GAMBLING-MOTIVATED MARKET ATTENTION AND STOCK MARKET VOLATILITY

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Abstract

Retail investors show gambling preferences and pay greater attention to the market than individual stocks. Previous studies report a positive and significant relationship between market attention and volatility. This relationship results from the joint effects of attention to investment-motivated and gambling-motivated components. However, the separate roles of these two components have not yet been examined. Hence, this study applied principal component analysis to identify the gambling-motivated component from market attention and gambling-related variables. The investment-motivated component is the regression residual of the market's attention paid to the gambling-motivated component. This study linearly relates these two components to volatility. The generalized method of moments regression was used to resolve endogeneity problems and biased estimates. The Google search volume index is a proxy for unobserved retail investors' market attention. Using a daily sample of the Thai market from August 6, 2008, to September 30, 2022 (a total of 3,450 observations), this study found a positive relationship between market attention and stock market volatility. This relationship results from the positive effects of both investment-motivated and gambling-motivated components. Attention to gambling is more influential than attention to investment. The explanatory powers of gambling-attention and investment-attention for volatility were 81.33% and 18.67%, respectively. These effects were less pronounced during the COVID-19 pandemic.

Keywords: Attention, Gambling, Retail Investors, Stock Market Volatility, Thai Stocks

1. INTRODUCTION

Investors cannot pay attention to all the available information, as their brains have a limited cognitive processing capacity (Pashler & Johnston, 1998), and their attention is a scarce resource (Kahneman, 1973). Attention is associated with rising and falling volatility. Prices respond only to the information that investors receive (Huberman & Regev, 2001). To increase volatility, limited attention reduces the speed at which new information is interpreted and incorporated into stock prices (Andrei & Hasler, 2015). Moreover, if attention is paid by retail investors, information may be interpreted incorrectly, leading to noise and mispricing (De Long et al., 1990). Attention helps improve the efficiency of the market (Grossman & Stiglitz, 1980). Most empirical studies (e.g., Dimpfl & Jank, 2016; Herwartz & Xu, 2022) support a positive relationship between attention and volatility.

Retail investors show gambling preferences when trading in stock markets (Dorn, Dorn, & Sengmueller, 2015; Gao & Lin, 2015). In the Polish market, the trading volume is driven more by gambling propensity than by investment propensity (Markiewicz & Weber, 2013). Kumar,

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Nguyen, and Putniņš (2021) studied gambling activities in 38 countries, finding that stock gambling activities are 3.5 times higher than traditional gambling activities.

This study examines the relationship of retail investors' attention with stock market volatility in the Stock Exchange of Thailand (SET) from August 6, 2008, to September 30, 2022. As investors show gambling preferences, in addition to investments, their attention can be motivated by gambling. This study decomposes attention into investment-motivated and gambling-motivated components and tests the effects of these two components on volatility.

The SET, the largest exchange in Thailand, is one of the most important markets in the world. With a market capitalization of $639 billion, the SET is the 24th largest stock market worldwide and the 10th largest market in the Asia-Pacific region (World Federation of Exchanges, 2023). In the SET, retail investors are the largest and only influential investor group (French, 2017). Their average trading share from August 2008 to September 2022 amounts to 49.58%, while it is also likely that retail investors in the SET possess strong gambling motivation when trading. Gambling-motivated trading in the Thai market accounts for 34.14%, which is the highest among the sample markets. China ranks second, with a share of 31.81 % (Kumar et al., 2021).

However, the effects of gambling-motivated market attention on stock market volatility have not been investigated. This study is able to decompose the market attention into investment-motivated and gambling-motivated components. The effects of the two components were tested. These findings offer insight into their determining roles and their relative significance in stock market volatility.

2. METHODOLOGY

2.1 Effect of Market Attention on Stock Market Volatility

Retail investors are non-sophisticated investors; therefore, their attention tends to be limited to the market rather than individual stocks (Vozlyublennaia, 2014). This study focuses on market attention and, following Vlastakis and Markellos (2012), linearly relates it to stock market volatility, as expressed in Equation (1):

$$\sigma_t = \beta_0 + \beta_A A_t + \varepsilon_t, \quad (1)$$

where variables σ_t and A_t are stock market volatility and market attention, respectively; variable ε_t is the error term; β_0 is the intercept; and β_A is the slope coefficient. When market attention has no effect on volatility, $\beta_A = 0$.

2.2 Decomposition of Market Attention

2.2.1 Investment-Motivated and Gambling-Motivated Attention

Market attention can be motivated by investment and gambling propensities (Markiewicz & Weber, 2013). The attention variable A_t results from two different motivations. That is:

$$A_t = I_t + G_t, \quad (2)$$

where I_t and G_t are the investment-motivated and gambling-motivated components, respectively. This study revised Equation (1) to Equation (3) to test for the effects of components I_t and G_t on stock volatility σ_t. The effects are revealed by the slope coefficients β_I and β_G, respectively.

$$\sigma_t = \beta_0 + \beta_I I_t + \beta_G G_t + \varepsilon_t \quad (3)$$

If the effects are significant, coefficients β_I and β_G must be different from zero. A positive β_I is consistent with Andrei and Hasler (2015) and De Long et al. (1990), whereas a negative β_I supports Grossman and Stiglitz (1980). Variable G_t is non-informational. A significant and positive β_G is explained by the noise trading of retail investors (De Long et al., 1990).

2.2.2 Decomposition Method

Investors reveal their attention when they use Google searches to find information (Herwartz & Xu, 2022). In this study, a market-related Google search volume index (SVI) is used as a proxy for attention (Da,

Engelberg, & Gao, 2011). As attention is motivated by investment and gambling propensities (Markiewicz & Weber, 2013), market-related SVI consists of investment-motivated and gambling-motivated components. These two components cannot be observed separately. These factors must be identified from data.

Let $G_{j,t}$ be gambling-related variable j. This is decomposed into the market gambling component G_t and the non-market gambling or non-gambling component $G'_{j,t}$ in Equation (4).

$$G_{j,t} = G_t + G'_{j,t}. \quad (4)$$

From Equations (2) and (4), the market gambling component G_t is the common component of A_t and $G_{j,t}$. This study follows previous studies (e.g., Khanthavit, 2022; Peltomäki, Graham, & Hasselgren, 2018) using a principal component (PC) analysis to identify G_t. This study considers that component G_t must move in the same direction as that of $G_{j,t}$. Unlike previous studies that chose the first PC, this study chooses the most influential PC whose correlation is positive with all $G_{j,t}$'s. However, this component is not necessarily the first PC (Khanthavit, 2018).

The investment-motivated component I_t is proxied using the residual of the regression of A_t on G_t. With respect to the variable construction, the relative explanatory power of I_t and G_t can be inferred from the coefficients of determination (R^2) from univariate regressions of σ_t on I_t and G_t, respectively.

2.3 Model Estimation

2.3.1 Instrumental-Variable Regressions

The linear models in Equations (1) and (3) were estimated using traditional ordinary least squares regression (OLS) as in previous studies (e.g., Vlastakis & Markellos, 2012). Thus, it is likely that OLS estimates are biased. Endogeneity problems exist in regressions (1) and (3) due to errors in variables (EIV) and omitted variables (OV).

Variables A_t, I_t, and G_t are proxies for unobserved market attention and its investment-motivated and gambling-motivated components. These were measured with errors, thereby constituting EIV problems. Economic and behavioral factors explain volatility. The regressions in Equations (1) and (3) limit the explanatory variables to market attention and its investment-motivated and gambling-motivated components, respectively. The remaining explanatory variables are not considered. Therefore, OV problems have emerged. This study resolves endogeneity problems using instrumental variable (IV) and generalized method of moments (GMM) regressions (Greene, 2018).

2.3.2 Construction of Instrumental Variables

In this study, the IVs were constructed using Racicot and Théoret's (2010) two-step IVs approach. First, Pal's (1980) IVs were computed. Khanthavit (2017) reported that the Racicot-Théoret IVs constructed from Pal IVs showed good validity and informativeness. In the second step, the Racicot-Théoret IVs were the residuals from the regressions of the variables A_t, I_t, and G_t on Pal's IVs.

2.4 Hypothesis Tests

In Equation (1), if the market attention affects volatility, the slope coefficient β_1^A will be significant. In Equation (3), significant effects of components I_t and G_t imply significant β_I and β_G coefficients, respectively. In this study, *t*-tests were performed to test the hypotheses. The *t*-statistic is computed from Newey and West's (1987) heteroskedasticity and autocorrelation-consistent (HAC) standard deviations.

3. THE DATA

3.1 Sample Period

Data were collected daily from August 6, 2008, to September 30, 2022. The study used

SVIs as proxies for market attention. Google reported its first SVIs on January 1, 2004. However, August 6, 2008, was chosen as the first observation in this study as SVIs before this date are not reliable (Challet & Ayed, 2014). The last observation was taken on September 30, 2022, as this is when Thailand ended the COVID-19 emergency decree, with COVID-19 being reclassified from a dangerous communicable disease to a communicable disease under surveillance (Thailand ends COVID-19, 2022). The sample comprised 3,450 observations.

3.2 Variables

3.2.1 Volatility

The daily volatility σ_t was measured by the standard deviation of returns on the SET index portfolio. This was computed using Parkinson's (1980) range volatility, scaled by 100. Parkinson's volatility is easy to compute and is among the popular choices for volatility measurements in finance (Chou, Chou, & Liu, 2010). The SET index data were retrieved from the SET database.

3.2.2 Market Attention

Retail investors pay more attention to the market than to individual stocks (Vozlyublennaia, 2014). The study followed Da et al. (2011) in measuring the unobserved market attention using the SVI query on *หุ้นไทย* (*Hûn thịy,* which means Thai stock in the Thai language). Alternative queries for market attention are *ตลาดหุ้น* (*Tlādh̄ûn*) or stock market, *ราคาหุ้น* (*Rākhā h̄ûn*) or stock price, and *SET Index*. However, these variables were not included in this study, as their SVI levels are significantly lower than *Hûn thịy* SVI.

A_t represents the de-trended and de-seasonalized *Hûn thịy* SVI; the variable is standardized by its mean and standard deviation. The trend is the logged time trend, following Zhang, Shen, Zhang, and Xiong (2013). Seasonality includes days of the week and months of the year, as in Nguyen and Pham (2018). *Hûn thịy* SVI can be downloaded from the website https://trends.google.co.th/home.

3.2.2 Investment- and Gambling-Motivated Components

These two components were constructed using market attention and gambling-related variables. This study chose the *เลขเด็ด* (*Lek̄h dĕd*) SVI, lagged volatility, and lagged skewness for $G_{j,t}$'s. The Thai word *Lek̄h dĕd* means lucky number. *Lek̄h dĕd* SVI is the best SVI to proxy Thai retail investors' gambling attention (Khanthavit, 2022). High volatility and skewness are characteristics of lottery-like stocks preferred by gambling-motivated stock traders (Kumar, 2009; Chen, Kumar, & Zhang, 2021). The de-trended and de-seasonalized *Lek̄h dĕd* SVI was used in the analysis. The lagged volatility refers to Parkinson's (1980) σ_{t-1}, whereas lagged skewness is the cube ratio of the lagged SET-index return over σ_{t-1}. The realized cube return is an estimator of the expected cube return. Return refers to the log of returns on the SET index portfolio. *Lek̄h dĕd* SVI was downloaded from the website https://trends.google.co.th/home.

From the PC analysis of the variable set {*Hûn thịy* SVI, *Lek̄h dĕd* SVI, lagged volatility, lagged skewness}, the gambling-motivated component G_t was found to be the most influential PC, whose correlations with *Lek̄h dĕd* SVI, lagged volatility, and lagged skewness are positive. A negative correlation is inconsistent with the fact that gambling-related variables attract market attention. However, this PC is not necessarily the first PC (Khanthavit, 2018). The investment-motivated component I_t is the residual of the regression of A_t on I_t. Finally, I_t and G_t were standardized using the means and standard deviations, respectively.

3.3 Descriptive Statistics

Columns 2 and 3 of Table 1 report the descriptive statistics for volatility and market attention, respectively. These two variables have positive skewness. While the excess kurtosis of volatility is large and positive, that of market attention is small and negative. The Jarque-Bera test rejected the normality hypothesis. These two variables were

positively and serially correlated. Finally, the Dickey–Fuller statistic indicates the existence of stationary variables. The non-normal and auto-correlated volatility and market attention variables support the use of GMM regressions and HAC standard deviations. The GMM does not require normally distributed variables. Despite the non-normality, GMM estimators are consistent, asymptotically normal, and efficient (Hansen, 1982). The HAC standard deviations were consistent even when regression errors were autocorrelated or heteroscedastic (Newey & West, 1987).

Table 2 reports the correlations of the four PCs for {*Hûn thịy* SVI, *Lēkh děd* SVI, lagged volatility, lagged skewness} with *Lēkh děd* SVI, lagged volatility, and lagged skewness. The third PC was chosen for the gambling-motivated component G_t. This is the only PC that positively correlates with the three gambling-related variables, and captures 22.28% of the information, while the first PC captures 35.21%.

The descriptive statistics for the investment- and gambling-motivated components are reported in Columns 4 and 5 of Table 1, respectively. The variables were stationary, non-normal, and serially correlated. The investment-motivated and gambling-motivated components explain 99.05% and 0.95% of market attention, respectively. Despite its low explanatory power, the gambling-motivated component is significant at the 99% confidence level. This low power is not necessarily inconsistent with the large gambling propensity for stock trading reported by Kumar et al. (2021) and Markiewicz and Weber (2013). Gambling-motivated attention generates more trades than investment-motivated attention (Mosenhauer, Newall, & Walasek, 2021).

4. EMPIRICAL RESULTS

4.1 Existence of Endogeneity Problems

This study proposes the use of a GMM regression to resolve the endogeneity problems in linear regression models (1) and (3). Hausman's (1978) tests were conducted to check for any problems. The Hausman

Table 1 Descriptive Statistics

Statistic	Volatility	Market Attention	Components of Market Attention	
			Investment-Motivated	Gambling-Motivated
Average	0.0080	0.0000	0.0000	0.0000
Standard Deviation	0.0061	1.0000	1.0000	1.0000
Skewness	4.7847	0.3684	0.3710	2.5630
Excess Kurtosis	43.6123	-0.4232	-0.4317	18.4174
First-Order Autocorrelation	0.6246***	0.8661***	0.8666***	0.3520***
Jarque-Bera Statistic	2.87E+05***	1.04E+02***	1.06E+02***	5.25E+04***
Dickey–Fuller Statistic	-10.5973***	-11.2104***	-11.3810***	-15.2618***

Note: *** denotes significance at the 99% confidence level.

Table 2 Correlations of Principal Components with Gambling-Related Variables

Principal Component	Gambling-Related Variable		
	Lēkh děd SVI	Lagged Volatility	Lagged Skewness
1st	-0.7509***	0.4485***	-0.1374***
2nd	-0.2277***	-0.5065***	0.8290***
3rd	0.1586***	0.7305***	0.5419***
4th	0.5456***	-0.0937***	-0.0076***

Note: *** denotes significance at the 99% confidence level.

statistics for Equations (1) and (3) were significant at 0.9989 and 0.9718, respectively. As an endogeneity problem exists, the GMM regression is the proper estimation technique.

4.2 Validity and Informativeness of Instrumental Variables

It is important that IVs are valid and informative. Valid IVs have low correlation with the error term ε_t, while informative IVs are strongly correlated with their corresponding explanatory variables. To check for validity, the IVs were regressed on the OLS residuals in Equations (1) and (3); the validity R^2's are 7.00E-06 and 0.0011, respectively. Market attention, investment, and gambling components were then regressed on the IVs. The corresponding R^2's were 0.9965, 0.9617, and 0.8714, respectively. The resulting validity and informativeness of R^2's leads to the conclusion that the IVs are valid and informative.

4.3 Relationship of Volatility with Market Attention and Their Components

4.3.1 Market Attention

The GMM regression for Equation (1) reports a slope coefficient β_A of 0.0878, significant at the 99% confidence level. Market attention increases stock market volatility. This finding is consistent with that of Dimpfl and Jank (2016) and Herwartz and Xu (2022).

4.3.2 Investment- and Gambling-Motivated Components

The slope coefficients β_I and β_G in Equation (3) are the effects of investment-motivated and gambling-motivated attention, respectively, on stock market volatility. Column 2 of Table 3 reports the GMM estimates. The two coefficients were positive and significant at the 99% confidence level. Both variables therefore increase market volatility. The positive β_I is explained by a reduced speed of information dissemination (Andrei & Hasler, 2015) or by the misinterpretation of information by retail investors (De Long et al., 1990). This finding does not support the improved market efficiency hypothesis (Grossman & Stiglitz, 1980). The positive β_G is explained by noise from gambling-attentive investors (De Long et al., 1990). The size of β_G is much larger than that of β_I. Therefore, gambling-motivated attention G_t is more influential than investment-motivated attention I_t. Attention I_t and G_t jointly explain 18.32% of variance in σ_t. The percentage shares of their performance were 18.67% and 81.33%, respectively. These findings are significant. G_t has a 0.95% share in A_t, while I_t has a 99.05% share. Despite having a small share, G_t is significant and powerful, driving volatility much more than I_t. This supports

Table 3 Effects of Investment- and Gambling-Motivated Attention on Stock Market Volatility

Coefficient	Unconditional Effect	Conditional Effect		
		Retail Investors	Institutional Investors	COVID-19 Pandemic
β_I	0.1172***	0.1028***	0.1116***	0.1883***
β_G	0.2189***	0.1775***	0.2103***	0.2090***
β_I^R		0.0794***		
β_G^R		0.0517**		
β_I^{In}			-0.0363*	
β_G^{In}			0.0370*	
β_I^C				-0.2569***
β_G^C				-0.1100***

Notes: *, ** and *** denote significance at the 90%, 95%, and 99% confidence levels, respectively.

the influential role of gambling in stock markets (Mosenhauer et al., 2021).

5. DISCUSSION

5.1 Robustness Checks

5.1.1 Alternative Choice for Instrumental Variables

This study checked the validity and informativeness of the Racicot-Théoret IVs. The selected IVs were found to be valid and informative. Choices for IVs affect parameter estimates. To ensure that the results are robust with respect to IVs, the Racicot-Théoret IVs were reconstructed based on Durbin's (1954) IVs in the first step, and then used in the estimation of Equation (3). Column 2 of Table 4 reports the results. Estimates β_I and β_G are very similar to those in Table 3.

5.1.2 Alternative Choices for the Market Search Volume Index

Alternative proxies for market attention are also available. The study examined whether the results changed for different SVIs. The *Tlādhûn*, *Rākhā hûn*, and *SET-Index* SVIs were substituted for the *Hûn thịy* SVI to re-construct variables I_t and G_t. The results for re-constructed I_t's and G_t's are reported in Columns 3, 4, and 5 of Table 4. For the three substitutes, the estimates of β_I and β_G are positive and significant at the 99% confidence level. This result is robust to the choice of proxies for market attention.

5.2 Effects of Retail and Institutional Investors' Trades

Ballinari, Audrino, and Sigrist (2022) studied the effects of retail and institutional investor attention on volatility, finding the effects to be positive and negative, respectively. The researchers explained that the effects were due to retail investors' attention reducing and institutional investors' attention increasing price adjustments to new information. Attention drives volatility through investor trading (Huberman & Regev, 2001; Ruan & Zhang, 2016).

This study examined how trading volumes, driven by retail and institutional investor attention, affected market volatility. The model in Equation (3) was revised to include trading volumes, as expressed in Equation (5):

$$\sigma_t = \beta_0 + \beta_I I_t + \beta_G G_t + \beta_I^k I_t V_t^k + \beta_G^k G_t V_t^k + \varepsilon_t, \quad (5)$$

where V_t^k is the trading volume of investor group k, and the coefficients β_I^k and β_G^k are the additional effects from investor group k's trades due to investment and gambling attention, respectively. $k = R$ (retail investors) or In (institutional investors). Variable V_t^k is the buying and selling volume of k over the aggregate market trading volume. This ratio was scaled to 10,000. Trading volumes were retrieved from the SET database. Columns 3 and 4 of Table 3 report the results for retail and institutional investors, respectively.

For investment-motivated attention, effects β_I^R and β_I^{In} from retail and institutional investors are significant and equal to 0.0794 and -0.0363, respectively. These results were consistent with those reported by Ballinari et al. (2022). Retail investors' attention increases volatility, while institutional investors' attention decreases it.

Higher volatility from the investment-motivated attention of retail investors can

Table 4 Robustness Checks

Coefficient	Durbin's (1954)'s Instrumental Variable in First Step	Alternative Attention Measure		
		Tlādhûn (Stock Market)	*Rākhā hûn* (Stock Price)	*SET Index*
β_I	0.1058***	0.0848***	0.1628***	0.1605***
β_G	0.1802***	0.0540***	0.1135***	0.0666***

Note: *** denotes significance at the 99% confidence level.

result from slow price adjustments (Andrei & Hasler, 2015) or noise trading (De Long et al., 1990). However, positive β_I^R and negative β_I^{In} lead to the conclusion that the higher volatility from retail investors' investment-motivated attention results from noise. Institutional investors trade against retail investors, accelerate price adjustments, and reduce market volatility.

Ballinari et al. (2022) did not analyze gambling-motivated attention. This study found that gambling attention of both retail and institutional investors increases volatility. The corresponding coefficients were 0.0517 and 0.0370, respectively. For retail investors, higher volatility can be explained by noise trading (De Long et al., 1990). The higher volatility from institutional investors is supported by the empirical evidence of institutional investors showing gambling preference (Shen, Cheng, Han & Chan, 2022). Their gambling attentive volume is a type of noise trading (De Long et al., 1990).

5.3 Effects of the COVID-19 Pandemic

The market attention of retail investors increased during the COVID-19 lockdown (Cahill, Ho, & Yang, 2021). Investors also paid significant attention to the COVID-19 pandemic, which led to rising stock volatility in markets worldwide (Chundakkadan & Elizabeth, 2022). This study examined whether investment-motivated and gambling-motivated attention affected volatility during the COVID-19 pandemic. The model in Equation (6) adds the COVID-19 dummy variable D_t to Equation (3).

$$\sigma_t = \beta_0 + \beta_I I_t + \beta_G G_t + \beta_I^C I_t D_t + \beta_G^C G_t D_t + \varepsilon_t. \quad (6)$$

Here, D_t is 1.00 if day t is during the COVID-19 pandemic; otherwise, it is 0.00. April 3, 2020, was chosen as the first day of the study period. The Thai government imposed its first curfew on this day, to contain the spread of the disease (Curfew starts on Friday, 2020). On September 30, 2022, Thailand reclassified the disease as a communicable disease, under surveillance.

Column 5 of Table 3 reports that coefficients β_I^C and β_G^C are negative and significant at the 99% confidence level. The effects of investment-motivated and gambling-motivated attention were lower during the COVID-19 pandemic. This finding can be explained by the limited attention of retail investors (Kahneman, 1973; Pashler & Johnston, 1998). During the COVID-19 pandemic, investors paid attention to the disease (Chundakkadan & Elizabeth, 2022), thus lessening investment-motivated and gambling-motivated attention.

6. CONCLUSION

Retail investors show gambling preferences. Market attention can be motivated by investments and gambling. In this study, retail investors' market attention was decomposed into investment-motivated and gambling-motivated components, to test whether and how each component affected stock market volatility. Regarding the SET, this study found that market attention and its components increase volatility. These effects were positive and statistically significant. Their sizes decreased during the COVID-19 pandemic.

Market attention was general. However, influential attention, such as that during pandemics, wars, and macroeconomic or corporate events, can be specific. Owing to investors' limited cognitive processing capacity, it is not clear which type of attention is the most influential. However, this question remains to be answered in future studies.

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