Thailand and The World Economy
P-ISSN: 2630-0931
E-ISSN: 2651-0529
Homepage : https://www.tci-thaijo.org/index.php/TER
Vol. 43, No.1, January – April 2025 **Page [72-84]**

Gambling-Motivated Attention and Improved Market Efficiency

*Anya Khanthavit**
Faculty of Commerce and Accountancy, Thammasat University, Thailand.

Received 20 June 2023, Received in revised form 4 December 2023,
Accepted 12 December 2023, Available online 6 January 2025

Abstract

Information is incorporated into stock prices when investors trade; consequently, prices respond only to the information investors pay attention to. Because market efficiency requires rapid information dissemination and fully informative prices, attention necessarily affects the level of market efficiency. This study examines the role of retail investors' market attention in determining the Stock Exchange of Thailand's market efficiency. This unobservable market attention is measured using the Google search volume index for H̄ûn thịy or Thai stock and a daily sample ranging from August 6, 2008, to March 31, 2023 (3,573 observations). The autocorrelation test does not contradict the efficient market hypothesis, indicating that market attention neither improves nor reduces efficiency. Attention is then decomposed into two components: investment- and gambling-motivated attention. Additional testing of these two components shows that the nonsignificant result against the null hypothesis is the net effect of the inefficiency and improved efficiency induced by gambling-motivated attention. Noise trading induced by gambling-motivated attention plays an important role in improving efficiency by attracting the attention of sophisticated institutional investors. These investors then aggressively search for information to trade against and benefit from retail investors. The resulting trades incorporate new information into prices, improving efficiency.

Keywords*:* Behavioral Finance, Gambling, Market Attention, Market Efficiency
JEL Classifications: G14, G41

* **Corresponding author**: Email: akhantha@tu.ac.th

1. Introduction

The efficient markets hypothesis (EMH) is one of the most important hypotheses underlining economic and finance theories. Under the EMH, markets are considered informationally efficient; that is, all information is immediately disseminated to all investors and fully incorporated into stock prices. Consequently, no investor can trade to earn abnormal returns (Fama, 1970). In spite of its significance, the hypothesis has been rejected by most empirical studies based on alternative tests for markets worldwide. The different behaviors of diverse investor types are considered a key factor in the deviation from full efficiency (Guo & Wong, 2016; Yen & Lee, 2008).

Information is incorporated into prices through investor trading (Bagehot, 1971). Huberman & Regev (2001) noted that prices respond only to the information investors pay attention to, and Boulland et al. (2017) reported that the level of the price response to information varies with the level of investor attention. As such, investor attention determines the level of market efficiency (Vozlyublennaia, 2014).

On the one hand, attention improves market efficiency via information acquisition and active searches (Grossman & Stiglitz, 1980; Vozlyublennaia, 2014), herding and synchronicity (Koch & Dimpfl, 2023), reduction of idiosyncratic risk (Chen, 2021), over- and under-reactions (Ahmad & Oriani, 2022), and sentiment (Mbanga et al., 2019). On the other hand, market efficiency can be reduced by attention. This occurs through mechanisms such as limited attention (Andrei & Hasler, 2015), noise trading (Da et al., 2011; Dong, 2020; Ibikunle et al., 2020), and stale or valueless information (Black, 1986). Empirical studies have reported inconsistent results. For example, Vozlyublennaia (2014) and Koch & Dimpfl (2023) support attention as improving efficiency, while Dong (2020), Han et al. (2018), and Jiang et al. (2022) reported that attention reduces efficiency. In Tantaopas et al.'s (2016) international study, attention improved efficiency for six markets, while four markets showed no effects.

Researchers have decomposed attention into different components; these components can affect market efficiency in different directions or to different degrees. Han et al. (2018) classified attention as pessimistic and optimistic. For six developed and nine developing markets, they found that attention reduced efficiency, and pessimistic attention was more influential than optimistic attention. Chen (2021) studied investor-based and information effects of investor attention in the U.S. market and showed that investor-based effects led to mispricing and inefficiency, while information effects increased the speed of information dissemination and, therefore, improved market efficiency. Recently, Khanthavit (2023) decomposed attention into investment- and gambling-motivated components. For the Thai stock market, the gambling-motivated component affected return volatility more than the investment-motivated component, and the effects were positive and significant. However, Khanthavit's (2023) study did not test how the two components affect market efficiency.

This study tests the effects of retail investors' attention on the Stock Exchange of Thailand's (SET) market efficiency using a daily sample from August 6, 2008, to March 31, 2023. Retail investors' attention has continually received strong interest from researchers (e.g., Da et al., 2011; Vozlyublennaia, 2014; Xu et al., 2023). This study focuses on retail investors' market attention. Retail investors tend to pay attention to market and sector information rather than firm-specific information (Peng & Xiong, 2006; Vlastakis & Markellos, 2012). This unobservable attention is measured using the Google search volume index (SVI), which is a revealed attention measure. Retail investors search Google for the information that they pay attention to (Da et al., 2011).

The SET is chosen as the sample market because of its importance in terms of market size and retail investors' strong participation (Khanthavit, 2023).

This study extends the test for attention effects to cover the effects of investment- and gambling-motivated components. Investment-motivated attention should improve efficiency due to information acquisition, fast dissemination, and risk and bias reduction. However, this attention may also create noise trading and reduce efficiency if the information is stale or valueless.

On the one hand, gambling-motivated attention tends to bring noise into the market and reduce efficiency. On the other hand, retail investors' trades—based on stale or valueless information from investment-motivated attention or even noise from gambling-motivated attention—can improve market efficiency. Such trades attract informed investors (Wu & Shamsuddin, 2014), who will trade against retail investors and benefit from them (Daniel & Titman, 1999). Informed investors aggressively search for information before making trades (Huang, 2015). If activities occur rapidly, information is incorporated into prices almost immediately. Because the two components can both improve or reduce market efficiency, their actual effects are an empirical question.

Tantaopas et al. (2016) studied and found that attention had a nonsignificant effect on the SET's efficiency. The nonsignificant result does not necessarily imply that the attention effect does not exist. The effects of investment- and gambling-motivated attention can have opposite signs and, therefore, cancel each other out. This study helps explain the nonsignificant result.

2. Methodology

2.1 The Model

This study considers market efficiency in its weak form. Efficiency is tested by evidence of significant return autocorrelation. The dynamics of returns are described by an autoregressive process of order 1 (AR(1)), as shown in Equation (1).

$$R_t = \rho_0 + \rho_{1,t} R_{t-1} + \varepsilon_t, \tag{1}$$

where R_τ is the stock return on days $\tau = t, t-1$ and ε_t is the regression error. The coefficients ρ_0 and $\rho_{1,t}$ are the intercept and AR(1)-slope coefficient, respectively. When $\rho_{1,t}$ is significant, the results provide evidence against the EMH. The choices of the AR(1) specification and time-varying $\rho_{1,t}$ follow Khanthavit (2016) and Lo (2004), while time-varying $\rho_{1,t}$ is general. When $\rho_{1,t}$ is a constant ρ_1, the test is a conventional autocorrelation test for the EMH (Jenwittayaroje, 2021). Setting $\rho_{1,t} = \rho_1$, Equation (1) becomes

$$R_t = \rho_0 + \rho_1 R_{t-1} + \varepsilon_t. \tag{2}$$

When $\rho_{1,t} = \rho_1 + \rho_1^A A_{t-1}$, Equation (1) is Vozlyublennaia's (2014) test for the effect of investor attention on market efficiency. The variable A_{t-1} is investor attention on day $t-1$. The coefficient ρ_1^A represents the effect of a unit change in investor attention on market efficiency. Substituting $\rho_1 + \rho_1^A A_{t-1}$ for $\rho_{1,t}$ in Equation (1) gives

$$R_t = \rho_0 + \left(\rho_1 + \rho_1^A A_{t-1}\right) R_{t-1} + \varepsilon_t, \tag{3.1}$$

so that

$$R_t = \rho_0 + \rho_1 R_{t-1} + \rho_1^A A_{t-1} R_{t-1} + \varepsilon_t. \tag{3.2}$$

Market attention can be motivated by investment and gambling (non-investment) propensities (Markiewicz & Weber, 2013). The attention variable A_t results from two different motivations. This study follows Khanthavit (2023) to decompose attention A_{t-1} into an investment-motivated component I_{t-1} and a gambling-motivated component G_{t-1}. That is, $A_{t-1} = I_{t-1} + G_{t-1}$. The coefficient $\rho_{1,t}$ becomes $\rho_1 + \rho_1^I I_{t-1} + \rho_1^G G_{t-1}$. The coefficients ρ_1^I and ρ_1^G are the effects of investment- and gambling-motivated attention, respectively. Equation (1) is modified as shown in Equation (4.1):

$$R_t = \rho_0 + \left(\rho_1 + \rho_1^I I_{t-1} + \rho_1^G G_{t-1}\right) R_{t-1} + \varepsilon_t. \quad (4.1)$$

Rearranging the terms in Equation (4.1) gives the estimation model in Equation (4.2):

$$R_t = \rho_0 + \rho_1 R_{t-1} + \rho_1^I I_{t-1} R_{t-1} + \rho_1^G G_{t-1} R_{t-1} + \varepsilon_t. \quad (4.2)$$

2.2 Decomposition of Attention

This study applies Khanthavit's (2023) methodology to decompose the attention variable A_t into its investment-motivated component I_t and gambling-motivated component G_t. Let $G_{j,t}$ be a gambling-related variable $j = 1, \ldots, n$. The variable G_t is the most influential principal component (PC) for the variable set $\left[A_t, G_{1t}, \ldots, G_{n,t}\right]$ whose correlations with $G_{1t}, \ldots, G_{n,t}$ are positive. Because the variable G_t represents non-investment attention, this study estimates the variable I_t for investment attention by the regression residual of A_t on G_t.

2.3 Estimation and Test

The models in Equations (1), (2), (3.2), and (4.2) are linear regression models, which are estimated using the ordinary least squares regression (OLS) technique. The standard deviations of the coefficients are Newey & West's (1987) heteroskedasticity and autocorrelation consistent (HAC) standard deviations. Significant coefficients are tested with t tests.

3. The Data

3.1 Sample Period

The sample is a daily sample beginning on August 6, 2008, and ending on March 31, 2023 (3,573 observations). This study employs Google SVIs to measure retail investors' unobservable market attention. Although Google first reported SVIs on January 1, Challet & Ayed (2014) warned that SVIs before August 6, 2008, were not reliable. Hence, August 6, 2008, was chosen for the first observation, and March 31, 2023, was the last observation date available for this study.

3.2 The Variables

3.2.1 Stock Return

The sample market is the SET, which is Thailand's largest stock exchange. The return R_t is a logged return, computed from the SET index, which is a value-weighted average index of all listed stocks on the SET. The SET index is retrieved from the SET database.

3.2.2 Retail Investors' Market Attention

Retail investors tend to use Google to search for stock, sector, and market information, whereas institutional investors have databases of their own or have access to more sophisticated information services (Da et al., 2011). Following Khanthavit (2023), *H̄ûn thịy*, meaning Thai stock in the Thai language, was chosen for the Google SVI query to measure retail investors' market attention. Its SVI level is significantly higher than those of alternative queries such as *Tlādh̄ûn* or stock market, *Rākhā h̄ûn* or stock price, and *SET Index*.

The attention variable A_t is constructed from the *H̄ûn thịy* SVI. The SVI is detrended by the logged time trend, and de-seasonalized by the days of the week and months of the year. Finally, the detrended and de-seasonalized series are standardized by their mean and standard deviation.

3.2.3 Investment- and Gambling-Motivated Attention

Three ($n = 3$) gambling-related variables were chosen for G_{jt} to construct gambling-motivated attention G_t. The three variables are *Lek̄h dĕd* or *lucky-number* SVI, lagged volatility, and lagged skewness (Khanthavit, 2023). The *Lek̄h dĕd* SVI is processed in the same way as the *H̄ûn thịy* SVI. Volatility is Parkinson's (1980) range-based volatility of the SET index portfolio's return R_t, whereas skewness is the cubed return over cubed volatility. The maximum and minimum SET indexes for the volatility and skewness calculations are retrieved from the SET database. The *Lek̄h dĕd* SVI was downloaded from the website https://trends.google.co.th/home.

The variable G_t is the most influential PC of the *H̄ûn thịy* SVI, *Lek̄h dĕd* SVI, lagged volatility, and lagged skewness. The correlations of G_t with the *Lek̄h dĕd* SVI, lagged volatility, and lagged skewness must be positive; as such, G_t is not necessarily the first component (Khanthavit, 2018). Investment-motivated attention I_t is the regression residual of A_t on G_t. Finally, the variables I_t and G_t are standardized by their means and standard deviations.

3.3 Descriptive Statistics

In Column 2 of Table 1, the statistics reveal that the return distribution is negatively skewed and fat tailed. The Jarque-Bera statistic rejects the normality hypothesis, and the augmented Dickey-Fuller statistic indicates that the return is a stationary variable. Finally, the variable is not serially correlated at its first order.

Columns 3 to 5 report the statistics of market attention and its investment- and gambling-motivated components. The three variables are stationary, positively skewed, and fat tailed. They are not normally distributed, whereas their first-order autocorrelations are positive and significant. Significant autocorrelation supports the use of HAC standard deviations. When regression errors are autocorrelated or heteroskedastic, HAC standard deviations remain consistent (Newey & West, 1987).

Table 1: Descriptive Statistics

Statistic	Return	Market Attention	Components of Market Attention	
			Investment-Motivated	Gambling-Motivated
Average	0.0002	0.0000	0.0000	0.0000
Standard Deviation	0.0117	1.0000	1.0000	1.0000
Skewness	-1.0866	0.8367	0.8061	2.7667
Excess Kurtosis	13.3574	0.9497	0.7546	19.7145
First-Order Autocorrelation	0.0195	0.9365***	0.9296***	0.3195***
Jarque-Bera Statistic	2.73E+04***	5.51E+02***	4.72E+02***	6.24E+04***

Statistic	Return	Market Attention	Components of Market Attention	
			Investment-Motivated	Gambling-Motivated
Augmented Dickey-Fuller Statistic	-23.4807***	-4.1499***	-3.9682***	-9.8107***

*Note: *** denotes significance at the 99% confidence level.*
Source: Author's calculation.

Gambling-motivated attention G_t in Table 1 is the third PC. It is the only PC whose correlations with *Lekh̄ dĕd* SVI, lagged volatility, and lagged skewness are positive. The correlations are significant at the 99% confidence level. The variable G_t explains 22.52% of the variation of the data set (*H̄ûn thị y* SVI, *Lekh̄ dĕd* SVI, lagged volatility, lagged skewness); the first PC explains 31.82%.

By construction, $A_t = I_t + G_t$. The variables I_t and G_t can explain 98.51% and 1.49% of A_t, respectively. The low explanatory power of G_t does not necessarily imply that G_t has a small effect on market efficiency. Investors' trades help incorporate information into stock prices (Bagehot, 1971). Mosenhauer, Newall, and Walasek (2021) reported that more trades are generated by gambling-motivated attention than investment-motivated attention.

4. Empirical Results

4.1 Autoregressive Model

This study estimates the AR(1) model in Equation (2) for a conventional autocorrelation test for the EMH. Under the null hypothesis, the coefficient $\rho_1 = 0.00$. From Table 1, the estimate equals 0.0195 and is nonsignificant, meaning that the EMH cannot be rejected. The nonsignificant AR(1) coefficient is similar to that of Tantaopas et al. (2016) and that for the early sample of Jenwittayaroje (2021).

The coefficient ρ_1 can be interpreted as the average speed of information dissemination, net of the effect of retail investors' attention. In Equations (3.1) and (3.2), if the coefficients ρ_1 and ρ_1^A are significant but possess opposite signs, attention improves efficiency (Tantaopas et al., 2016). The net effect averages zero.

4.2 Effect of Market Attention

An OLS regression is conducted using Equation (3.2) to test for the role A_t plays in market efficiency. If attention improves market efficiency, the coefficients ρ_1 and ρ_1^A will be significant with opposite signs. If ρ_1 and ρ_1^A are significant with the same sign, it suggests that attention reduces efficiency. From the estimation, $\rho_1 = 0.0200$ and $\rho_1^A = -0.0016$; both are nonsignificant. This nonsignificant result is similar to Tantaopas et al.'s (2016) result for the Thai market. Although the coefficients ρ_1 and ρ_1^A have opposite signs, the results do not provide conclusive evidence that attention improves market efficiency.

4.3 Effects of Investment- and Gambling-Motivated Attention

Retail investors' attention is decomposed into investment- and gambling-motivated attention. Investment-motivated attention improves market efficiency (Grossman & Stiglitz, 1980), whereas gambling-motivated attention reduces it (Da et al., 2011). The effects of the two components cancel each other out; therefore, it is possible that this cancelling out explains the nonsignificant coefficients ρ_1 and ρ_1^A. The model in

Equation (4.2) is estimated to measure the effects of investment- and gambling-motivated attention on market efficiency. The results are reported in Column 2 of Table 2.

Table 2: Effects of Investment- and Gambling-Motivated Attention on Market Efficiency

Coefficient	Investment- and Gambling-Motivated Attention						Institutional Selling
	H̄ûn thiy SVI				*Tlādh̄ûn* SVI	*SET Index* SVI	
	Full Sample			COVID-19 Sample			
	OLS	GMM	Time				
ρ_1	0.0460**	0.0799*	0.0014	0.0565	0.0375*	0.0865***	0.0982**
ρ_1^I	0.0020	0.0659	-0.0095	-0.0497	-0.0080	-0.0661***	-0.0230
ρ_1^G	-0.0295***	-0.0929**	-0.0284***	-0.0654*	-0.0474***	-0.0341***	
ρ_1^T			0.2881				
ρ_1^S							-0.7931*

Note: *, **, *and* *** *denote significance at the 90%, 95%, and 99% confidence levels, respectively.*
Source: Author's calculation.

If investment- or gambling-motivated attention improves market efficiency, the coefficient ρ_1 must be different from zero. Moreover, the coefficients ρ_1^I and ρ_1^G must be significant with signs opposite that of ρ_1. The results show that the coefficient ρ_1 is significantly positive, whereas the coefficient ρ_1^G is significantly negative. The coefficient ρ_1^I is positive but nonsignificant. This result leads to the conclusion that gambling-motivated attention helps improve the Thai market's efficiency. The fact that the average net effect ρ_1 in Equation (2) is nonsignificant is explained by the netting effect from gambling-motivated attention. Moreover, the nonsignificant coefficients ρ_1 and ρ_1^A are also explained by the average net effect.

5. Discussion

5.1 Robustness Check

5.1.1 Endogeneity Problem

The autoregressive model in Equation (2) exhaustively describes the return R_t by its lag (Sims, 1980). The variable is endogenous and measured without error; thus, endogeneity problems do not affect the OLS estimation. Equations (4.1) and (4.2) extend the AR(1) model in Equation (2). In this study, OLS is used to estimate Equation (4.2). The variables on the right-hand side are explanatory variables. These variables may be measured with errors or may not be able to exhaustively explain the return. Despite the fact that it originates from an AR model, Equation (4.2) is effectively a linear regression model. Thus, endogeneity problems may arise, and OLS cannot be used.

Equation (4.2) is re-estimated, and possible endogeneity problems are resolved by using the generalized method of moments (GMM) method. GMM is an instrumental variable (IV) regression technique that returns consistent, asymptotically normal, and efficient estimates even for non-normal variable specifications (Hansen, 1982). The weighting matrix was the HAC matrix. It is a heteroskedasticity and autocorrelation consistent estimator of the long-run covariance matrix of orthogonality conditions based on an initial estimate of the coefficients. This study employs Racicot & Théoret's (2010) two-step technique to construct the IVs. Pal's (1980) IVs are the inputs in the first step.

The GMM results are reported in Column 3 of Table 2 and are consistent with the OLS results in Column 2. The coefficients ρ_1 and ρ_1^G are significantly positive and negative, respectively, whereas the coefficient ρ_1^I is nonsignificant.

5.1.2 Alternative Search Queries

The *Hūn thịy* SVI is used to measure retail investors' market attention. This query is the most actively searched among possible market-attention-related queries. The *Hūn thịy* SVI refers to Thai stocks, whereas alternatives such as the *Tlādh̄ûn* SVI and *SET Index* SVI are associated with stock market and stock price attention, respectively. This study checks whether having market attention in different areas affects the result. The *Tlādh̄ûn* SVI and *SET Index* SVI replace the *Hūn thịy* SVI, and Equation (4.2) is re-estimated.

Columns 6 and 7 of Table 2 report the results for the *Tlādh̄ûn* and *SET Index* SVIs; these results are very similar to those for the *Hūn thịy* SVI in Column 2.

5.1.3 Improving Market Efficiency

It is unlikely that a market is efficient in its early years. Over time, as investors gain more experience and market systems develop further, the level of efficiency improves (Zalewska-Mitura & Hall, 1999). Khanthavit (2016) and Sukpitak & Hengpunya (2016) reported rising efficiency in the Thai market. The coefficient ρ_1 measures the efficiency level; if efficiency improves, the absolute value of ρ_1 must be smaller over time.

The effect of improving efficiency is incorporated by adding the regressor $\rho_1^T \frac{1}{T_t} R_{t-1}$ in Equation (4.2) and estimating the new equation. The variable T_t is the logged time trend on day t. The fact that the coefficients ρ_1 and ρ_1^T are significant and have the same sign indicates improving efficiency.

Column 4 of Table 2 shows that the signs of ρ_1 and ρ_1^T are positive, which is consistent with the positive ρ_1 in Column 2. However, they are both nonsignificant. Therefore, a test is conducted for the joint hypothesis of $\rho_1 = 0$ and $\rho_1^T = 0$. Under the null hypothesis of no improvement, the Wald statistic is a chi-squared variable with 2 degrees of freedom. The statistic is 6.9142 and is significant at the 95% confidence level. The results for the coefficients ρ_1^I and ρ_1^G in Column 4 are similar to those in Column 2. The result for the coefficients ρ_1^I and ρ_1^G, together with the significant Wald statistic for the joint test, leads to maintaining the conclusion that market efficiency is improved by gambling-motivated attention.

5.2 COVID-19 Pandemic

COVID-19 is a contagious viral disease that led to a world health and economic crisis, referred to as the COVID-19 pandemic. It brought fear to investors (Vasileiou, 2021) and made them pay more attention to macro news (Xu et al., 2023). Vasileiou (2021) and Xu et al. (2023) consistently reported worsening market efficiency in the U.S. market during the pandemic period. This study checks how the COVID-19 pandemic affects attention's role in determining the Thai market's efficiency. A pandemic-sample period from April 3, 2020, to September 30, 2022, was employed to estimate Equation (4.2). April 3, 2020, was chosen as the first day of the pandemic because that is the day the Thai government imposed its first curfew to contain the spread of the disease ("Curfew starts on Friday", 2020). The country reclassified COVID-19 from a dangerous communicable disease to a communicable disease under surveillance on September 30, 2022. Hence, that day is considered the end of the pandemic in Thailand ("Thailand ends COVID-19", 2022).

The results for the pandemic sample are reported in Column 5 of Table 2. The coefficients ρ_1^I and ρ_1^G are nonsignificant and significantly negative, respectively. This is similar to the full sample result. The coefficient ρ_1^G for the pandemic sample is -0.0654. The statistic's absolute value is much larger than that of the coefficient $\rho_1^G(-0.0295)$ for the full sample. The coefficient's larger size is consistent with the fear associated with COVID-19 (Vasileiou, 2021) and the increasing attention on COVID-19 in the macro news (Xu et al., 2023). The coefficient ρ_1 is positive. Gambling-motivated attention helps in terms of efficiency improvement during the pandemic period. However, the coefficient ρ_1 is nonsignificant, and its size is about the same as that for the full sample. This finding could be explained by the low power of the test due to the much smaller sample size for the pandemic period than the full period. Another explanation could be that the nonsignificance is the result of the improved efficiency during the SET's recent years (Khanthavit, 2016; Sukpitak & Hengpunya, 2016).

5.3 Explanation for Improved Market Efficiency

This study's results show that gambling-motivated attention helps improve the SET's market efficiency. Because gambling is non-informational, gambling-motivated attention should induce noise trading (Da et al., 2011). This should reduce market efficiency, not improve it (Ibikunle et al., 2020). Thus, how is improvement possible?

One explanation could be that the active trading of informed institutional investors dominates the noise trading of retail investors. Noise trading attracts institutional investors (Wu & Shamsuddin, 2014), who aggressively search for information to create gains from trades (Huang, 2015). This new information is revealed and incorporated into stock prices (Bagehot, 1971). Ozdamar et al. (2022) found such behavior by retail and institutional investors in the cryptocurrency market.

Barber & Odean (2008) found that retail investors in the U.S. market buy attention-grabbing stocks. Because their attention is limited, they must focus their attention on a small number of stocks, and they can only sell stocks that they already own. Institutional investors benefit from this gambling-motivated buying by selling or short-selling attention-grabbing stocks to these gambling-motivated retail investors.

This study relies on Barber & Odean (2008) and uses institutional investors' selling volume to test the institutional-trading explanation. In the tests, selling volume is scaled by total market trading volume. The volume data are retrieved for the SET database.

5.3.1 Regression Test

If institutional selling is induced by retail investors' gambling-motivated attention, it necessarily helps improve market efficiency. In this study, the term $\rho_1^S S_{t-1} R_{t-1}$ is substituted for $\rho_1^G G_{t-1} R_{t-1}$ in Equation (4.2). The variable S_{t-1} is institutional investors' selling volume on day $t-1$. The linear regression model is modified to the one shown in Equation (5).

$$R_t = \rho_0 + \rho_1 R_{t-1} + \rho_1^I I_{t-1} R_{t-1} + \rho_1^S S_{t-1} R_{t-1} + \varepsilon_t \quad (5)$$

If the institutional-trading explanation is correct, the coefficient ρ_1^S must be negative and significant. The results are reported in Column 7 of Table 2. The coefficient ρ_1^S equals -0.7931 and is significant at the 90% confidence level. The remaining coefficients ρ_1 and ρ_1^I are nonsignificant and significantly positive, respectively. The results are similar to those in Column 2.

5.3.2 Contemporaneous-Causality Test

The result for ρ_1^S reveals a significant correlation between gambling-motivated attention and institutional investors' selling volume, which show similar effects on market efficiency. The sufficient condition for the institutional-trading explanation is the causality of gambling-motivated attention for institutional investors' selling volume. The directed acyclic graph (DAG) (Swanson & Granger, 1997) is employed to test contemporaneous causality. The institutional-trading explanation requires a uni-directed edge of the form $(G_t \rightarrow S_t)$. The DAG test finds the $(G_t \rightarrow S_t)$ relationship, which is significant at the 99% confidence level.

6. Conclusions

The efficient market hypothesis is the foundation of economic and finance theories and has been extensively tested. However, it is not supported by most studies, and behavioral factors are one of the key explanations. This study examines the role of retail investors' market attention in determining the level of efficiency. It extends previous studies by decomposing attention into its investment- and gambling-motivated components. The effects of these two components tend to be opposite and cancelling; thus, tests based on the decomposed components are more insightful regarding each component's separate role.

The sample market is the SET. The study's autocorrelation test results show that the efficient market hypothesis cannot be rejected. Additional testing of attention's two components—investment- and gambling-motivated attention—shows that the nonsignificant result against the null hypothesis is the net effect of the inefficiency and improved efficiency induced by gambling-motivated attention. The improvement in market efficiency resulting from noise trading induced by retail investors' gambling-motivated attention can be explained as follows: Noise trading attracts institutional investors, who aggressively search for information to trade against and benefit from noise traders. As a result, new information is incorporated into stock prices after the trades, and market efficiency improves.

This study can be extended in at least two directions. First, attention is not limited to market attention; alternatives include war and terrorism, pandemics, corporate events, air quality, and sustainability. It would be interesting to examine whether the investment- and gambling-motivated components of different types of attention have similar or different effects. Second, some markets, such as the Chinese, Indian, and Vietnamese markets, also have large retail investor groups, and the methodology used in this study can be applied to study these markets. These two extensions are left for future research.

Acknowledgments

The author would like to thank the Faculty of Commerce and Accountancy, Thammasat University, for the research grant; the Stock Exchange of Thailand for stock market data; and Chanya Siriarayaphan for research assistance.

References

Ahmad, F., & Oriani, R. (2022). Investor attention, information acquisition, and value premium: A mispricing perspective. *International Review of Financial Analysis*, *79*, 101976.

Andrei, D., & Hasler, M. (2015). Investor attention and stock market volatility. *Review of Financial Studies*, *28*(1), 33–72.

Bagehot, W. (1971). The only game in town. *Financial Analysts Journal*, *27*(2), 12–14.

Barber, B. M., & Odean, T. (2008). All that glitters: The effect of attention and news on the buying behavior of individual and institutional investors. *Review of Financial Studies*, *21*(2), 785–818.

Black, F. (1986). Noise. *Journal of Finance*, *41*(3), 528–543.

Boulland, R., Degeorge, F., & Ginglinger, E. (2017). News dissemination and investor attention. *Review of Finance*, *21*(2), 761–791.

Challet, D., & Ayed, A. B. H. (2014). Predicting financial markets with Google Trends and not so random keywords. New York: Cornell University. Retrieved from https://arxiv.org/pdf/1307.4643

Chen, Z. (2021). Investor attention and market correction. *Review of Behavioral Finance*, *13*(4), 386–409.

Curfew starts on Friday: All travel to nation halted for 2 weeks. (2020, April 3). *Bangkok Post*. Retrieved from https://www.bangkokpost.com/thailand/general/1891910/curfew-starts-today

Da, Z., Engelberg, J., & Gao, P. (2011). In search of attention. *Journal of Finance*, *66*(5), 1461–1499.

Daniel, K., & Titman, S. (1999). Market efficiency in an irrational world. *Financial Analysts Journal*, *55*(6), 28–40.

Dong, F. (2020). Noise-driven abnormal institutional investor attention. *Journal of Asset Management*, *21*, 467–488.

Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *Journal of Finance*, *25*(2), 383–417.

Grossman, S. J., & Stiglitz, J. E. (1980). On the impossibility of informationally efficient markets. *American Economic Review*, *70*(3), 393–408.

Guo, X., & Wong, W. (2016). Multivariate stochastic dominance for risk averters and risk seekers. *RAIRO—Operations Research*, *50*(3), 575–586.

Han, L., Li, Z., & Yin, L. (2018). Investor attention and stock returns: International evidence. *Emerging Markets Finance and Trade*, *54*(14), 3168–3188.

Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica*, *50*(4), 1029–1054.

Huang, E. J. (2015). The role of institutional investors and individual investors in financial markets: Evidence from closed-end funds. *Review of Financial Economics*, *26* (1), 1–11.

Huberman, G., & Regev, T. (2001). Contagious speculation and a cure of cancer: A nonevent that made stock prices soar. *Journal of Finance*, *56*(1), 387–396.

Ibikunle, G., McGroarty, F., & Rzayev, K. (2020). More heat than light: Investor attention and bitcoin price discovery. *International Review of Financial Analysis*, *69*, 101459.

Jenwittayaroje, N. (2021). Testing weak-form market efficiency in the Stock Exchange of Thailand. *Global Business and Economic Review*, *24*(3), 211–224.

Jiang, L., Liu, J., Peng, L., & Wang, B. (2022). Investor attention and asset pricing anomalies. *Review of Finance*, *26*(3), 563–593.
Khanthavit, A. (2016). The fast and slow speed of convergence to market efficiency: A note for large and small stocks on the Stock Exchange of Thailand. *Social Science Asia*, *2*(2), 1–6.
Khanthavit, A. (2018). Investors' weather-related moods and the stock market. *Human Behavior, Development and Society*, *19*, 7–15.
Khanthavit, A. (2023). Gambling-motivated market attention and stock market volatility. *ABAC Journal*, *43*(2), 1–11.
Koch, S., & Dimpfl, T. (2023). Attention and retail investor herding in cryptocurrency markets. *Finance Research Letters*, *51*, 103474.
Lo, A. (2004). The adaptive markets hypothesis. *Journal of Portfolio Management*, *30*(5), 15–29.
Markiewicz, Ł., & Weber, E. U. (2013). DOSPERT's gambling risk-taking propensity scale predicts excessive stock trading. *Journal of Behavioral Finance*, *14*(1), 65–78.
Mbanga, C., Darrat, A. F., & Park, J. C. (2019). Investor sentiment and aggregate stock returns: The role of investor attention. *Review of Quantitative Finance and Accounting*, *53*, 397–428.
Mosenhauer, M., Newall, P. W. S., & Walasek, L. (2021). The stock market as a casino: Associations between stock market trading frequency and problem gambling. *Journal of Behavioral Addictions*, *10*(3), 683–689.
Newey, W. K., & West, K. D. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica*, *55*(3), 703–708.
Ozdamar, M., Sensoy, A., & Akdeniz, L. (2022). Retail vs institutional investor attention in the cryptocurrency market. *Journal of International Financial Markets, Institutions and Money*, *81*, 101674.
Pal, M. (1980). Consistent moment estimators of regression coefficients in the presence of errors in variables. *Journal of Econometrics*, *14*(3), 349–364.
Parkinson, M. (1980). The extreme value method for estimating the variance of the rate of return. *Journal of Business*, *53*(1), 61–65.
Peng, L., & Xiong, W. (2006). Investor attention, overconfidence and category learning. *Journal of Financial Economics*, *80*(3), 563–602.
Racicot, F. E., & Théoret, R. (2010). Optimal instrumental variables generators based on improved Hausman regression, with an application to hedge fund returns. *Journal of Wealth Management*, *13*(1), 103–123.
Sims, C. A. (1980). Macroeconomics and reality. *Econometrica*, 48(1), 1–48.
Sukpitak, J., & Hengpunya, V. (2016). Efficiency of Thai stock markets: Detrended fluctuation analysis. *Physica A: Statistical Mechanics and its Applications*, *458*, 204–209.
Swanson, N. R., & Granger, C. W. J. (1997). Impulse response functions based on a causal approach to residual orthogonalization in vector autoregression. *Journal of the American Statistical Association*, *92*(437), 357–367.
Tantaopas, P., Padungsaksawasdi, C., & Treepongkaruna, S. (2016). Attention effect via internet search intensity in Asia-Pacific stock markets. *Pacific-Basin Finance Journal*, *38*, 107–124.
Thailand ends COVID-19 Emergency Decree on 30 September 2022. (2022, September 30). *TAT News*. Retrieved from https://www.tatnews.org/2022/09/thailand-ends-covid-19-emergency-decree-on-30-september-2022/

Vasileiou, E. (2021). Behavioral finance and market efficiency in the time of the COVID-19 pandemic: Does fear drive the market?. *International Review of Applied Economics*, *35*(2), 224–241.

Vlastakis, N., & Markellos, R. N. (2012). Information demand and stock market volatility. *Journal of Banking and Finance*, *36*(6), 1808–1821.

Vozlyublennaia, N. (2014). Investor attention, index performance, and return predictability. *Journal of Banking and Finance*, *41*, 17–35.

Wu, Q., & Shamsuddin, A. (2014). Investor attention, information diffusion and industry returns. *Pacific-Basin Finance Journal*, *30*, 30–43.

Xu, L., Zhang, X., & Zhao, J. (2023). Limited investor attention and biased reactions to information: Evidence from the COVID-19 pandemic. *Journal of Financial Markets*, *62*, 100757.

Yen, G., & Lee, C. (2008). Efficient market hypothesis (EMH): Past, present and future. *Review of Pacific Basin Financial Markets and Policies*, *11*(2), 305–329.

Zalewska-Mitura, A., & Hall, S. G. (1999). Examining the first stages of market performance: A test of evolving market efficiency. *Economics Letters*, *64*(1), 1–12.