)	(18.50)	(-1.94)	(-5.47)		
Fashion	1.1482***	0.8430***	1.0969***	-0.01295	-0.0447*	0.4401	0.1089
	(35.43)	(15.74)	(15.37)	(-1.10)	(-1.77)		
Financials	1.039***	0.510***	0.6212***	-0.0121***	-0.0232**	0.432	0.8725
	(54.95)	(18.58)	(16.91)	(-3.13)	(-2.39)		

Table5 Herding behavior in 26 sectors

Regression estimates from the equation(9): $RD_t = \alpha_0 + \beta_1(1-D)\left|R_{s,t}^{Down}\right| + \beta_2(D)\left|R_{s,t}^{UP}\right| + \beta_3(1-D)R_{s,t}^{Down^2} + \beta_4 D R_{s,t}^{UP^2} + \varepsilon_t$ In the equation, RD_t indicates the measure of CSAD for each equal weight sector portfolios. $\left|R_{s,t}\right|$ is a daily absolute equal weight sector portfolio return and $R_{m,t}^2$ a square of daily equal weight sector portfolio return. The model is specified as $RD_t = \alpha_0 + \beta_1\left|R_{s,t}^{Down}\right| + \beta_3 R_{s,t}^{Down^2} + \varepsilon_t$ if $R_{s,t} < 0$ and $RD_t = \alpha_0 + \beta_2\left|R_{s,t}^{UP}\right| + \beta_4 R_{s,t}^{UP^2} + \varepsilon_t$ if $R_{s,t} > 0$. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Sector	Constant	$\left\|R_{s,t}^{Down}\right\|$	$\left\|R_{s,t}^{UP}\right\|$	$R_{s,t}^{Down^2}$	$R_{s,t}^{UP^2}$	Adj. R^2	P-value of F-test
Food & Beverage	1.0668***	0.4634	0.5732	-0.00985*	-0.0166	0.375	0.6577
	(65.10)	(15.59)	(13.68)	(-1.74)	(-0.99)		
Health Care Services	0.7574***	0.5299***	0.7074***	-0.0210***	-0.0502***	0.4223	0.0145**
	(47.95)	(16.67)	(19.21)	(-2.90)	(-4.03)		
Home & Office Products	1.0373***	0.7807***	1.0383***	-0.025**	-0.0660***	0.4091	0.0092***
	(30.10)	(14.71)	(17.65)	(-2.23)	(-4.19)		
Info. & Communication	1.2084***	0.4670***	0.5091***	-0.016**	0.0522***	0.3524	0.9999
	(48.16)	(11.91)	(10.67)	(-2.15)	(3.93)		
Industrial Materials & Machinery	1.0871***	0.537***	0.6181***	-0.0190**	0.0454***	0.769	0.0000***
	(34.91)	(11.45)	(18.61)	(-2.04)	(26.44)		
Insurance	0.7761***	0.913***	1.081***	-0.0769***	-0.0602***	0.4718	0.1941
	(32.47)	(19.53)	(19.44)	(-6.61)	(-3.39)		
Media & Publishing	1.3724***	0.454***	0.6211***	0.0034	-0.0123	0.3612	0.9082
	(60.22)	(11.77)	(14.76)	(0.42)	(-1.20)		
Personal Products & Pharmaceutical	0.7371***	0.7112***	0.5934***	0.0344***	0.0850***	0.7897	0.0000***
	(21.83)	(22.38)	(12.21)	(20.55)	(12.12)		
Petrochemicals & Chemicals	0.904***	0.7097***	0.6748***	-0.0056	0.0431***	0.8521	0.0000***
	(38.36)	(16.82)	(19.89)	(-0.67)	(28.59)		

Table 5 Herding behavior in different sectors

Regression estimates from the equation(9): $RD_t = \alpha_0 + \beta_1(1-D)\left|R_{s,t}^{Down}\right| + \beta_2(D)\left|R_{s,t}^{UP}\right| + \beta_3(1-D)R_{s,t}^{Down^2} + \beta_4 D R_{s,t}^{UP^2} + \varepsilon_t$ In the equation, RD_t indicates the measure of CSAD for each equal weight sector portfolios. $\left|R_{s,t}\right|$ is a daily absolute equal weight sector portfolio return and $R_{m,t}^2$ a square of daily equal weight sector portfolio return. The model is specified as $RD_t = \alpha_0 + \beta_1\left|R_{s,t}^{Down}\right| + \beta_3 R_{s,t}^{Down^2} + \varepsilon_t$ if $R_{s,t} < 0$ and $RD_t = \alpha_0 + \beta_2\left|R_{s,t}^{UP}\right| + \beta_4 R_{s,t}^{UP^2} + \varepsilon_t$ if $R_{s,t} > 0$. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Sector	Constant	$\left\|R_{s,t}^{Down}\right\|$	$\left\|R_{s,t}^{UP}\right\|$	$R_{s,t}^{Down^2}$	$R_{s,t}^{UP^2}$	Adj. R^2	P-value of F-test
Property Fund & REITs	0.6459*** (56.45)	0.9598*** (25.53)	1.0455*** (19.43)	-0.0754*** (-8.67)	-0.1028*** (-3.29)	0.5085	0.1884
Packaging	0.1071*** (17.88)	1.4967*** (43.77)	1.5593*** (52.40)	0.11292*** (6.37)	0.0752*** (6.96)	0.9393	0.0246**
Professional Services	0.8215*** (16.36)	0.2379*** (5.07)	0.3738*** (8.26)	0.0210*** (3.59)	0.0186*** (3.59)	0.3422	0.6372
Property Development	1.2309*** (44.97)	0.6392*** (16.60)	0.7893*** (13.67)	-0.0266*** (-4.69)	-0.0584** (-3.15)	0.3353	0.9584
Steel	0.9606*** (21.43)	1.1733*** (19.42)	1.4568*** (20.27)	-0.0161 (-1.30)	-0.0736*** (-4.16)	0.6251	0.9984
Tourism & Leisure	0.9567*** (33.33)	0.6569*** (14.02)	0.7617*** (13.49)	-0.0299*** (-2.90)	-0.0025 (-0.15)	0.3887	0.065*
Transport & Logistics	1.1638*** (46.88)	0.4909*** (14.55)	0.6812*** (17.57)	-0.0247*** (-4.75)	-0.0519*** (-5.93)	0.3065	0.0015***

5. Size-based portfolio tests

Table 6 reports the estimation for large firms and small firms' regression. We see evidence supporting herding while the market declines in small company portfolios and the F-test cannot reject the null hypothesis that. The result implies that herding is more significant in the bull market conditions. On the other hand, for large firms, we find insignificant negative = -0.0019, and the F-test rejects the null hypothesis. These results support the lack of herding in the big-cap stock portfolio and consistent with Chang 2000, which also finds that small stock portfolios would further substantiate their evidence in favor of herding in the emerging financial markets.

Table 6 Controlling for firm size

The table shows the estimate result from the equation(12):$RD_t = \alpha_0 + \beta_1(1-D)\left|R_{m,t}^{Down}\right| + \beta_2(D)\left|R_{m,t}^{UP}\right| + \beta_3(1-D){R_{m,t}^{Down}}^2 + \beta_4 D{R_{m,t}^{UP}}^2 + \varepsilon_t$ In the baseline equation, RD_t indicate the measure of CSAD for equal weight size portfolio. $\left|R_{m,t}\right|$ is a daily absolute equal size port return and $R_{m,t}^2$ a square of daily equal weight size port return. The model is specified as $RD_t = \alpha_0 + \beta_1\left|R_{m,t}^{Down}\right| + \beta_3{R_{m,t}^{Down}}^2 + \varepsilon_t$ if $R_{m,t} < 0$ and $RD_t = \alpha_0 + \beta_2\left|R_{m,t}^{UP}\right| + \beta_4{R_{m,t}^{UP}}^2 + \varepsilon_t$ if $R_{m,t} > 0$. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Constant	$\left\|R_{m,t}\right\|_{down}$	$\left\|R_{m,t}\right\|_{up}$	$R^2_{m,t_{down}}$	$R^2_{m,t_{up}}$	Adj. R^2	P-value of F-test
Small	1.55***	0.663***	0.8454***	-0.024***	-0.046**	0.31	0.1267
	(58.80)	(13.81)	(14.10)	(-2.59)	(-2.47)		
Large	1.01***	0.3***	0.338	-0.0019	0.008	0.46	0.0373**
	(90.47)	(16.39)	(14.71)	(-0.84)	(1.45)		

6. Herding behavior and Covid19

Table 7 report the empirical results for the herding behavior during the Covid19. The coefficient β_3 and β_4 are significantly -0.0188 and insignificantly -0.0126, respectively. For the coefficient of covid19 dummy β_5 and $\beta_6$are significantly -0.00065 and -0.0478 which shows that with downward market condition during crisis period the effect on CSAD is (-0.0188-0.00065) = -0.01945 whereas, rising market condition (-0.0126-0.0478) = -0.0604 and both are significant at 1% level. The results imply that during the epidemic, the investors in Thailand are more likely to herd. These are consistent with the finding of Khan et al. (2011) and Economou et al. (2011) that suggest herding is more severe during a crisis or uncertain periods. The F-test rejects the null hypothesis, so the covid effect to herding during upward market condition is more extreme than downward.

Table 7 Regression estimates during Covid19 period

The table shows the result from equation(15): $RD_t = \alpha_0 + \beta_1(1-D)\left|R_{m,t}^{Down}\right| + \beta_2(D)\left|R_{m,t}^{UP}\right| + \beta_3(1-D){R_{m,t}^{Down}}^2 + \beta_4 D{R_{m,t}^{UP}}^2 + \beta_5(CD)\left|R_{m,t}^{Down}\right| + \beta_6(CD)\left|R_{m,t}^{UP}\right| + \beta_7(CD){R_{m,t}^{Down}}^2 + \beta_8(CD){R_{m,t}^{UP}}^2 + \varepsilon_t$ In the baseline equation, RD_t indicate the measure of CSAD for equal weight market portfolio. $\left|R_{m,t}\right|$ is a daily absolute equal weight market portfolio return and $R_{m,t}^2$ is a square of daily equal weight market portfolio return. CD is a covid19 dummy and CD equal to 1 during the covid19 period. The model is specified as $RD_t = \alpha_0 + \beta_1\left|R_{m,t}^{Down}\right| + \beta_3{R_{m,t}^{Down}}^2 + \beta_5(CD)\left|R_{m,t}^{Down}\right| + \beta_7 CD * {R_{m,t}^{Down}}^2 + \varepsilon_t$ when $R_{m,t} < 0$ and $RD_t = \alpha_0 + \beta_2\left|R_{m,t}^{UP}\right| + \beta_4{R_{m,t}^{UP}}^2 + \beta_6(CD)\left|R_{m,t}^{UP}\right| + \beta_8 CD * {R_{m,t}^{UP}}^2 + \varepsilon_t$ when $R_{m,t} > 0$. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Market	Constant	$\left\|R_{m,t}\right\|$	$R_{m,t}^2$	C$\left\|R_{m,t}\right\|$	$CR_{m,t_{down}}^2$	Adj. R^2
Down	1.2557***	0.3954***	-0.0340***	0.0087***	-0.00065**	0.5282
	(96.51)	(10.82)	(-2.96)	(3.31)	(-2.90)	
Up	1.2557***	0.5019***	-0.0126	0.2171***	-0.0478***	
	(96.51)	(15.78)	(-1.13)	(9.03)	(-8.44)	

7. Herding among investor types and their performance

We find that the trading of Individual and institutional investors is positively correlated with market returns, whereas foreign investors and proprietary trading trade opposite with the market returns. At least one day, Institution and Individual investors change the feedback trading to negative, whereas the feedback trading of Proprietary and foreigners change to positive. The result indicates institutions and Individuals are very short-term momentum whereas, Foreigners and Proprietary are very short-term contrarian. Furthermore, We find all investor groups do self-herding since the coefficient on the day t-1 is significantly positive. For herding among investor testing, we find foreign investors and Proprietary form herd to all investor groups. And Institutions are positive correlation with the Proprietary and negative correlation with the Foreigners and Individual trading. In contrast, Individual trading is a negative correlation to all investors and tends to positive to other investors in a couple of days. Figure 1. shows the cumulative performance of four types of investors. We find that Institution, Proprietary, and Foreigners achieve positive return and the Institution do the most outstanding performance, while Individual investors experienced large negative returns in the sample period. This consistent with Gwangheon Hong (2011) who find individual performance is underperforming foreigners and Institution.

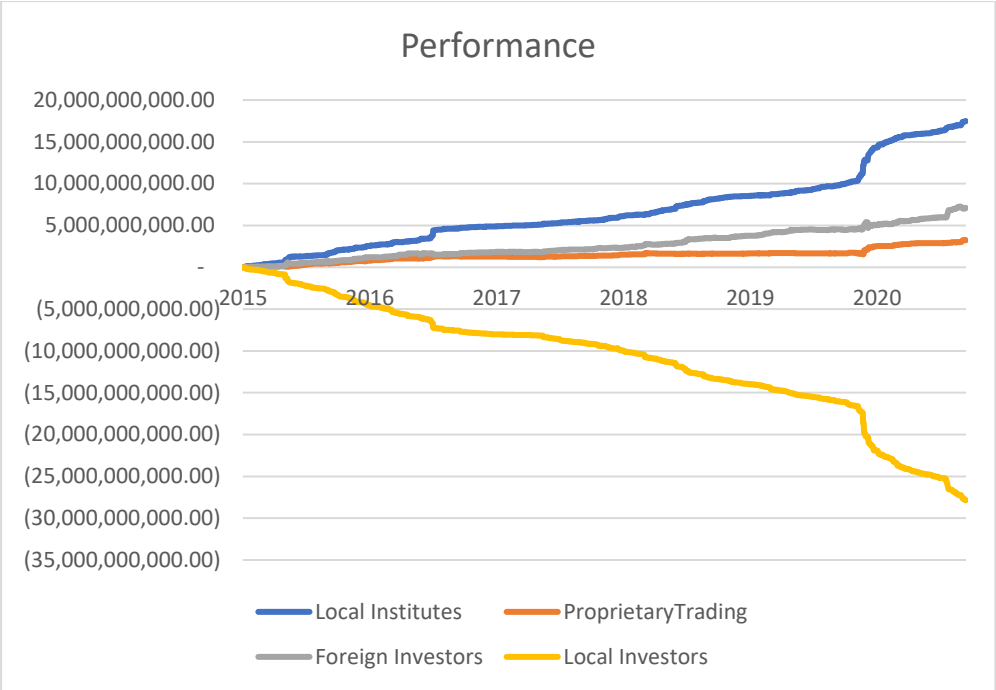

Figure 1 Cumulative performance of each investor type

The figure demonstrates the result from equation (20): Cumulative Return = $\sum_{t=1}^{T}(Buy_{i,t-1} - Sell_{i,t-1})$ x $R_{m,t}$ where the $R_{m,t}$ is a market return, $Buy_{i,t-1}$ is a buy volume of each investor type at time t-1 and $Sell_{i,t-1}$ is a sell volume of each investor type at time t-1

Table 8 VAR model estimates of Net investment flow and SET index

Regression estimates from the baseline equation(19): $NIF_{J_t} = \alpha + \sum_{i=1}^{p} \beta_i R_{m,T-i} + \sum_{i=1}^{p} \beta_{1j} NIF_{ID_{t-i}} + \sum_{i=1}^{p} \beta_{2j} NIF\_F_{t-i} + \sum_{i=1}^{p} \beta_{3j} NIF\_IT_{t-i} + \sum_{i=1}^{p} \beta_{4j} NIF\_P_{t-i} + \varepsilon_{i,t}$ Where NIF is a net investment flow of each investor from equation (18):

NIF = $\frac{\text{Buying Value – Selling Value}}{\text{Buy Value + Sell Value}}$ ***, **, and * denote statistical significance of coefficients at 1%, 5%, and 10% levels, respectively.

NIF:	**Institutions**	**Proprietary**	**Foreigners**	**Individual**	**Rm**
Institutions					
T=-1	0.1240**	0.0624	-0.2081	-0.2337	0.0969
	(2.06)	(0.75)	(-1.26)	(-1.13)	(0.16)
T=-2	0.0673	-0.0975	-0.0459	0.2393	-1.799**
	(1.09)	(-1.13)	(-0.27)	(1.12)	(-3.01)
T=-3	0.0826	-0.0336	-0.1301	-0.0006	-2.146***
	(1.34)	(-0.39)	(-0.75)	(-0.00)	(-3.55)
T=-4	0.0486	-0.1086	-0.1638	0.0237	-1.162**
	(0.82)	(-1.31)	(-1.00)	(0.11)	(-1.97)
Proprietary					
T=-1	0.0299	0.1897***	0.116	0.0056	-0.4026
	(1.13)	(5.21)	(1.61)	(0.06)	(-1.53)
T=-2	-0.0175	0.0018	0.0067	-0.0194	0.9138***
	(-0.64)	(0.05)	(0.09)	(-0.21)	(3.48)
T=-3	-0.021	-0.0403	-0.0113	-0.0719	0.3838
	(-0.78)	(-1.07)	(-0.15)	(-0.76)	(1.45)
T=-4	-0.0096	0.0165	-0.0696	-0.0865	-0.0095
	(-0.37)	(0.45)	(-0.96)	(-0.95)	(-0.04)
Foreigners					
T=-1	0.0661***	0.0918***	0.4550***	0.1172*	-0.2351
	(3.50)	(3.54)	(8.83)	(1.81)	(-1.25)
T=-2	-0.0334*	-0.0177	0.0674	-0.0934	0.163
	(-1.73)	(-0.66)	(1.25)	(-1.40)	(0.87)
T=-3	-0.0434**	-0.0124	-0.0373	-0.1191*	0.3323**
	(-2.25)	(-0.46)	(-0.69)	(-1.79)	(1.76)
T=-4	-0.0083	-0.0076	-0.0031	-0.0436	0.289
	(-0.45)	(-0.29)	(-0.06)	(-0.67)	(1.56)
Individual					
T=-1	-0.0203	-0.0347	-0.1178**	0.2210***	0.1413
	(-1.02)	(-1.27)	(-2.17)	(3.23)	(0.71)
T=-2	0.0389*	0.0530*	0.04484	0.0997	-0.0104
	(1.90)	(1.86)	(0.79)	(1.41)	(-0.05)
T=-3	0.0141	0.0324	0.0696	0.1228*	0.171
	(0.69)	(1.14)	(1.22)	(1.75)	(0.86)
T=-4	0.021	0.0499	0.0881	0.1285**	-0.0017
	(1.07)	(1.80)	(1.62)	(1.88)	(-0.01)

8. Herding behavior and augmented four-factors Fama French model

The estimate of four-factor regression for large and small portfolios are reported in table 9 and 10, respectively. The result shows that all risk factors are significant except the intercept. The HML for both portfolios are positive significant and decrease from small-cap to large-cap. These are consistent with Fama and French (2012). The error term of CASD which are taken as a new risk factor are significantly positive correlation with the expected market return. The coefficient of new risk factor in the large firm size portfolio is greater than small firm size portfolio. The high adjusted R square value (0.9476 and 0.9162) suggests that those modified models are a good fit in explaining the expected return. Thus, we find the NRF is a significant risk factor in the process of return generation and affects expected returns on sample stocks.

Table 9 Four factor model

This table reports the Fama-French and Carhart's four-factor model from the baseline equation(21) : $R_{p,t} = \propto + \beta_1 RMRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \beta_5 NRF_t + e_t$ where RMRF is a market risk premium, SMB is a small premium, HML is a value premium, MOM is a momentum premium and NRF is new risk factor that exclude herding behavior. ***, **, and * denote statistical significance of coefficients at 1%, 5%, and 10% levels, respectively.

Portfolio	Constant	RMRF	SMB	HML	MOM	NRF	$Adj.R^2$
Large-Cap	0.004	0.72***	-0.89***	-0.04***	0.34***	0.12***	0.9476
	(0.82)	(22.88)	(-39.76)	(-3.01)	(10.73)	(5.32)	
Small Cap	-0.0028	0.67***	0.52***	-0.279***	0.416***	0.046***	0.9162
	(-0.4)	(18.48)	(20)	(-16.59)	(11.31)	(4.16)	

Conclusion

This study explores the appearance of herding behavior in Thailand under various market conditions and levels, including during the Covid19 period. Furthermore, we also study herding among investor types and performance and develop new prick risk factor by exclude herding behavior. The finding indicates that herding behavior occurred among investors in Thailand. We find herding in 20 sectors. Property Fund & REITs, Steel, and insurance are the large herding magnitude. The sectors that show the minor herding magnitude are Energy & Utilities and Food & Beverage. And six sectors which are no evidence of herding behavior are Agribusiness, Commerce, Personal Products & Pharmaceutical, Petrochemicals & Chemicals, Packaging, Professional Services. Moreover, in the test of herding behavior under different market conditions, we find investors do herd only downward market for the aggregate market portfolio. And for sector portfolio toward the market test, herding occurs in both market conditions. Furthermore, testing herding activities in sectors portfolio level, some sectors indicate herding in one circumstance, and some sectors show evidence of herding for both market conditions. This confirms asymmetry herding behavior.

During the covid19 period, the market experience higher uncertainty. Herding behavior in this period is more severe and occurs in both up and down-market conditions. We also find asymmetry herding in different firm-size portfolios. The result indicates that the herding in a small firm is more severe than in a large firm. We see all investors do self-herding and foreign form herding to all investors. Individual investors tend to form herding to all investors after a couple of days. And the result

shows that institutions and Individuals are very short-term momentum whereas, Foreigners and Proprietary are very short-term contrarian. In terms of performance, Institution, Proprietary and Foreigners achieve positive return and the Institution do the most outstanding performance, while Individual investors encountered negative returns in the period. Lastly, we find the new risk factor that we develop can help the Carhart four factor model explain the expected return for both firm sizes and impact the expected return of the big-cap portfolio more than a small-cap portfolio.

Our findings indicate the presence of herding behavior in the Thai equity market, indicating inefficiencies market. The market could improve by developing the quality of information disclosed. Due to insufficient information disclosure, market players often lack basic knowledge about organizations, prompting them to trade on alternative signals. Additionally, Froot, Scharfstein, and Stein (1992) suggest that informational inefficiencies result from the presence of short-term speculators. Thus, it implies the existence of a more significant number of speculators.

This paper contributes to policymakers developing the policy that improves information disclosure and market liquidity to reduce herding behavior. And suggest fund manager or investor establish investment policies because herd behavior results in suboptimal diversification advantages since discovering and investing in negatively correlated equities may be challenging. As a result, investors may need to invest in a greater range of equities to obtain the same level of diversification as they would in a market free of herding. Furthermore, since the result suggests that the new risk factor that take out of herding can explain expected return, this may cause investors or fund managers return. An investment policy should support the investor to find underpriced

stock to compensate the risk. This process will remove some mispricing and improve price efficiency.

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