The Effect and Prediction of Investor's Sentiment on Equity Return: An Empirical Study on the Thai Stock Market

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Abstract

An essential question in finance is whether investor sentiment significantly affects stock returns. The empirical literature has expanded the study to the developed stock markets. However, the emerging markets lack the subject of study, especially the Thai equity market. The purpose is to understand further the relationship between investor sentiment and Thai stock market returns. The objectives include customizing investor sentiment indexes to reflect the Thai stock aggregate movement, estimating the predictive ability of the customized investor sentiment, and providing referable trading strategies for the equity investors.

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The empirical sample period is from 1999 to 2019. This paper uses the first Principal Component Analysis to construct the customized investor sentiment indexes at the domestic and global levels based on eight underlying proxies extracted from literature and then classifies the Thai stock market states using investor sentiment. Second, the paper compares the predictive errors of the Martingale model, the Autoregression model, and the Multivariate threshold autoregressive models using the customized sentiment indexes. Third, the paper designs trading strategies based on the sign of either models' projection or customized investor sentiment fluctuation for maximizing investors' profit.

The results show that 1) Customized investor sentiment strongly reflects the aggregate return movement of the Thai market, especially the local index. 2) The customized investor sentiment accurately forecasts the Thai stock aggregate movement using the out-of-sample method. 3) The trading strategy based on customized investor sentiment provides higher predicted returns than other empirical models. The paper suggests that taking the customized investor sentiment into regular financial reference would benefit the equity investors.

Keywords: Customized Investor Sentiments, Stock Returns, Aggregate Effect, Model Predictive Abilities, Equity Trading Strategies

ผลกระทบและการทำนายความเชื่อมั่นของนักลงทุนที่มีต่อผลตอบแทนของตลาดทุน: การศึกษาเชิงประจักษ์ในตลาดหุ้นไทย

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บทคัดย่อ

ความสัมพันธ์ของความเชื่อมั่นของนักลงทุน และผลตอบแทนของตลาดหุ้นมักเป็นคำถามที่ได้รับการกล่าวถึง ซึ่งวรรณกรรมเชิงประจักษ์ได้มีการศึกษาในตลาดหุ้นที่พัฒนาแล้ว แต่อย่างไรก็ตาม ยังไม่มีการศึกษาในตลาดหุ้นของตลาดเกิดใหม่เท่าไรนัก การวิจัยฉบับนี้จึงมีวัตถุประสงค์เพื่อทำความเข้าใจเกี่ยวกับความสัมพันธ์ระหว่างความเชื่อมั่นของนักลงทุน และผลตอบแทนของตลาดหุ้นไทย โดยการสร้างดัชนีความเชื่อมั่นของนักลงทุน การคาดการณ์ผลตอบแทนของตลาดหุ้นต่อความเชื่อมั่นของนักลงทุน รวมไปถึงการคำนึงถึงกลยุทธ์การซื้อขายที่นักลงทุนใช้อ้างอิง

การวิจัยฉบับนี้ใช้กลุ่มตัวอย่างจากข้อมูลในช่วงระหว่างปี พ.ศ. 2542 ถึง พ.ศ. 2562 และใช้ Principal Component Analysis ในการสร้างดัชนี ความเชื่อมั่นของนักลงทุนแบบเฉพาะบุคคล และเปรียบเทียบผลคลาดเคลื่อนเชิงคาดการณ์ระหว่างแบบจำลองมาร์ติงเกล แบบจำลองการถดถอยอัตโนมัติ และแบบจำลองการถดถอยอัตโนมัติของหลายตัวแปร หลังจากนั้น ผู้เขียนได้สร้างกลยุทธ์การซื้อขายที่อิงการคาดการณ์จากแบบจำลอง หรืออิงระดับของดัชนีความเชื่อมั่น เพื่อสร้างผลกำไรให้แก่นักลงทุน

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การวิจัยฉบับนี้พบว่า 1) ความเชื่อมั่นของนักลงทุนแบบเฉพาะบุคคลสะท้อนผลตอบแทนโดยรวมของตลาดหุ้นไทยเป็นอย่างมาก 2) ความเชื่อมั่นของนักลงทุนแบบเฉพาะบุคคลสามารถคาดการณ์การเคลื่อนไหวของหุ้นไทยได้อย่างแม่นยำในช่วงนอกกลุ่มตัวอย่าง 3) กลยุทธ์การซื้อขายตามความเชื่อมั่นของนักลงทุนแบบเฉพาะบุคคลให้ผลตอบแทนที่คาดการณ์ได้สูงกว่าแบบจำลองเชิงประจักษ์อื่น ๆ

คำสำคัญ: ความเชื่อมั่นของนักลงทุนแบบเฉพาะบุคคล ผลตอบแทนของตลาดหุ้น Aggregate Effect ความสามารถในการทำนายของแบบจำลอง กลยุทธ์การซื้อขายหลักทรัพย์

Introduction

The traditional financial theory believes that investor emotions do not affect stock prices (Fama, 1970). However, investors in major stock markets worldwide have experienced wild fluctuations in stock prices since the stock market's initial day. The traditional finance model on the macroeconomic and corporate fundamentals makes the stock market fluctuations challenging to explain rationally (Black, 1986; Kahneman & Tversky, 1979; Tversky & Kahneman, 1974). Investor sentiment has become an essential topic in the modern stock market.

Investor sentiment is an elusive concept that is hard to define and measure (Miller, 1977). Investor sentiment is either their subjective belief or noisy information that is irrelated to the value of stocks, resulting in stock mispricing in continuance, affecting stock prices (Barberis et al., 1998). The researchers describe the investor's sentiment as their subjective overly optimistic or pessimism about the stock market in general (Brown & Cliff, 2004). When rational traders find it hard to exploit profit opportunities from mispricing, the investor's self-evaluation is the main effect on asset pricing (Stambaugh et al., 2012). In recent research, investor sentiment could define investor conservatism, which leads to a subjective preference to adhere to prior options regardless of new information (Seok et al., 2019).

Furthermore, the existing studies consider that the market price can depart from sentiment-driven fundamental values (Keynes, 2018). The investor's sentiment could lead to overestimating or underestimating the entire stock market. Therefore, it affects aggregate market return (Bali et al., 2011; Da et al., 2011). Such irrational investors affected by sentiment factors express an optimistic (pessimistic) view of the aggregate stock price. Identifying and capturing a full picture of the investor sentiment is too board and vague, and contains many factors base on different research purpose. Therefore, the author creates a custom indicator, which calls this as the investor sentiment to capturing a researchable effect of the customized investor sentiment to study the Thai stock market.

The World Bank identified Thailand as an Asian "Tiger cub" economy as an emerging capital market. The Thai financial market represents the ASEAN finance region with a widely accessible investor group and comprehensive trade system (French, 2017). The Thai stock market has a high proportion of retail investors, and most have not mature enough investment concepts (Phansatan et al., 2012). The speculative market activities are relatively high,

which is more likely to cause "herding behaviour" and market overreaction (Padungsaksawasdi & Seetharam, 2020). The influence of investor sentiment in the Thailand stock market is more salient than the effect in the developed stock market.

This paper endeavours to construct two comprehensive customized investor sentiment indexes (local and global) for the Thai equity market to expand the financial understanding further. The logic is the basis of the existing papers (Baker & Wurgler, 2007; Hong & Lee, 2003). The Thai equity stock market is relatively smaller than other developed equity markets. Besides, its market sentiment is easily affected by domestic and global events. The authors capture the rapid change of customized investor sentiment utilising the daily data. This paper selects market turnover, the Thai T-bill rate, the RSI, and local gold price for constructing the local sentiment index. Also, this paper sets the U.S. T-bill rate, the S&P 500 index, the Exchange rate, and VIX for building the global sentiment index. The choice of selective variables is authors' subjective set of variables, which relates to investors' sentiment. And those selective variables could provide a researchable significant scale to the topic of investor sentiment.

The customized investor sentiment indexes obtained from the Principal Component Analysis are separated, taking the first principal component. Then, the customized investor sentiment indexes are applied to measure the Thai equity market's movement. Second, the sentiment indexes are implemented to classify the Thai equity market states using a Multivariate threshold autoregression model. The value of the Mean Squared Forecast Error and the Mean Absolute Forecast Error is evaluated with the empirical models, such as the Martingale model, Autoregression models, and out-of-sample forecasting performance. The third study uses sentiment indexes to design the trading strategy. The Mean Forecast Trading Return evaluation applies in this process. The customized indicators that create by author, have potential market predictive power. Then, the authors test the predictive properties of those indicators.

The authors study observations of the daily price of the index of the Stock Exchange of Thailand (.SETI) from January 1999 to January 2019. The majority of the sample expect from the Bloomberg DataStream and Reuters database and the Stock Exchange of Thailand.

Literature Review

Behavioural finance research can trace Noise Trading's related theoretical analysis (Black, 1986; De Long et al., 1990). The noise traders with strong subjective cognition will bring additional risks to the market. The early studies indicated a link between an investor's confidence in the success of their early action causing overconfidence in the following decision-making (Daniel et al., 1998). Also, a parsimonious theoretical model argues the different reactions of investors' sentiments to the good or bad news (Barberis et al., 1998). The existing research suggests that retail investors consider the impact of sentiment on their investment strategies (Sharpe, 2001).

The investor sentiment measurement reflects the investor sentiment's effect on the aggregate market return. Early researchers used closed-end funds as a standard proxy to measure the market sentiment because most retail investors own closed-end funds and small stocks (Neal & Wheatley, 1998; Swaminathan, 1996). After, a well-known composite investor’s sentiment was formed by the previous researchers to test the aggregate sentiment effect on stock market return(Baker & Wurgler, 2007). They provide shreds of evidence for sentiment affecting asset prices.

There are different predictive powers of investor sentiment for different investment horizons. In the short term, the sentiment mainly drives investors more aggressively during pessimistic periods (Ahmed, 2020). The existing noise traders drive intraday sentiment in the first half-hour, affecting the stock return in the last half hour in the U.S. stock market (Renault, 2017). Even though the intraday momentum effects from noise traders are only active in the last half hour, the sentiment effect continues at least the last two hours of a trading day (Sun et al., 2016). In the long term, the investor's behaviour could be an index for market forecasting. The researchers found that the sentiment has predictive power to explain the deviation of asset prices from the intrinsic value (Brown & Cliff, 2005), supported by the evidence of the consumer sentiment on U.S. stock returns (Gupta et al., 2014). An Exhibiting mean-reverting behaviour on the effect of investor sentiment on stock returns is negative but small in the long-term in the Chinese stock market (Ni et al., 2015). The investor sentiment index in European has a strong predictor of market return and conditionally market volatility long-term (Reis & Pinho, 2020). Therefore, investor sentiment has different predictive powers for varied horizons.

The investor sentiment is localisation property (Wu et al., 2017). Previous researchers show that the global and local sentiments are contrarian predictors of cross-sectional market returns (Baker et al., 2012). Another researcher found that the existing adjustment in the offer price by underwriters compensated the regular investor when the sentiment became progressively worse in Hong Kong IPO (Jiang & Li, 2013). Another researcher finds a very weak contagion to the Asia-Pacific stock returns using the predictive power of the Chinese investor sentiment (Li, 2021). Constructing a local sentiment index reflects the effect of local investor emotion and as a reliable reference for market prediction (Hei-Ling Lam & Chi-Man Hui, 2018). However, a prior study finds that global pessimism sentiment results in undervaluation in the entire market return (Chen et al., 2013). The assets are strongly related to global sentiments (Chen et al., 2017). In Thailand, the existing research use vary variables to construct the investor sentiment. The number of new IPO, foreign buy and sell volume, ratio of new issuance in bond and equity markets (Chuthanondha, 2016), the online social media word (Tantisantiwong, 2020). Also the Number of IPO securities registered, the turnover ratio of number of shares, the ratio of funding in equity instruments to debt and equity instruments, and the total trading fee Works of foreigners from the CMRI (SET-CMRI).

The proportion of constructing investor sentiment in different countries is diverse to the stock market dynamics. Thus, the component of investor sentiment is varied.

Market turnover

The early research discusses a considerable value on turnover associates, typically with a soaring stock price (Ying, 1966). The bull markets have a high turnover ratio on the market horizon, but the bear markets have a lower turnover ratio (Karpoff, 1987). Also, financial bubbles are associated with high turnover due to abnormal trading activities (Smith et al., 1988). The researchers found a correlation between trading and price differentials by the investor's speculative intentions (Mei et al., 2009). Also, the overpriced stocks are a pattern with a high trading volume (Baker et al., 2012). The turnover information is essential to investor sentiment index construction and reports the share volume to average shares in the listed firms. (Baker & Wurgler, 2006, 2007).

Treasury bill rate

The investors generally trade more and increase the speculative investor activities at a relatively low and short-term Treasury interest rate (Stambaugh et al., 2015). An increase in the government yield may cause an investment shift from a risky asset to a safety asset in an investor's portfolio (Fong & Toh, 2014). Investors who are more risk-averse and hold government bonds indicate a low sentiment period (Gómez-Puig et al., 2014). Research indicates a striking co-movement between the T-bill rate and the situal investor sentiment index (Chue et al., 2019; Sibley et al., 2016).

The relative strength index

The relative strength index (Ryu et al., 2016) examines whether the market is oversold/ overbought, reflecting the investor's overreaction/underreaction (Chen et al., 2010; Kim & Ha, 2010). In traditional interpretation, the RSI of 70 implies that the security is overbought, while the RSI of 30 implies the security is oversold (Chong & Ng, 2008). With a fluctuating relative index co-movement with the investor's abnormal trading behaviours, the price of sensitive-driven stocks is most likely volatile (Hudson & Green, 2015; Yang & Zhou, 2015).

Local gold price

In the emerging market, golds are like a “safe haven” against stock market volatility (Baur & McDermott, 2010). Gold represents a safe and risk-hedge instrument for the major equity markets by dropping before the extreme market downturn (Agyei-Ampomah et al., 2014). When the investor increases the weight on the commodities, the aggregate market returns are most likely to decline (Smales, 2014). The volatility of gold prices can reflect the intraday investor sentiment in the equity market (Balcilar et al., 2017). The change in gold price negatively correlates with the investor sentiment index, then comes with the short-term government yields (Capie et al., 2005; Reis & Pinho, 2020). Thailand's stock markets are one of the financial and commodity markets that have been highly volatile with high capital mobility in recent years (Pastpipatkul et al., 2016). Therefore, categorising the gold price into local sentiment would better reflect the market movement index.

U.S. treasury bill rate

The federal interest rate is a primary concern for the international investor on the weight of capital in the overseas financial market (Alam & Uddin, 2009; Gagnon et al., 2011; Schmeling, 2009). The announcements related to the change of the U.S. Federal interest rate significantly affect investor sentiment (Kurov, 2010). The federal interest rates are a good reflection of recalling overseas capital and purchasing a safe asset (Zouaoui et al., 2011). The monetary policy actions in downturn periods have a more significant effect on stocks that are more sensitive to investor sentiment changes (Glick & Leduc, 2012). The U.S. federal funds rate is a standard proxy for global liquidity conditions, showing that a lower federal funds rate is associated with higher liquidity (Csontó, 2014; Lee et al., 2014).

The S&P 500 index

Nowadays, domestic and international investors are eyes on U.S. financial market activity (Cheung & Mak, 1992). Foreign investors would increase capital allocations to emerging markets when global risk aversion decreases (Gagnon et al., 2011). The volatility of the S&P500 would affect the Thai equity market and retail investors (Alfonso Perez, 2017). The U.S. equity market's influence significantly impacts the value at risk in Asian markets (Shen, 2018). Therefore, the total return index of S&P 500 is a proxy to measure the global investor sentiment index.

The exchange rates

The exchange rate change would impact the investor's international asset allocation (Cushman, 1983; Viaene & de Vries, 1992). The change of exchange rate of the home currency to U.S. dollars through high-frequency trading positively influences the stock price (Richie & Madura, 2006). The expected exchange rate of USD changes accounts for a high share's total variation as many researchers take the change in the exchange rate (Arquette et al., 2008; Chan et al., 2008; Gagnon & Andrew Karolyi, 2010) and measure it for the home equity market (Wu et al., 2017). The THB keeps an eye on the movement of USD (Bouraoui & Phisuthtiwatcharavong, 2015). Thus, the paper considers the exchange rate (THB per USD) as a proxy to measure Thai investor sentiment.

The Chicago board options exchange volatility index (VIX)

Significantly, the VIX is a factor considered as the prior proxy for constructing the global sentiment index (Bandopadhyaya & Jones, 2006). The early research indicates that an increasing proportion of individual ownership is associated with volatility (Sias, 2019). The negative VIX reflects a global optimistic sentiment investment in emerging markets (Smales, 2017). The sentiment substantially affects hard-to-value and hard-to-arbitrage stocks in the international market (Marfatia, 2020). Therefore, the VIX is essential to study the global sentiment on the equity market.

The authors acknowledge that this paper might be missing some essential rational factors, but the authors feel the set of measured variables is a reasonable effort to mitigate the research problems.

Significance of the Problem

Based on the background and previous research, studying investor sentiment is unified in theoretical or practical aspects. For the Asian market, investor sentiment has the property of localization. Hence, studying the local sentiment should take local market features into account. Understanding the investor sentiment would provide a healthy growing stock market and contribute to the development of the whole economy. The main reason for selecting Thailand as the laboratory is that Thailand's equity market has been one of the most resilient after the 1997 Asian financial crisis (French & Li, 2017). Thailand's equity market and the Thai Baht rebounded rapidly after the financial crisis. With a higher percentile of foreign equity issuers and a low entrance barrier, the Thai equity market have more capital diversification and a high degree of capital flow (Calomiris et al., 2021). However, additional financial uncertainty, combined with political instability, may increase the likelihood of such reversals and significant Herd-behavior with firm-specific information in recent years (Padungsaksawasdi & Seetharam, 2020). Therefore, studying the investor sentiment effect is better for predicting the movement of the Thai equity market.

Many studies focus on the relationship between investor sentiment and stock market returns in developed markets, explaining how investor sentiment affects stock returns and price fluctuations (Tantisantiwong, 2020). Nevertheless, there currently is a paucity of studies on behavioral finance in developing countries. The existing literatures are far from understanding the investor sentiment issues in the Thai equity market (Phansatan et al., 2012).

The market's regulatory authorities' supervision and intervention do not fully consider the potential impact of irrational factor (French & Li, 2017). As a result, the policies are often ineffective and have severe side-effects on the stock market's growth. Therefore, researching investor sentiments based on the theory and framework of behavioral finance has crucial practical significance.

For theoretical significance, this paper assists the traditional financial theory research in studying the abnormal market phenomenon and offers a deep understanding of investor decision-making and capital market operation. As investor sentiment research is an essential part of behavioral finance theory, studying this issue helps the researchers understand how investor sentiment affects market operation and helps researchers develop and improve behavioral finance theory in the Thai equity market.

For empirical significance, the research on investor sentiment helps decision-making and supervision during the operation of the Thai stock market. Studying the investor sentiment helps investors understand the market business cycle and asset prices' actual characteristics. Besides, studying investor sentiment helps investors to cultivate a rational and healthy investment mind. For regulatory authorities, researching the investor sentiment helps them develop a more complete and adequate regulatory system. Moreover, researching the investor sentiment helps them perform more targeted supervision functions, thus positively developing the Thai stock market.

Research Questions and Objectives

The paper constructs two-principal component-based composite sentiment indexes (local and global) for the Thai equity market.

Research questions

The authors use the local sentiment index and global investor sentiment index to answer the below specific research questions separately:

1. Can the customized investor sentiment index significantly reflect the aggregate market return movement in the Thai equity market?
2. Can the customized investor sentiment index predict the Thai stock market movement using the out-of-sample method?

Objectives

1. Construct two appliable comprehensive customized investor sentiment indexes (local and global) to study the Thai stock aggregate return movement.
2. To estimate the investor's sentiment indexes' predictive performance on the expected return of Thai stock. If the investor's sentiment index is significant in predicting the stock price using the out-of-sample forecast method, it could be a valuable reference for investment timing.
3. To generate a trading strategy that uses the fluctuation of the customized investor sentiment indexes. Compared with empirical trading strategies that use other models, if the trading strategy based on the customized investor sentiment indexes has a higher expected profit, it could be a helpful reference for the investor's normal trading behaviours.

Data and Methodologies

The authors construct two comprehensive customized investor sentiment indexes separately for the Thai stock market. Studying the aggregate stock market's customized investor sentiment is learned from the existing research (Baker & Wurgler, 2007).

Empirical sample

The authors study observations of the daily price index of the Stock Exchange of Thailand (.SETI) from January 1999 to January 2019 and the daily total return index of the Stock Exchange of Thailand (TRI) from January 2002 to January 2019. Most of the sample expect from Bloomberg DataStream, the Stock Exchange of Thailand and The Bank of Thailand.

Measurement to Variables

The following factors' principal component is expected to develop the Thai investor sentiment's local and global measurement based on the literature review.

Market Value Turnover

The authors define a turnover ratio (*MVTN*) as follows:

$$MVTN_t = \frac{The\ average\ turnover\ for\ the\ past\ 10\ trading\ days_t}{The\ average\ turnover\ for\ the\ past\ 250\ trading\ days}$$

Thai Treasury Bill Rate

This research uses a daily Thai Government T-bill rate as a proxy for the localised investor sentiment index to capture the change of sentiment, "TTB" The daily T-bill rate in time t is expected to obtain from the BOT database.

The Relative Strength Index

The 14-day RSI is a standard measurement in the financial market, defined as follows:

$$RSI_t = \frac{\sum_{j=1}^{14}(P_{t-j} - P_{t-j-1})}{\sum_{j=1}^{14} | P_{t-j} - P_{t-j-1}|}$$

$$where\ (P_{t-j} - P_{t-j-1}) = P_{t-j} - P_{t-j-1} \quad if\ P_{t-j} - P_{t-j-1} > 0, otherwise = 0.$$

Gold Price

The Gold Price is the intraday price of one unit of gold in Thai currency. An uptrend in the local gold price would lead to pessimistic investor sentiment in the equity market. The Gold price, "TGP", at time t

The U.S. Treasury Bill rate

The daily Federal interest rate is the primary data to be the proxy of The U.S. Treasury bill rate to capture global investor sentiment change, defined as "UST".

The S&P 500 Index

The total daily return of the S&P 500 index is selected in the sentiment measure. The time-zone difference defines the rate of return on the U.S. equity market at time t:

$$SPX_t = \ln S\&P_{t-1} - \ln S\&P_{t-2}$$

Exchange Rate

The movement of the exchange rate closely relates the international capital flows. A sustained appreciation of THB attracts more Thai assets from international investors, leading to a higher investor sentiment index. The daily series of THB per USD is defined as "F.X. t".

VIX

VIX is a well-known index to measure volatility's market expectation. The daily time series of VIX is considered to construct the global sentiment index, defined as "VIX t".

Methodologies

The Principal Component Analysis (PCA) method's first principal component in econometrics represents the optimal combination of the selected proxies that maximises its total variance (Reis & Pinho, 2020). The authors firstly use the Stata to construct the compound customized investor sentiment index by PCA function, which selects the first principal components as the compound investor sentiment index is the highest eigenvalue, namely the Thai compound investor sentiment index, "SENT_th" and the Global Compound investor sentiment index "SENT_gb", with the statistic description. The authors then test the correlation between the selected variables and the SENT indexes by running the multiple regression.

The customized investor sentiment's effect on the Thai aggregate returns

First uses Excel to examine the customized Thai compound investor sentiment's effect on the aggregate return. The authors input the Rm, Rf and SEN indexes into the Excel sheet and then follow the single-index model to inspect the relationship between the customized investor sentiment and market aggregate return:

$R_{m,t} - R_f = \propto + \beta_i SEN_{i,t-j} + \varepsilon_t$, where the j is the lagged term daily, ε is the error term.

Then the authors check the regression result with a significant test result of 5%. After, the authors use the Granger Causality Test to estimate the causality relationship between the sentiment indexes and the market return.

Furthermore, The Granger causality test can test whether customized investor sentiment has impacted the value of returns in current and lagged terms. The regression results show the correlation between customized investor sentiment and the market aggregate return for answering research question 1.

The prediction power of Sentiment indexes on the Thai stock market movement

The authors use the Multivariate threshold autoregressive model (Chen et al., 2010; Chen et al., 2014; Tsay, 1998) and the rolling sampling test. First, the authors separately use the sentiment indexes (SEN_th, SEN_gb) to define the stock market cycle using the multivariate threshold model to classify the bull and bear market states. With the multivariate threshold autoregressive model, the authors use sentiment indexes as the threshold variable to capture the stock market's nonlinear movement. The authors input the data of the SET index of all the sample periods and then obtained the two threshold values for each sentiment index, X and Y, following the function:

$$R_t = \begin{cases} a_0 + a_1 R_{t-1} + a_2 R_{t-2} + \cdots + a_q R_{t-q1} + \epsilon_{1t}, & if\ Sen_{t-1} \leq X \\ \beta_0 + \beta_1 R_{t-1} + \beta_2 R_{t-2} + \cdots + \beta_q R_{t-q1} + \epsilon_{2t}, & if\ X < Sen_{t-1} \leq Y \\ \theta_0 + \theta_1 R_{t-1} + \theta_2 R_{t-2} + \cdots + \theta_q R_{t-q1} + \epsilon_{3t}, & if\ Y < Sen_{t-1} \end{cases}$$

$where\ R_t = 100 \ln\left(\frac{P_t}{P_{t-1}}\right),\ the\ Sen_{t-1}$ is the threshold variable, which constructs from the past date at time t-1. Note that the Sen_{t-1} is separately defined as the local sentiment index and the global sentiment index, namely $Sen_{th,t-1}\ and Sen_{gb,t-1}$ ϵ_{it} denotes noise terms, the X and Y are the threshold values relating to the local sentiment index, namely $X_{th}\ and\ Y_{th}$ And to the global sentiment index, namely $X_{gb}\ and\ Y_{gb}$.

The authors use the statistical method to calculate the threshold values, classify the bullish and bear market and compare the SET sentiment indexes.

$$Upper\ \ threshold\ value_i = mean_i + standard\ deviation_i$$

$$Lower\ threshold\ value_i = mean_i - standard\ deviation_i$$

Note that i is the sentiment index.

Second, setting the predictive criteria: the authors consider a sample size of *T=m+n,* where the *n* is the observations for the out-of-sample projection evaluation, and the *m* is the number of observations for estimation. The entire observation is 4178. The authors consider the sample size for testing the predictive ability of the multivariate threshold Autoregressive model based on the customized investor sentiment indexes ($MTAR_{Sen\ i,t}$) is *T=m+n*, where *m=1000*, *n=200*. The authors use a rolling sample of the size m to estimate model parameters, where the series t starts from 2nd Jan 2002 to 29th Mar 2017 (McCracken, 2000; West, 1996).

Third, use a rolling sample to predict the following sample, then replace the rolling staps through the end of the sample period. After, the authors generate a sequence of one-step-ahead projections. The authors compare the out-of-sample prediction with the criteria (Hong & Lee, 2003) of the Mean Squared Forecast Error (MSFE) and the Mean Absolute Forecast Error (MAFE) between the Multivariable threshold autoregressive model based on SENT indexes ($MTAR_{Sen\ i,t}$) with the Martingale model, with the simple Autoregression model (AR), in which the order p choosing by a particular information criterion, Akaike Information Criterion (AIC) (Shibata, 1976).

$$MSFE_t = \frac{1}{n}\sum_{j=0}^{n-1}(R_{t-j} - \widehat{R_{t-j}})^2 \qquad MAFE_t = \frac{1}{n}\sum_{j=0}^{n-1}|R_{t+j} - \widehat{R_{t+j}}|$$

The martingale model $R_t = \mu_t + \varepsilon_t$ And its prediction is $\hat{R}_t = \frac{1}{m}\sum_{i=t-m}^{t-1} R_i$.

To determine whether the MTAR model with the sentiment-based performs better than the other two models, the authors apply the average difference (AF) of MSFE and MAFE between the (1) Martingale model, (2) Autoregression model (AR), (3) Multivariable threshold autoregressive model with SENT indexes (MTAR),

$$AF_{MSFE} = \frac{\sum(MSFE_{i,t} - MSFE_{j,t})}{T} \qquad AF_{MAFE} = \frac{\sum(MAFE_{i,t} - MAFE_{j,t})}{T}$$

Where i and j are different models, T is the count of the entire rolling sample, starting from 22nd Nov 2006 to 31st Jan 2019.

If the criteria value is greater than 0, model i has a time series statistical dominance over model j. Thus, model i has better forecast ability than model j, and vice versa. Additionally, using the T-test with unequal variances estimates the significance of the average difference between the two models.

3. The trading strategies of using sentiment indexes on the Thai stock market

Most investors would use the economic either index or model to maximise their trading returns rather than minimising the model forecast errors. The trading strategies are designed differently as the property of the sentiment indexes. The paper provides two principles of a trading strategy based on the forecasting models and the local sentiment indexes. The authors, therefore, evaluate the models base on their expected trading profits (Hong & Lee, 2003).

The first principle of a trading strategy based on the forecasting models is to use the forecasting return value from the Martingale model, the Simple Autoregression model, the Multivariate threshold autoregression model using the local sentiment index and the Multivariate threshold autoregression model using the local sentiment index. If the forecasting return value in time t is positive, then the strategy should buy the benchmark index but should sell the benchmark index if the forecasting return value in time t is negative. The estimation for this trading strategy is the mean forecast trading return (MFTR), and it is defined as follows:

$$MFTR_i = \frac{1}{T-m}\sum_{t=m+1}^{T} sign(\hat{R}_{i,t})R_t$$

where T = Observation 4179, 31st Jan 2019. m=Observation 1000, 26th Jan 2006. $t=m+1$, start from 27th Jan 2006. $\hat{R}_{i,t}$ is the forecasting return value from model i, $R_t = 100\ln\left(\frac{P_t}{P_{t-1}}\right)$1)) of the Total returns index.

The second principle of a trading strategy based on sentiment indexes is to use daily values from the sentiment indexes to decide the buy and sell actions.

1) The trading strategy based on the local sentiment index is to follow the movement of the customized investor sentiment index. When the local investor sentiment index is higher, which means the investors are optimistic, the investor should buy the benchmark index, but when the investor sentiment index is lower, which means the investors are pessimistic, the investor should sell the benchmark index. Thus, the trading strategy is to buy the Thai Total return index when the local sentiment index is greater than the lower threshold value but sell the Thai Total return index when the local sentiment index is less than the lower threshold value. The estimation for this trading strategy is the mean forecast trading return ($MFTR_{th}$), and it is defined as follows:

$$MFTR_{th} = \frac{1}{T-m}\sum_{t=m+1}^{T} sign(Sen_{th,t} - the\ lower\ threshold\ value_{th,t})R_t$$

2) The trading strategy based on the global sentiment index is opposite to the movement of the customized investor sentiment index. When the global investor sentiment index is higher, global investors are optimistic, and they will seek other investment assets with better returns than Thai stocks. Thus, the trading strategy based on the global sentiment index should buy the benchmark index when the global sentiment index in time t is smaller than the upper threshold. However, the trading strategy should sell the Thai Total return index when the global sentiment index in time t exceeds the upper threshold value. The estimation for this trading strategy is the mean forecast trading return ($MFTR_{gb}$), and it is defined as follows:

$$MFTR_{gb} = \frac{1}{T-m}\sum_{t=m+1}^{T} sign(the\ Upper\ threshold\ value_{gb,t} - Sen_{gb,t})R_t$$

3) For the trading strategy of the buy-and-hold, the mean forecast trading return is defined as follows:

$$MFTR_{buy\&hold} = \frac{1}{T-m}\sum_{t=m+1}^{T} R_t$$

Note: T= Observation 4179, 31st Jan 2019. m=Observation 1000, 26th Jan 2006. $t=m+1$, start from 27th Jan 2006. The lower threshold value in the local sentiment index is -0.7254, while the upper threshold value in the global sentiment index is 0.7754. And $R_t = 100\ln\left(\frac{P_t}{P_{t-1}}\right)$. of the Total returns index.

The authors apply the T-test to test the significance of the mean forecast trading return and then compare its values—the higher value of the mean forecast trading return, the better the trading strategy.

Results and Discussions

1. Customized Investor sentiment indexes

Collecting the database on the methodology section and running in Stata and Excel program are customizing the investment sentiment indices for the Thai Equity market, then answering research questions. After data standardizing, the author applies the PCA method to the eight variables and develops two composite measures of investor sentiment for the Thai stock market. The Summary descriptive statistics and correlation matrix of the variables are reported in Table 1.

Table 1: The Summary descriptive statistics and correlation matrix of the variables.

Variable	Mean	Std.Dev	MIN	Max
MVTN	108.6335	47.4831	30.52733	427.5312
TTB	4.1904	1.3553	1.5396	8.75
RSI	53.2958	13.5668	14.6397	91.2293
TGP	14583.9	6765.735	4605.45	278868.8
UST	3.5906	1.2902	1.3579	6.788
SPX	0.0002	0.1183	-0.0946	0.1096
FX	35.9916	4.3673	28.68	45.8
VIX	19.9306	8.4706	9.14	80.86
			Observation:	4915

	MVTN	TTB	RSI	TGP	UST	SPX	FX	VIX
MVTN	1							
TTB	-0.698	1						
RSI	0.4897	-0.154	1					
TGP	-0.0716	-0.7241	0.1008	1				
UST	0.0172	0.8559	-0.1178	-0.9017	1			
SPX	0.006	-0.0227	0.1049	0.0219	-0.0181	1		
FX	0.0159	0.4894	-0.0909	-0.8566	0.6815	-0.0244	1	
VIX	-0.0773	0.1511	-0.2398	-0.2032	0.1444	-0.1179	0.1535	1

Table 1

For each time t, the authors name "$SEN_{i,t}$" as the stock market sentiment index defines the first principal component of the variables as mentioned above. $SEN_{th,t}$ represents the investor sentiment index constructed by Thai local variables, while $SEN_{gb,t}$ represents the investor sentiment index constructed by global variables. The Stata program is used to estimate the principal component, the PCA results as follows,

The PCA result of the customized local investor sentiment

Components	*Eigenvalue*	*Proportion*	*Cumulative*
PC1	1.791	0.4478	0.4478
PC2	1.4444	0.3611	0.8089
PC3	0.5043	0.1261	0.9349
PC4	0.26	0.0651	1.0

The eigenvecotrs of principal compoents

Variables	*PC1*	*PC2*	*PC3*	*PC4*
MVTN	0.2127	0.6883	-0.6698	0.1799
TTB	-0.6631	0.2192	0.1993	0.6874
RSI	0.3413	0.6076	0.7136	-0.0714
TGP	0.6313	-0.3301	0.0492	0.70

Note: PC# represents the order number of principal compoment

In the PCA results of the customized local investor sentiment, the upper panel shows the eigenvalues, proportion and cumulation of each principal component (PC1 to PC4) with descending order. The first principal component (PC1) dominates the highest eigenvalue, which is 1.791, while it has 44.78% explaining proportion of the total variance. Four principal components have cumulative 100% explanation of the total variance. The lower panel shows the corresponding eigenvectors of each selective variable to the principal components. The eigenvectors show the directors of selective variables in each principal component. For instance, the PC1 dominates the highest eigenvalues, compared with the rest of PCs. Then, the customized local sentiment index gets the most positive stretched from the Thai local gold price index but gets the most negative stretched from the Thai T-bill rate. Forwarding the similar interpretation to PC2 to PC4, the customized local sentiment index gets the most positive stretched from the market turnover rate in PC2. The customized local sentiment index gets the most positive stretched from the relative strength index in PC3, and it obtains the most positive stretched from the Thai T-bill rate in PC4.

The PCA result of the customized global investor sentiment

Components	*Eigenvalue*	*Proportion*	*Cumulative*
PC1	1.7464	0.4366	0.4366
PC2	1.076	0.269	0.7056
PC3	0.8592	0.2148	0.9204
PC4	0.3185	0.0796	1.0

The eigenvecotrs of principal compoents

Variables	*PC1*	*PC2*	*PC3*	*PC4*
UST	0.6746	0.1741	-0.1272	0.706
SPX	-0.0832	0.7883	0.6096	-0.0051
FX	0.6768	0.1606	-0.1213	-0.7081
VIX	0.2828	-0.5779	0.7729	0.0091

Note: PC# represents the order number of principal compoment

In the PCA results of the customized global investor sentiment, the upper panel shows the eigenvalues, proportion and cumulation of each principal component (PC1 to PC4) with descending order. The first principal component (PC1) dominates the highest eigenvalue, which is 1.7464, while it has 43.66% explaining proportion of the total variance. Four principal components have cumulative 100% explanation of the total variance. The lower panel shows the corresponding eigenvectors of each selective variable to the principal components. The eigenvectors show the directors of selective variables in each principal component. For example, the PC1 dominates the highest eigenvalues, compared with the rest of PCs. Then, the customized global sentiment index gets the most positive stretched from the exchange rate and gets the second larger positive stretched from the US T-bill rate. Forwarding the similar interpretation to PC2 to PC4, the customized global sentiment index gets the most positive stretched from the S&P 500 index in PC2. The customized global sentiment index gets the most positive stretched from the VIX index in PC3, and it obtains the most positive stretched from the US T-bill rate in PC4.

	MVTN	*TTB*	*RSI*	*TGP*
Local Sentiment index	0.2846	-0.8875	0.4567	0.8449

	USTz	*SPXz*	*FXz*	*VIXz*
Global Sentiment index	0.8915	-0.1099	0.8944	0.3737

Additionally referring the correlation results of the customized sentiment indices (PC1) and its selective variables, the Thai gold price has highest positive correlation to the customized local sentiment index. Thus, the Thai gold price performs a stronger positive influence on the PCA construction of local sentiment index. However, Thai T-bill rate has highest negative correlation to the customized local sentiment index. Therefore, the Thai T-bill rate has stronger negative influence on the PCA construction of local sentiment index. On the global aspect, the exchange rate has highest positive correlation to the customized global sentiment index. Thus, the exchange rate between THB and USD performs a stronger positive influence on the PCA construction of global sentiment index. Nevertheless, the return of S&P 500 index has highest negative correlation to the customized local sentiment index. Thereby, the return of S&P 500 has stronger negative influence on the PCA construction of global sentiment index.

The results of corresponding eigenvectors in the first principal component (as the customized investor sentiment indices) show that:

For the customized local sentiment index, the major positive driver is the local gold price,

$$SEN_{th,t} = 0 + 0.2127MVTN_t - 0.6631TTB_t + 0.3413RSI_t + 0.6313TGP_t + \varepsilon_t$$

$$SEN_{gb,t} = 0 + 0.6746UST_t - 0.0832SPX_t + 0.6768FX_t + 0.2828VIX_t + \varepsilon_t$$

which has 0.6313 corresponding eigenvectors to the principal component. The second positive driver for the local sentiment index is the relative strength index, which dominates 0.3413 corresponding eigenvectors. The third positive driver for the local sentiment index is the market turnover rate, which dominates 0.2127 corresponding eigenvectors. However, the main negative driver for the local sentiment index is the Thai T-bill rate, which occupies -0.6631 corresponding eigenvectors. For the customized global sentiment index, the major positive driver is the exchange rate between THB and USD, which has 0.6768 corresponding eigenvectors to the principal component. The second positive driver for the global sentiment index is the US T-bill rate, which dominates 0.6746 corresponding eigenvectors. The third positive driver for the global sentiment index is the VIX index, which dominates 0.2828 corresponding eigenvectors. Nevertheless, the main negative driver for the global sentiment index is the S&P 500 index, which occupies -0.0832 corresponding eigenvectors.

Notably, the turnover variable is positively related to the local investor sentiment index, but the Thai treasury bill rate is negative coefficient with the local sentiment index. Both the RSI and Thai gold price have a positive effect on the local sentiment index. The result of positive coefficient between the sentiment index and the Thai gold price could because 1) using the Thai gold price index as selective variable, the proportion of Thai gold price would lead to strong statistical effect on the customized local sentiment index. Thus, the Thai gold price is the main contributor to the principal component of customized local sentiment index. 2) the local gold price follows the global gold price. And the global sentiment negatively correlates with the local sentiment. Then the global gold price negatively correlated with the global sentiment index. Thus, the local gold price performs a positive correlation with the local sentiment index.

On the global horizon, the US T-bill rate, the spot exchange rate (THB/USD), and the VIX index explain the most variation in global investor sentiment. An increasing rate of US T-bills leads to positive global investor sentiment. Nevertheless, the good performance of the US equity market leads to negative global investor sentiment. A depreciation of THB attracts global capital into Thailand and benefits Thai export, and the exchange rate variable appears to be positively related to the global sentiment index. The volatility index has a positive relationship with the global sentiment index.

2. The aggregate effect

The first goal of the research is to analyze the correlation between the customized investor sentiment indices to the two returns of the Thai equity market index, namely, return of the price index and return of the total return index. After, the author estimates the lag terms of the customized investor sentiment indices to the two Thai market indices returns using the Granger Causality test.

1) The effect of Sentiment indexes to SET Price index

Table 2: The Summary results of the sentiment indexes to The Thai price index.

Sentiment index' s effect to SET Price index

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	**0.000**	**0.0124**	**0.0000**	**1**
SEN_{th}	**0.4439**	**0.0173**	**25.6264**	**5E-136**
SEN_{gb}	**0.0942**	**0.0175**	**5.3675**	**8E-08**
Multiple R	0.4935			
R Square	0.2435			
ANOVA Significance F	2E-298		Observations	4915

Table 2

$$R_{SETI,t} - R_{f,t} = 0 + 0.4439Sen_{th,t} + 0.0942Sen_{gb,t} + \varepsilon_t$$

Both local investor sentiment index and global sentiment index are a significant positive correlation with the market return of SET Price index, which adjusts the risk-free rate. The local sentiment has the stronger effects on the Thai price.

2) The effect of sentiment indexes to SET Total Return index

Table 3: The Summary results of the sentiment indexes to The Thai total return index.

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	**-0.188**	**0.0128**	**-14.7137**	**0.00**
SEN_{th}	**0.7316**	**0.0188**	**38.9385**	**3E-283**
SEN_{gb}	**0.2038**	**0.0181**	**11.2364**	**7E-29**
Multiple R	0.6213			
R Square	0.3860			
ANOVA Significance F	0		Observations	4179

Table 3

$$R_{TRI,t} - R_{f,t} = -0.1881 + 0.7316Sen_{th,t} + 0.2038Sen_{gb,t} + \varepsilon_t$$

A similar result from the Price index, both the local investor sentiment index and global sentiment index significantly positively correlate with the market return of SET Total Return index, which adjusts the risk-free rate. Moreover, the greater effect to the market return is generating from local investor sentiment.

3) Granger causality test

The causality result shows in Table 4. The author tests the causality of the two investor sentiment indices to the return of two market indices by subtracting the risk-free using the Granger Causality Wald Tests. The author implements the lagged periods of 1, 5, 10, 21, 126, and 252. The results show that the lagged local investor sentiment does cause the market returns over a year. Similarly, the results show that the lagged global investor sentiment does cause the market returns over a year.

The results on the P value are rejecting the null hypothesis of the granger causality test. Thereby, the causality results interpret that the past information of the investor sentiments significantly cause the return of Thai Price index and Total return index, as corresponding those p-values are less than 0.05. However, the causal effects of investor sentiments are diminishing over the sample period, corresponding to the decreasing trend i n the value of causality. Despite that, the results have a limitation, which ascertains whether the time series of investor sentiments help predicate the return of Thai market indices. The results do not show how well does the investor sentiment index predicts the return of the Thai equity market index. Overall, customized investor sentiments significantly cause the Thai equity market return in the near year.

Table 4: The summary results of Granger Causality Test

Equation	Excluded	lag 1	lag 5	lag 10	lag 21	lag 126	lag 252
$Price\ Index$	SEN_{th}	*30.994****	*55.319****	*12.945****	*5.5636****	*2.077****	*1.571****
$Total\ Return\ Index$	SEN_{th}	*703.34****	*45.681****	*10.863****	*3.55****	*1.442****	*1.2117***
$Price\ Index$	SEN_{gb}	*209.72****	*11.459****	*5.0547****	*2.4184****	*1.3606****	*1.3292****
$Total\ Return\ Index$	SEN_{gb}	*290.07****	*19.1****	*7.5606*	*3.5137****	*1.5809****	*1.4584****

The null hypothesis: The Exculded dose not Granger-cause the Equation.

The values in the table are F statistics; ** represents the significance level of 5%, *** represents the significance level of 1%.

Table 4

From the results of the multivariate regression model, all the variables significantly correlate with the Thai equity market return. Therefore, the conclusion is that both customized investor sentiment indices have significant and researchable explanatory power to the market index return movement in the Thai equity market, emphasizing that the change in local investors' sentiments significantly affects Thai equity market movement. Additionally, the past information of customized investor sentiments has significant causality to the return of market index.

3. Predictive ability

One main goal of the research is that the sentiment index can be used to identify Thai stock market states, which classify the equity market into bull and bear states. Then using the customized local investor sentiment index and global investor sentiment index separately as the threshold variable. The authors use the local investor sentiment index and global investor sentiment index separately as the threshold variable, and the authors construct the multivariate threshold model, which estimates to capture the movement of the Thai stock market.

1) The Thai stock market classification using the threshold model

Figure 1: The comparisons between the sentiment indexes and the Thai total return index with its threshold values.

The sample period is from 3rd Jan 2002 to 31st Jan 2019 since the total return index of the SET is available starting from 2002. Using the statistical method, the upper threshold value of the local sentiment index is 1.4296, while the lower threshold value of the local sentiment index is -0.7255. The upper threshold value of the global sentiment index is 0.7754, while the lower threshold value of the global sentiment index is -1.457. All the threshold values are statistical significance at the 5% level of the T-test. Using the threshold values, three regions of the stock market have been classified and shown in the below charts, compared with the Thai Total return index.

From the Time series plot of the sentiment indices, the local sentiment index is moving opposite the global sentiment index. When the local investor is optimistic about the local equity market, they would more focus on the local market and pay less attention to the global market. Therefore, the global sentiment declines. When the global sentiment is optimistic, which means the global equity market has more investment opportunities, the Thai local investor would shift their eyes to the global market, thus the optimist of local sentiment is diminishing

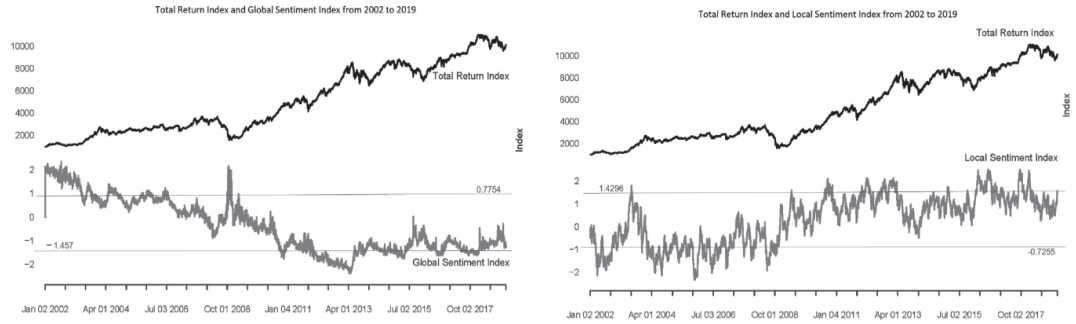

Figure 1: Total Return Index and Global Sentiment Index

The comparison between the local sentiment index and SET total return index shows that the local sentiment index is moving with the benchmark index in the same direction. When the local investors are optimistic, they are willing to invest their capital in the Thai stock market. Thus, it drives the benchmark index to go up. Such high-frequency fluctuation of the local sentiment index could reflect the investor's irrational financial behaviours. Additionally, the high-frequency oscillation could support that the local investors have a micro informational advantage in equity selection. The change of sentiment reflects the adjusting of their equity portfolio in real-time. The overall trend of the local sentiment index can reflect the Thai stock market movement. Therefore, it supports that the customized investor sentiment index positively correlates with market returns. The local optimistic (pessimistic) sentiment, the higher (lower) market returns on the local horizon.

The comparison between the global sentiment index and SET total return index shows that the global sentiment index is moving oppositely with the benchmark index. This comparison could imply that when the global sentiment index is high, the global investors are more optimistic about chasing the hot flood of other assets with relatively higher returns and become more risk lovers of another high-stake asset rather than investing in Thai stocks. When global investors find it challenging to handle the uncertainty of the global financial market, they will seek assets that could be able against the loss rather than a financial environmental downtrend. Therefore, the global investors would shift their capital to the Thai equity market against partial uncertainty in the global financial market. In addition to the relatively lower inflation in the Thai goods market and small bubble in stock prices,

this suggests that Thai listed stocks have "risk and loss resistance" in the downtrend of the global financial market than other assets with relatively higher national inflation and giant value bubble. It supports that the customized investor sentiment index negatively correlates with market returns. The global optimistic (pessimistic) sentiment, the lower (higher) market returns on the global horizon.

The estimation result of the multivariate threshold models (MTARs) is as respectively follows:

$$R_t = \begin{cases} -0.052 - 0.0016R_{t-1} + 0.0645R_{t-2} - 0.0512R_{t-3} + \varepsilon_{2t}, & if\ Sen_{th,\,t-1} \le -0.7255 \\ 0.0809 + 0.0491R_{t-1} + 0.0142R_{t-2} + \varepsilon_{2t}, & if\ -0.7255 < Sen_{th,\,t-1} \le 1.4296 \\ 0.1035 - 0.032R_{t-1} + 0.017R_{t-2} - 0.0783R_{t-3} - 0.0435R_{t-4} - 0.113R_{t-5} + \varepsilon_{3t}, & if\ 1.4296 < Sen_{th,\,t-1} \end{cases}$$

$$R_t = \begin{cases} 0.1036 - 0.0489R_{t-1} + \varepsilon_{1t}, & if\ Sen_{gb,\,t-1} \le -1.457 \\ 0.0533 - 0.0123R_{t-1} + \varepsilon_{2t}\ , & if\ -1.457 < Sen_{gb,\,t-1} \le 0.7754 \\ 0.0287 + 0.0923R_{t-1} + 0.0847R_{t-2} - -0.0028R_{t-3} + 0.0109R_{t-4} - 0.0462R_{t-5} - 0.0902R_{t-6} + 0.0228R_{t-7} \\ +0.0491R_{t-8} - 0.0744R_{t-9} + 0.1046R_{t-10} + \varepsilon_{3t}, & if\ 0.7754 \le Sen_{gb,\,t-1} \end{cases}$$

The AIC chooses the lag terms of the multivariate threshold autoregressive model. Using the Ljung-Box test, all the autoregressive models within the MTAR are consistent with time series stationary. The residual errors look like white noise.

With the different threshold values, the forecast model of each autoregressive in the MTAR is different. Based on the local sentiment index, the auto-regression in the bear period chooses three lag terms ($Sen_{th,\,t-1} \le -0.7255$). Nevertheless, the auto-regression based on the global sentiment index chooses one lag term ($Sen_{gb,\,t-1} \le -1.457$). In the natural period, auto-regression based on the local sentiment index chooses two lag terms ($-0.7255 < Sen_{th,\,t-1} \le 1.4296$). However, the auto-regression base on the global sentiment index chooses one lag term ($-1.457 < Sen_{gb,\,t-1} \le 0.7754$). In the bull period, the auto-regression base on the local sentiment index chooses five lag terms ($1.4296 < Sen_{th,\,t-1}$). By contrast, the auto-regression base on the global sentiment index chooses ten lag terms ($0.7754 \le Sen_{gb,\,t-1}$).

2) The predictive ability of models

Table 5: The averaging difference of MSFE and MAFE compared between the two models.

The result of Average difference(AF)

Table 5

	$AF_{(Martingale-AR_{(p)})}$	$AF_{(Martingale-MTAR_{th})}$	$AF_{(Martingale-MTAR_{gb})}$	$AF_{(AR_{(p)}-MTAR_{th})}$	$AF_{(AR_{(p)}-MTAR_{gb})}$	$AF_{(MTAR_{th}-MTAR_{gb})}$
MSFE	*0.359****	*0.516****	*0.353****	*0.157****	*-0.006*	*-0.163****
MAFE	*0.122****	*0.288****	*0.183****	*0.165****	*0.061****	*-0.104****

Note: $AR_{(P)}$ is Autoregression model with lag order p, $MTAR_i$ is the Multivariate threshold autoregression model.
*The values in the table are averaging difference bwtween two models; ** represents the significance level of 5%, ***represents the significance level of 1%*

From the result of MSFE, the Multivariate threshold autoregressive model based on the local sentiment index has the most statistical dominance in rank compared with the Martingale model, the Autoregression model and the Multivariate threshold autoregressive model based on the global sentiment index. The second statistical dominance model is the Multivariate threshold autoregressive model based on the global sentiment index, which has more minor forecast errors than the Martingale model. However, there is insignificance between the Autoregression model and the Multivariate threshold autoregressive model based on the global sentiment index. The least predictive ability is the Martingale model compared with other models. The results from MSFE suggest that the local sentiment index, as a reference to the Multivariate threshold model, had the most statistical advantage for predicting the aggregate movement of the Thai stock market. Additionally, the result suggests that the Multivariate threshold autoregressive model based on the global sentiment index has a better predictive ability to the aggregate movement of the Thai stock market than the Martingale model. Nevertheless, the predictive ability of the Autoregression model and the Multivariate threshold autoregressive model based on the global sentiment index are indifferent.

From the results of MAFE, the Multivariate threshold autoregressive model based on the local sentiment index has the most statistical dominance in rank like the result of MSFE. However, The Multivariate threshold autoregressive model based on the local sentiment index is the second statistical dominance in rank, which has more minor forecast errors than the Autoregression model with statistical significance. The third model is the Autoregression model, and the last is the Martingale model. The results from MSFE imply that using the local

sentiment index has a majority statistical advantage in predicting the aggregate movement of the Thai stock market. Then, the results imply that based on the global sentiment index has a better predictive ability on the aggregate movement of the Thai stock market than the Autoregression model then the Martingale model.

Overall, the above results indicate that the customized investor sentiment indexes have a better predictive ability of the Thai stock market movement, thus answering the second main research question of this paper, using the out-of-sample test, the customized investor sentiment index predicts the Thai stock market movement. Especially the local sentiment index is more reliable in forecasting the benchmark index based on MSFE and MAFE. The result implies that to predict the Thai stock market movement, the investor should pay more attention to the change in the local sentiment index. Furthermore, the authors suggest taking the global sentiment index as the second reference when the investors predict the entire stock market because of the deep global connection in nowadays financial market and the high degree of the open economic environment in Thailand.

4. The trading strategies

As the results from MSFE and MAFE, the customized investor sentiment index can predict the movement of the Thai stock market with fewer predictive errors. The authors apply the trading strategy for estimating the expected profit of the forecasting models, which includes the Martingale model, the simple Autoregression model, the Multivariate threshold autoregression model based on the local sentiment index and the Multivariate threshold autoregression model based on the global sentiment index.

Table 6: The expected profit result of using the forecasting models.

The Expected Profit Result of The Forecasting Models

Table 6

The Forecasting Models	*Mean Forecast Trading Return*
Martingale Model	*3.313%****
Simple Autoregression Model	*14.7%****
Multivariate Threshold Autoregression Model based on the Local Sentiment Index	*33.779%****
Multivariate Threshold Autoregression Model based on the Global Sentiment Index	*30.291%****

*The ***represents the significance level of 1%*

From the result of the mean forecast trading return of the forecasting models, The Multivariate threshold autoregression model (MTAR) based on the local sentiment index has a 33.779% expected return compared to the rest of the forecasting models. The multivariate threshold autoregression model (MTAR) based on the global sentiment index has a 30.291% of expected return. The Martingale and simple Autoregression models perform 3.313% and 14.7% of expected return, respectively. All the mean forecast trading returns are statical significant at the 1% level.

Table 7: The expected profit of trading strategies on the Total return index.

From the expected profit of trading strategies, the trading results show that the Total returns index gains 12.635% trading return following the local sentiment index to buy or sell. The implementation of the opposing the global sentiment index to buy or sell the Total returns index gains 9.293% trading return. The buy-and-hold strategy gains a 3.998% trading return. The results suggest that with different sentiment indexes, the trading strategy should keep different for chasing a higher profit.

The result supports the principle of trading strategies. The investors who use the trading strategy based on the local sentiment index should buy the Thai benchmark index when it exceeds its lower threshold, which means the local investors turn optimistic and buy the Thai stock market. When the local sentiment index falls below its lower threshold value, local investors turn pessimistic and have a higher probability of selling their Thai stocks. Then, selling the Thai stocks and moving the capital to other assets are recommendations. Therefore, following the local sentiment index could be more likely to gain a positive return.

The Expected Profit Result of Trading Strategies

Table 7

Trading Strategies	*Mean Forecast Trading Return*
Total Returns Index based on the Local Sentiment Index	*12.635%****
Total Returns Index based on the Global Sentiment Index	*9.293%****
Total Returns Index based on the Buy-and-Hold	*3.988%****

*The ***represents the significance level of 1%*

Unlikely the local sentiment index on the trading strategy, the investors who prefer the trading strategy based on the global sentiment index should invest in the Thai stock market when the global sentiment index is less than its upper threshold, which means the global investor turn to pessimistic to the other assets and seek for the assets that have well uncertainty-resistance. When the global sentiment index turns optimistic, the global market becomes boom. Then, the global investor would seek other assets that have expected higher returns as they are willing to bear more risk. The Thai stocks may be less returns-attractive to global investors. Selling the Thai stocks and chasing other assets would be better. Overall, opposing the global sentiment index could generate a higher profit.

As the paper mentions above, the MTAR of the local sentiment index follows the trading strategy of local sentiment, while the MTAR of the global sentiment index follows the trading strategy of global sentiment. The authors apply the Buy-and-Hold trading strategy to the Martingale and simple Autoregression models. Combining the results of the forecasting errors from the previous section, the paper suggests that the Multivariate threshold autoregression model based on the local sentiment index has the highest expected daily profit with the relatively lowest forecasting errors. The paper also implies that the Multivariate threshold autoregression model based on the global sentiment index has better expected daily profit with fair predictive ability than the Martingale model and simple Autoregression model. In addition to the trading result on the Total returns index, both sentiment indexes perform better than the Buy-and-hold strategy. Therefore, the paper recommends taking the customized investor sentiment indexes into account for the projection of the Thai benchmark movement. Moreover, the paper suggests using the customized investor sentiment indexes as a reliable reference to deal with daily trading.

Conclusions and Contributions

Studying the existing theories, the authors know there are noise traders in the stock market. The noise traders bring hazy information into the stock market and influence other investors through the social network. Thus, keeping a fully rational mind on investment behaviour is challenging for investors.

This paper studies the effects of customized investor sentiment in the Thai stock market from the existing concept of behavioural finance theory, which supports the applicability of behavioural finance theory in the Thai stock market, thus filling the gap of such research in the emerging financial market.

Research findings

This paper reviews the existing research to customize the two indicators by compiling composite investor sentiment using the first component of the principal component analysis (PCA). In addition to the result of the Granger Causality Wald Test, the findings of this paper are as follows:

1. The customized investor sentiment has a significant effect on the Thai equity market returns.
2. The customized local investor sentiment affects the market index returns more than the global investor sentiment over time.
3. The customized investor sentiment indices have significant time-delayed causality to the Thai equity market returns.

Furthermore, using the rolling out-of-sample method, the result from the estimation of predictive ability shows that the multivariate threshold autoregressive model based on the customized investor sentiment indices has fewer forecasting errors in the market index movement than other classical econometric models, such as the Martingale model and simple Autoregression model. Thus, the findings of this paper are as follows:

4. With a lagged term of customized sentiment indices, the local sentiment index is moving with the Total returns index of the Thai stock market in the same direction. However, the global sentiment index is moving with the Total return index in the pomposity direction.
5. The customized investor sentiment performs a high accuracy to predict the Thai equity market index movement, compared with other empirical econometric models.
6. In interval comparison of the customized sentiment indices, the local investor sentiment index has better forecast ability than the global investor sentiment index.

This paper designs a series of trading strategies to compare the average forecast return based on the forecasting models. The trading result shows that using the prediction returns of the Multivariate threshold autoregression model based on the customized local sentiment index achieves the highest expected trading profit than other empirical models. The Multivariate threshold autoregression model based on the customized global sentiment index achieves the second higher expected trading profit. Also, Using the change of customized investor sentiment indices have higher expected profit on the trading of the Total return index than the Buy-and-Hold strategy. Thus, the suggestions of this paper are as follows:

7. The daily equity traders should follow the trend of customized local sentiment to buy/sell the Thai benchmark index but oppose the trend of customized global sentiment to buy/sell the Thai benchmark index.
8. The daily equity traders should use the prediction from the multivariate threshold autoregression models based on the customized investor sentiment as a signal to buy/sell the Thai equity.
9. Compared with the passive trading method, following the change of customized investor sentiment indices to buy/sell the Thai equity on intraday is a recommended trading strategy.

Research contributions

This paper offers a small contribution to the growth of literature studying the role of customized investor sentiment:

1. As the lack of literature on the studying of investor sentiment in the emerging financial market, this paper customizes two indices using the local and global factors to study the movement of the Thai stock market's return, calling the local sentiment index and the global sentiment index, which are relatively more minor research focus. Also, this research extends the study of the global factors on the Thai market index returns.
2. The authors emphasize the localized investor sentiment. The segmentation of the customized investor sentiment would have a more substantial predictive power on the Thai equity market's return movement, comparing the existing research that mainly focuses on the explanation power of general investor sentiment.

This paper contributes to the customized investor sentiments by focusing on factors that could reflect the local and global properties, respectively, based on the previous literature studies:

3. The variables for constructing the local sentiment index include the market turnover, the Thai T-bill rate, the relative strength index, and the local gold price index.
4. The variables for constructing the global sentiment index includes the U.S. T-bill rate, the S&P 500 index, the Exchange rate, and the Chicago board options exchange volatility index (VIX).

Although the existing research provides evidence of investor sentiment can forecast the market return, it lacks the estimation of the predictive ability of investor sentiment in the stock market, thereby offering investment suggestion, especially the studies in the emerging market.

5. This paper estimates the predictive ability of customized investor sentiment compared with other classical econometric models. Customizing the investor sentiment is a valuable predictive reference for the Thai benchmark movement.
6. This research estimates the expected profit of customized investor sentiment on the Thai equity market and then offers the researchable investment strategy for investors who like to use investor sentiment as a signal to buy/sell equity, which follows the local investor sentiment but opposes the global investor sentiment.

Limitation

The literature indicates that investor sentiment reflects individual investors' subjective preference for the financial market. Additionally, retail investors in different financial markets react differently to the financial market change. Researchers utilize various variables to estimate the investor sentiment based on their subjective background. Thus, identifying the full variables of the investor sentiment index is a long-term journey and needs horizontal and vertical study resources. The papers admins that there are inappropriate estimations on selective variables, such as the Thai gold price index, which dominates the significant effect on the customized local sentiment index, and the US T-bill rate, return of the S&P 500 index,

which may contain the systematic risk of US market, affecting the measurement of global sentiment index. Therefore, this paper enlightens future research exploring other potential variables with more market explanatory power, measuring the selective variables appropriately, and better reflecting the subjective preference of the retail investor.

Last but not least, using high-frequency data in this paper aim to capture the rapid reaction of investor sentiment to the change in the Thai stock market. The side-effect is that such high-data frequency customizes and estimates the effects of the investor sentiment could contain the volatile market noise. Therefore, further study may consider using comparable low-frequency data to construct the investor sentiment index. Moreover, future research could expense other econometric models to examine, thereby improving investor sentiment's predictive accuracy.

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