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Research on the Investor Sentiment Moderating Effect of the Impact of Investor Attention on Stock Returns

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Abstract

The purpose of this paper is to discuss the impact of investor attention on stock returns, and to further explore the moderating effect of investor sentiment. We choose the weekly data of 463 US-listed firms that are part of the S&P 500 from January 4, 2021, to May 2, 2022, as a sample. This study runs fixed effect regression using the Google Search Index (GSVI) and the Popularity Index (AR) as proxies for investor attention and investor sentiment respectively. According to the regression results, investor attention has a positive impact on stock returns in general, indirectly proving that the positive impact of the "attention-driven trade hypothesis" is stronger than the negative one of the "risk compensation hypothesis". We build interaction terms to further investigate the moderating impact of investor sentiment, we build interaction terms. The results of the regression demonstrate that investor sentiment has a positive moderating effect, i.e., an improvement in investor sentiment will increase the positive effect of investor attention on stock returns.

Keywords

Investor Sentiment; Investor Attention; Moderating Effect.

1. Introduction

The Capital Asset Pricing Model (CAPM), developed by Sharpe (1964) on the basis of Markowitz's portfolio theory, represents the traditional asset pricing models. However, because the theoretical assumptions of these models are difficult to satisfy in reality, their empirical findings are not desirable. And with the emergence of some situations that cannot be explained by conventional models, such as "The equity premium puzzle" (Mehra and Prescott (1985)) and "The risk-free return puzzle" (Weil (1989)), people are beginning to question their pricing efficiency. The pertinent behavioural finance theories came into play in this situation. Experts in behavioural finance usually hold that it is impossible for investors to fully understand the market while also maximising utility to produce a balanced return. As a result, investors are not entirely rational in real investment decisions.

Scholars brought investor sentiment into the behavioural finance field of study firstly. The DSSW model proposed by Delong et al (1990) firstly incorporates investor sentiment into the asset pricing model. They found that the impact of investor sentiment on stock trading cannot be eliminated, and creates systemic risk that cannot be diversified. Since then, an increasing number of scholars have used empirical testing to confirm the relationship between investor sentiment and stock returns (Kumari and Mahakud (2016), Lee et al. (2004), Stambaugh, Yu and Yuan (2011), etc.). Scholars also started to pay more attention to investor attention at the same time. The first person to draw attention to financial studies was Hirshleifer (2002). According to him, paying attention is how investors receive and accept outside information while making financial decisions. However, researchers' findings on the connection between investor attention and stock returns are contradictory. The "attention-driven trade hypothesis" holds that investor attention will increase returns, in contrast to the "price pressure

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hypothesis" and the "risk compensation hypothesis," which hold that the two are changing in the opposite direction. According to the "information effect theory," the nature of information has something to do with the relationship between investor attention and stock returns.

The above-mentioned studies have confirmed that both investor sentiment and investor attention have a significant impact on stock returns, and some scholars have found that the explanatory power of investor attention on stock returns is stronger than that of investor sentiment (Prapan et al. (2020), Bucher (2017), etc.). In addition, the existing literature believed that when investor attention is attracted to stocks, the stock returns do not always increase, and emotions, the nature of information, and many other factors may affect it (Kelmola et al. (2016)). However, most of the existing studies did not clarify the mechanism and path of investor attention and investor sentiment affecting stock returns. They only study the impact of investor attention and investor sentiment on stock returns separately; or regard investor sentiment as part of the indicator of investor attention. The potential impact and moderating effect of investor sentiment have not been fully considered. Therefore, we have reason to assume that investor attention is the main channel that affects stock returns, and the level of investor sentiment will affect the extent to which investor attention affects stock returns.

To sum up, the main purpose of this paper is to explore the moderating effect of investor sentiment on the impact of investor attention on stock returns. For this reason, we select the companies included in S&P 500 as the sample in the empirical study part. In addition to the dependent variable---stock returns (RET), we also use the Google search index GSVI and the investor popularity index AR as proxies for investor attention and sentiment, respectively. We first use the fixed effect model to indirectly test which of the "risk premium hypothesis" and "attention-driven trading hypothesis" has the stronger influence, that is, the overall impact of investor attention on stock returns. Next, we further explore the moderating effect of investor sentiment on the impact of investor attention on stock returns by constructing the interaction term between investor sentiment and investor attention, and incorporating it into the empirical model.

Our empirical findings show that investor attention has a positive effect on stock returns generally. When we examine the moderating effect of investor sentiment in more depth, the empirical results reveal that the interaction term between investor attention and investor sentiment has a positive and significant sign. This suggests that investor sentiment has a moderating effect, and an increase in investor sentiment will increase the extent to which investor attention has an impact on stock returns.

2. Literature Review

2.1. Relationship between Investor Attention and Stock Returns

Following the conclusion that investor attention has an impact on the stock market, the available literature focuses on four impact paths. For starters, proponents of the "attention-driven trade hypothesis" argued that investor attention will boost returns. Odean and Barber (2008), for example, argued that news will attract investor attention, and investors will be enticed to buy shares, which will enhance the prices, whether the news is good or bad. Engelberg (2012) used the commentator's judgemnt in TV news as a proxy variable for investor attention. He discovered that after being evaluated by the commentator, the stock returns on the next trading day will improve.

Some academics, however, believed that increased investor attention will lower predicted future and short-term returns. For example, the "price pressure hypothesis" supported by the research of Said and Slim (2022) thought that GSVI has led to future fluctuations in almost all markets and has a positive impact on returns in the short term, but this impact will be reversed

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in the long term. And the "risk compensation hypothesis" is confirmed by the findings of Fang and Press (2009), who argued that companies without media coverage receive higher returns. More specifically, this is because media coverage can increase investor attention to the firm and thus reduce the degree of information asymmetry, in which case investors will be less require for returns; conversely, if there is less media coverage, the degree of information asymmetry will be greater and investors will expect more risk-return compensation from firms that have less news coverage.

Furthermore, the " Information Effect Hypothesis " discusses many types of information in a novel way. Lai et al. (2021) believed that when a positive shock occurs, trading volume increases; but, when a negative shock occurs, investors are hesitant to sell due to the disposition effect, thus the increase in attention induced by the negative shock has no substantial impact on stock returns. The "ostrich effect," as proposed by Wanidwaranan and Padungsaksawasdi (2022), explains this phenomenon.

To summarise, experts arrived at various findings regarding the relationship between investor attention and stock returns. The literature on the relationship between investor attention and stock returns can be broadly divided into two categories. The first is the "attention effect", which focuses only on the impact of changes in investor attention on stock returns. In this category, scholars have come to two opposite conclusions. On the one hand, investor attention can contribute to the reflection of new information in stock prices, due to short-selling restrictions, stock prices mostly reflect optimistic investor expectations, so an increase in investor attention means an increase in potential investment demand, driving up the stock price; on the other hand, an increase in investor attention means an increase in information transparency and a decrease in the degree of information asymmetry, resulting in a decrease in the required returns by investors, resulting in a decrease in stock returns. The second is the "information effect", which is more complex because it takes into account the impact of the nature of new information on investor decisions. Increased attention promotes the stock prices to fully reflect the information, and the nature of information determines the direction of stock prices change, when positive information leads to positive stock prices change. The direction of stock returns movement is determined by the nature of the information, with stock returns rising when positive information is given more attention and stock returns decreasing when negative information is given more attention.

2.2. Relationship between Investor Sentiment and Stock Returns

Investor sentiment is included in the research scope of behavioural finance professionals earlier than investor attention, therefore theoretical results are more plentiful. Moreover, unlike the uncertain relationship between investor attention and stock returns, most scholars believed that investor sentiment is positively correlated with stock returns in the short run and will reverse in the future.

Stambaugh, Yu, and Yuan (2011), one of the more well-known studies, ingeniously added high and low investor sentiment as dummy variables to the empirical analysis and contend that, while there is no relationship between investor sentiment and stock returns over the long term, it has a significant impact on abnormal returns in the short term. On the other hand, Kim and Kim (2014) construct investor sentiment by mining network data and demonstrate that future changes in investor sentiment are positively driven by changes in stock returns, but that this kind of positive effect is absent in the effect of investor sentiment on future stock returns.

2.3. Investor Attention and Investor Sentiment

All of the foregoing research demonstrated that both investor sentiment and investor attention can influence stock returns, and many academics have begun to factor both into the price prediction process. Some scholars argued that there is a link between sentiment and attention.

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For example, Ali and Gurun (2009) argued that during periods of high sentiment, when noisy investors overvalue stocks and drive stock prices higher, investor attention decreases. This is more likely to happen with small stocks because individual investors are more likely to invest in small stocks, and individual investors have shorter attention spans. Mbanga et al. (2019), argued that attention affects sentiment in one direction, with low attention amplifying over-optimism and over-pessimism, causing investors to miss the right information, and high attention enhancing market efficiency and helping investors form the right expectations, thus reducing the predictive power of sentiment.

In addition, other studies have found that models that take into account both sentiment and concern can better explain changes in stock returns. Li et al (2020)., for example, extracted investor sentiment data from online comments and weight them with attention to derive a composite sentiment indicator, found empirically that this approach can more accurately reflect the relationship between investor sentiment and stock returns. Chen et al. (2022) showed that investor attention provides unique information about the stock market that complements sentiment prediction.

However, some studies have found that investor sentiment and attention have different degrees of impact on stock returns, with some scholars suggested that investor attention has a more significant impact. Prapan et al. (2020) who believed that returns reflect investor attention rather than investor sentiment. Bucher (2017), by exploring the sensitivity of stocks to investor attention and sentiment find that both are positively related to positive stock market volatility, but investor attention is more powerful and strong in explaining asset pricing, while investor sentiment is not as strong an explanatory power as a pricing factor.

2.4. Summary

Although the existing research suggested that both investor sentiment and investor attention have an impact on stock returns, the literature examining investor sentiment and investor attention at the same time still limited. Indeed, according to current findings, investor attention is the primary channel through which investor behaviour affects stock returns, which is more significantly than investor sentiment, and investor attention alone does not fully explain stock returns. More recently, a lot of academics have discovered that the two have very distinct impacts on the stock market and that changes in returns are best described by investor attentiveness. Additionally, there are conflicting findings in the literature about the link between investor attention and stock returns. That is, there is evidence to support that changes in investor attention have various effects on stock returns since the available literature argued that stock returns do not always increase when investor attention increases. Sentiment, the nature of the information, and many other factors may influence it. However, the majority of the currently available literature either examined the effects of sentiment and attention independently on stock returns or included investor sentiment in the construction of the investor attention index, omitting the moderating effect of investor sentiment. This study will build on this foundation by examining the moderating role of investor sentiment in the process of investor attention affecting stock returns.

3. Methodology

3.1. Sample and Data Source

Since the S&P 500 index covers a wider range of industries than other indexes like the NASDAQ, we first chose the 475 US-listed companies that are included in the S&P 500 index. We then excluded the companies from the database that have any missing data, leaving 463 companies as our sample. The selected time period is from January 4, 2021, to May 2, 2022. In order to match the data frequency of the Google search index GSVI, all the data used in this study is

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weekly data. This period is selected because it can not only reflect the latest situation of the relationship between investor attention and stock returns, but also, more importantly, 2020 is a year of the global COVID-19 outbreak, with many capital markets in a state of turmoil, and after 2021 they are starting to get back on track, so our data will be more stable.

We obtained the stock returns and the highest and lowest stock prices, as well as other company data, from the WIND database. Additionally, the Google Search Index (GSVI), one of the key independent variables, is derived from the Google Trends page. In terms of control variables, the data included in the Carhart four-factor model is derived from the Wharton Research Service System WRDS.

3.2. Variable Description

3.2.1. Dependent Variable

First, the stock returns (RET), which can reflect the returns delivered to investors by investing in a particular stock, has been chosen as the dependent variable in this study. Because the observations need to follow iid model in regression, that is, the observations need to be random and have no trend, this study selects the returns rather than the stock price to assure the stationarity and randomicity of the data. The stock returns utilised in this paper are also the weekly data in order to match the frequency of the GSVI data. Dividends are not taken into account as an investment returns in this study because they are not controlled by the market but rather are determined by the company itself and are not considered returns like capital gains are. After referring to the calculation formula of the weekly return rate in WIND database, the specific calculation method of stock returns is obtained as follows:

$$RET_{it} = \frac{P_{il} - P_{if}}{P_{if}} \tag{1}$$

In the above equation, RET_{it} is the return of stock i in period t. In this study, the period represented by t is week. P_{il} is the closing price of the last trading day of each week, and P_{if} is the closing price of the first trading day of each week.

3.2.2. Key Independent Variables

A) Investor attention index

Investor attention is the degree to which an investor pays attention to information related to a company or stock given limited cognitive ability. We select the Google Search Index (GSVI) as a proxy variable for the Investor Attention Index (Att) based on prior research. According to the statistics released by StatCounter Global Stats, from 2020 to March 2022, the Google search engine had more than 90% of the market share. As a result, investors' search behaviour on the Google search engine can roughly reflect the attention behaviour of the whole market. The higher the search index, the more attention the company receives. The fact that investors spontaneously use search engines to find information about the firm demonstrates their attention to that company, hence the search index is a stronger indicator of investors' proactive intentions than other measurements.

Investors generally use the company name or stock tickers as keywords when looking for information about stocks. Although they both refer to the same company, there are distinctions in the level of attention that these two keywords indicate. The stock tickers are difficult to remember and easy to confuse with phrases, for example, many stock tickers are just a letter or simply a word (such as BALL). This can lead to an increase in the noise contained in the data. So this study uses the method of Da (2011) as a guide and uses the abbreviation of company name as the search keyword.

B) Investor sentiment index

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Currently, there are two major kinds of indicators used to measure investor sentiment: direct and indirect indicators, and the latter of which is built using relevant stock market data. This study believes that any shift in investor sentiment will have an impact on how they make decisions and finally show up in relevant market data. As a result, this study uses indirect indicators, i.e., market data, to measure investor sentiment. Inspired by the work of Zhou et al. (2021) and Dong et al. (2020), this study uses the popularity index AR to create the investor sentiment index IS. The popularity index AR can reflect the strength of the bulls and bears in the market, i.e. the buying and selling popularity of the stocks, and investors pessimistic or optimistic expectations about the stocks. The specific calculation method is as follows:

$$IS_{it} = \frac{\sum_{t-4}^{t} Hig_{\ \ it} - Open_{it}}{\sum_{t-4}^{t} Open_{it} - Low_{it}} \tag{2}$$

In the equation above, $High_{it}$ is the highest price of stock i on day t, $Open_{it}$ is the opening price of stock i on day t and Low_{it} is the lowest price of stock i on day t. Moreover, the index generally uses the sum of the data of 27 or 26 days before day t. As the data used in this paper is weekly data, the sum of the data of 4 weeks before day t is taken here. The higher IS represents the higher investor sentiment.

3.2.3. Control Variables

Among the current traditional theories on "What factors determine the return of stocks?", the classic one is the three-factor model proposed by Fama and French. They claimed that the exposure to three factors-market factor Mkt, size factor SMB, and value factor HML-can adequately account for the excess returns of stocks. Following that, Carhart (1995) improved the Fama-French three-factor model by including the momentum factor UMD. It reasonably explained the "momentum phenomenon," which stated that a stock with a higher return in the market over a period of time will continue to have a higher return in the future than a stock with a lower return rate in the past. After that, in 2013, Fama and French proposed a five-factor model. On the basis of the three-factor model, they added a profit factor RMW (measuring the excess return of a company with a higher operating profit margin) and an investment factor CMA (measuring the level of investment of a company), which is more thoroughly explained the factors effect the stock returns. However, this study does not take into account the usage of the Fama-French five-factor model due to the absence of RMW and CMA data sources.

Scholars have used a variety of different control variables in their studies on the relationship between investor attention, investor sentiment, and stock returns, but they have all included the previously mentioned factors in their control variables. For instance, Bucher (2017) used the Fama-French three-factor model, while Baker and Wurgler (2006) used the Carhart four-factor model as the control variable. In conclusion, four factors from the Carhart four-factor model are chosen as the control variables in this study to assure the comprehensiveness of the control variables.

3.3. Hypothesis Development

As mentioned in chapter 2, the explanations of the relationship between investor attention and stock returns at this stage are mainly divided into the "attention effect" and "information effect". The former merely takes into account the influence of changes in investor attention on stock returns, the latter focuses on the effects of the nature of new information on the relationship between investor attention and stock returns. We have yet to find a reliable and precise method for distinguishing the type of information, the nature of information is therefore not considered in this paper. And the main topic of this paper is testing the impact of investor attention on stock returns, as well as the moderating role that sentiment play in it. That is to say, our theoretical analysis is made through the "attention effect," which includes the "attention-driven

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trade hypothesis" and the "risk premium hypothesis." The two hypotheses mentioned above lead to conflicting conclusions. The "attention-driven trade hypothesis" argues that because investors have limited cognitive resources, they can only choose stocks from the stock set they are concerned about to invest. This means that as investor attention increases, potential investment demand also grows, and then raises the stock returns. In addition, due to the restriction of short selling, the opinions of investors with pessimistic beliefs cannot be fully expressed, while the opinions of investors with optimistic beliefs are more strongly reflected in the stock price. Therefore, more attention means more potential demand, which is also the other reason for the rise of stock prices. On the contrary, according to the "risk premium hypothesis", the increase in attention will reduce the degree of information asymmetry, and the returns required by investors will be correspondingly reduced, which will lead to a decline in stock returns. Figure 1 shows the influence mechanism of these two hypotheses.

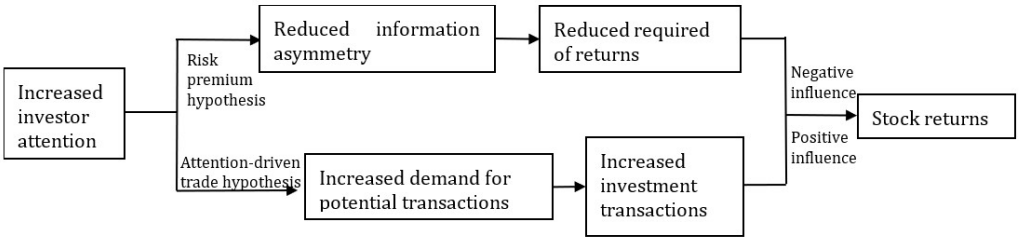

Figure 1. Two mechanisms of Investor Attention on Stock Returns

As the figure above illustrates, the effect directions of these two mechanisms are diametrically opposed. The relative intensity of these two impacts will ultimately determine whether an increase in investor attention will result in an increase or decrease in stock returns. This paper considers that the "attention-driven trade hypothesis" has a stronger impact. Because information asymmetry generally means that investors cannot get the internal information of companies, in general, internal information can help investors get excess returns, but public information cannot. And the proxy variable of investor attention in this study is the Google search index, and it is challenging for investors to obtain internal information about a company through an online search, so the increase in online search volume can not obviously lead to a decrease in information asymmetry. Based on this, we make the following assumptions:

Hypothesis 1: Investor attention represented by the Google Search Index is positively correlated with stock returns.

Further, the "attention-driven trade hypothesis" states that an increase in investor attention will only enhance the potential demand for investments, but will not necessarily translate into actual investment activities. This transformation process will be influenced by emotions. In reality, when the investor sentiment is high, they think that the returns will rise in the future, so they will be more inclined to invest, and vice versa (Wen et al. (2014)). Wang et al. (2020) also found that when sentiment is high, investors will overestimate the returns and are therefore more willing to buy stocks; when sentiment is low, investors are more risk averse and invest more cautiously, or even not to make any investments at all. So we assume that investor sentiment can amplify the impact of investor attention on stock returns by expanding the proportion of potential investment demand converted into actual investment behaviour. Specifically, when the investor sentiment is high, the proportion of potential investment demand converted into actual transactions will be higher, thus expanding the influence of investor attention on the stock returns.

Figure 2 above reflects the moderating effect of investor sentiment on the influence mechanism of the "attention-driven trade hypothesis". Based on this, the following hypothesis is proposed in this paper:

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Hypothesis 2: Investor sentiment has a moderating effect on the impact of investor attention on stock returns, with increased investor sentiment enhancing the positive impact of attention on stock returns.

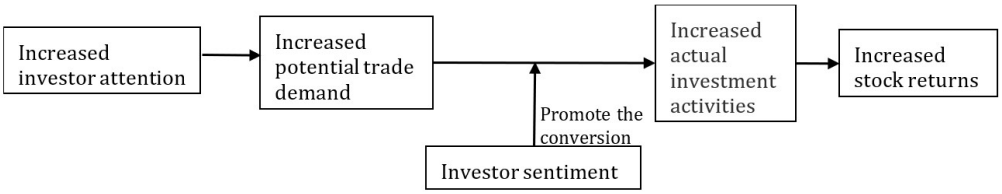

Figure 2. Moderating Effect of Investor Sentiment

3.4. Research Model

This paper uses panel data of 463 US-listed companies from January 4, 2021, to May 2, 2022.We first investigate the relationship between investor attention and stock returns in their entirety. Addtionally, Boeker and Goodstein (1993) explored how external and internal successors affected company performance. And by constructing the interaction terms, they also examined how factors like board structure and ownership concentration had a moderating effect on this relationship. Their research purpose is the same as that of this paper, that is, on the basis of discussing the overall influence of a certain factor on dependent variables, then add moderating variables and study their moderating role in the process of the main effect. So this study draws on their method to further explore the moderating role played by investor sentiment by including an interaction term of investor attention and investor sentiment.

According to Hypothesis 1, there is a positive correlation between stock returns and investor attention. As a result, we use the stock returns as the dependent variable and investor attention which is measured by the Google search index as the primary explanatory variable. The regression equation 3 that follows is inspired by Baker and Wurgler (2006) and is used to test Hypothesis 1. According to Hypothesis 2, there is a positive moderating effect of investor sentiment on the impact of investor attention on stock returns. Therefore, based on equation 3, we add an interaction term and moderating variable (investor sentiment) to assess the moderating effect of sentiment. Equation 4 below is used to determine hypothesis 2. The specific equations are as follows:

$$RET_{it} = \beta_0 + \beta_1 Att_{it} + \beta_2 Controls_t + \varepsilon_{it} \tag{3}$$

$$RET_{it} = \beta_0 + \beta_1 Att_{it} + \beta_2 Att_{it} * IS_{it} + \beta_3 IS_{it} + \beta_4 Controls_t + \varepsilon_{it} \tag{4}$$

Among them, RET_{it} is the return of stock i during t. Att_{it} is the investor attention to stock i during t, which is represented by the Google search index GSVI. IS_{it} is the investor sentiment towards stock i during t, which is represented by Popularity Index AR. $Att_{it} * IS_{it}$ is the interaction term of investor attention and investor sentiment. $Controls_t$ are the control variables, which include the Carhart four-factor model. And ε_{it} is the residual term following the standard normal distribution.

4. Data Presentation and Analysis

4.1. Descriptive Statistics

As can be seen from Table 1, the mean value of RET for the whole sample is 0.276%, the maximum value and the minimum value are 4.903% and -4.425% respectively, among which the minimum value and 25% quantile are both negative, and the median value is also very close to 0, which indicates that nearly half of the observed stock returns are negative. This proportion

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is not negligible, we speculate that this may be related to the impact of the COVID-19 epidemic on the stock market.

The standard deviation of Att is in sharp contrast with that of RET. According to the calculation method of the Google search trend, the highest value of the Google Search Volume Index (GSVI) will not be less than 100, and the minimum value will not be greater than 0. Therefore, our Att observation value fluctuates from 0 to 100, and the data fluctuates greatly. Its standard deviation reaches 22.455, and the median and mean values are 66 and 62.743 respectively.

Under the impact of Att, the standard deviation of the interactive item is also very high (43.764). Its maximum and minimum values are 155.428 and 19.645, respectively. The maximum value of the interactive item is higher than that of Att, resulting in greater data volatility.

The moderating variable (IS) has a range of values from 0.4313426 to 2.283191 with a very low standard deviation of only 0.597. Furthermore, the means for the control variables Mkt, SMB, HML, and UMD are 0.063, 0.001, 0.002, and 0.3 respectively, which is also consistent with the research results of related literatures (Bucher (2017) Baker and Wurgler (2006)).

Table 1. Descriptive Statistics

	Mean	SD	Min	p25	Median	p75	Max
RET	0.276	2.905	-4.425	-1.927	0.311	2.504	4.903
Att	62.743	22.455	0	46	66	81	100
IS	1.141	0.597	0.431	0.642	0.993	1.54	2.283
Att_IS	70.924	43.764	19.645	34.520	59.477	99.566	155.428
Mkt	0.063	1.053	-2.740	-0.65	0.1	0.74	2.45
SMB	0.001	0.007	-0.013	-0.004	0	0.006	0.019
HML	0.002	0.01	-0.023	-0.005	0.002	0.007	0.022
UMD	0.002	0.01	-0.022	-0.005	0.002	0.007	0.033

This table shows descriptive statistics for all the variables used in this study.

4.2. Regression Analysis

4.2.1. Results and Interpretation

Table 2. Regression Result

	(1)	(2)
Variables	RET	RET
Att	0.00537***	-0.00378**
	(3.50)	(-2.41)
Mkt	0.824***	0.792***
	(50.68)	(53.64)
SMB	-14.78***	-16.58***
	(-6.58)	(-7.92)
HML	23.20***	17.54***
	(11.14)	(9.54)
UMD	25.76***	-26.89***
	(-14.24)	(-16.56)
IS		1.211***
		(18.03)
Att_IS		0.00748***
		(6.96)
_cons	-0.0848	-1.409***
	(-0.88)	(-14.15)
N	31021	31021
R^2	0.0904	0.2073

This table presents fixed-effect model regression results for the relationship between stock return and investor attention, investor sentiment, and the interaction term between the two. The data in brackets are robust standard errors. *, ** and *** indicate that the coefficients are significant at the 10%, 5%, and 1% levels, respectively.

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In the regression part, we first test Hypothesis 1; and then add moderating variables (investor sentiment) and interaction terms to the model to test Hypothesis 2. In accordance with the previous research, we employ the Google search index (GSVI) as a proxy for investor attention and the Popularity Index (AR) as a proxy for investor sentiment. The detailed results are listed below.

The first column in Table 2 above relates to Hypothesis 1, which aims to examine the relationship between investor attention and stock returns, making investor attention the only key independent variable. The regression results demonstrate that investor attention is positively correlated with stock returns at the 1% level of significance after adding the control variables. The stock returns increase by 0.00537% for every unit of increased investor attention. This outcome supports our Hypothesis 1, which states that stock returns are positively impacted by investor attention in general. Based on the analysis in Chapter 3, we concluded that investor attention affects stock returns mainly through two paths: the "attention-driven trade hypothesis" and the "risk compensation hypothesis", and that these two paths affect stock returns in opposite directions. Therefore, our regression results indirectly indicate that the positive impact of the "attention-driven trade hypothesis" is stronger than the negative impact of the "risk compensation hypothesis", because this is the only way to make the overall impact of investor attention on stock returns positive. However, we find that our coefficients are much smaller than those obtained in the studies of Odean and Barber (2008) and Engelberg (2012). We note that the correlation coefficient between investor attention and stock returns in Table 2 is also very small (0.023), indicating that their correlation itself is weak. Therefore, we think that data units should not be blamed. According to Liu and West (2016), this might be because we have different definitions of stock returns, and the different data periods may also contribute to the different correlation coefficients and regression coefficients. In conclusion, the regression results demonstrate that higher investor attention leads to higher stock returns, this conclusion is statistically significant, while not has economical significance.

In terms of moderating effect, the second column in the table above is what we use to test hypothesis 2, i.e., to test whether investor sentiment has a moderating effect on the effect of investor attention on stock returns, so we add the moderating variable (investor sentiment) and the interaction term of investor attention and investor sentiment based on the first column. According to the regression results, we observe that the coefficient of the interaction term is positive at 1% level of significance, which is consistent with hypothesis 2 that an increase in investor sentiment increases the positive impact of investor attention on stock returns. Our results indicate that for every unit increase in investor sentiment, the impact of investor attention on stock returns expands by 0.00748%. At the same time, we are concerned with the strange phenomena where, when we include the interaction term as well as the moderating variable, the coefficient of the main effect (investor attention) changes from 0.00537 to -0.00378. Additionally, Table 3 shows that the coefficients of investor attention and investor sentiment are both significantly positive when the interaction term is excluded. Therefore, we believe that the change in the sign of the main effect after adding the interaction term may be due to the fact that the significant interaction effect distorts the effect mechanism and direction of investor attention. In other words, the effect of investor attention on stock returns is in different directions at different levels of investor sentiment and is not always positive, and thus the sign of the main effect changes after adding the interaction term. Future studies can focus on the specific analysis of this issue, and this study simply focuses on if there is a significant interaction effect.

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Table 3. Regression Results Without Interaction Term

	(1)
Variables	RET
Att	0.00285**
	(2.23)
IS	1.664***
	(69.97)
Mkt	0.794***
	(53.67)
SMB	-16.54***
	(-7.91)
HML	17.63***
	(9.58)
UMD	-26.90***
	(-16.57)
_cons	-1.812***
	(-21.38)
N	31021
R^2	0.2064

This table presents fixed-effect model regression results for the relationship between stock return and investor attention, investor sentiment. The data in brackets are robust standard errors. *, ** and *** indicate that the coefficients are significant at the 10%, 5%, and 1% levels, respectively.

Additionally, the influence direction of investor sentiment in Table 2 supports the findings of researchers like Stambaugh, Yu, and Yuan (2011), Brown, and Cliff (2004), according to which investor sentiment positively affects contemporaneous stock returns. The results show in Table 2 that when investor attention is 0, the stock returns will improve by 1.211% for every unit increase in investor sentiment. In Table 2, the correlation coefficient between investor sentiment and stock returns is larger than that between investor attention and stock returns. However, this result is conflicting with the conclusion of Bucher (2017), who believed that investor attention can explain more changes in stock returns than investor sentiment.

Finally, our regression results for the control variables are also consistent with the correlation matrix, which shows that the market factor Mkt and the value factor HML have a positive correlation with stock returns while the scale factor SMB and momentum factor UMD have a negative correlation with stock returns.

4.2.2. Discussion

The above empirical results suggested that investor attention has a positive effect on stock returns in general, meaning that the more attention a firm receives, the higher its contemporaneous stock returns. This result is consistent with our Hypothesis 1 and with the literature that supported the "attention-driven trade hypothesis" (Odean and Barber (2008), Engelberg (2012)), but not with those supported the "risk compensation hypothesis" (Fang and Press (2009)). The reason behind this may be that attention does not significantly reduce information asymmetry (Gao, Y. et al. (2018)), and therefore the extent of the negative effect of investor attention on stock returns as suggested by the "risk compensation hypothesis" is limited. Further, when we add the interaction term and the moderating variable to the model, we found that the coefficient of the interaction term is significantly positive, indicating that the increase in investor sentiment helps to amplify the positive effect of investor attention on stock

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returns. The mechanism can be explained by the "attention-driven trade hypothesis". Due to the limited cognitive ability of investors, they only select investment targets in the set of stocks they pay attention to, so the more attention a company receives, the more investors include it in their investment choice set. However, being included in the selection set does not necessarily mean that it will be selected as an investment target. If it is only included in the selection set but not actually invested, the increase in investor attention will not have an impact on stock returns. This transformation process from potential investment demand to actual investment behaviour is influenced by investor sentiment, and when investor sentiment is high, there is more willingness and behaviour to invest (Wen et al. (2014), Wang et al. (2020)), thus facilitating this transformation process and expanding the impact of investor attention on stock returns.

5. Conclusion

This research aims to investigate the impact of investor attention on stock returns as well as the moderating effect of investor sentiment. To that end, we first look over the relevant academic literature. Most academics agree that investor sentiment has a strong positive impact on contemporaneous stock returns (Stambaugh, Yu, and Yuan (2011), Brown and Cliff (2004), Schmeling (2009)). In terms of investor attention to the impact on stock returns, there are mainly four popular theories, among which the "attention-driven trade hypothesis" (Odean and Barber (2008), etc.) and the "risk compensation hypothesis" (Press and Fang (2009), etc.) are relatively mature. It is interesting that these two hypotheses come to completely different conclusions. According to the "attention-driven trade hypothesis," rising investor attention leads to more potential demand for investments, which raises stock prices. The "risk premium hypothesis" holds that an increase in attention will reduce the degree of information asymmetry and the return required by investors will correspondingly decrease, which will lead to a decrease in the stock returns. This study argues that since it is exceedingly challenging for investors to get internal company information online, an increase in search volume cannot significantly result in a decrease in information asymmetry. As a result, the "attention-driven trade theory" is given more weight in this paper. Based on this, this paper put forward Hypothesis 1: the investor attention represented by the Google search index is positively correlated with the stock returns. Further, the impact of investor attention on stock returns has been found by some researchers to be greater than the impact of investor sentiment (Chen et al. (2022), Prapan et al. (2020), Bucher (2017)). At the same time, we also discovered that some scholars have started to focus on the relationship between investor attention and investor sentiment (Ali and Gurun (2009), Mbanga (2019)). However, at present, there are still few pieces of literature that study investor attention and investor sentiment at the same time. According to this study, the increased investor attention merely serves to enhance the demand for potential investments and does not always result in actual investment activity. When the investor sentiment is high, they will think that the expected returns will rise in the future, so they will be more inclined to invest (Wen et al. (2014), Wang et al. (2020)), and the proportion of potential investment demand converted into actual transactions will be higher, thus expanding the impact of investor attention on the stock returns. Based on this, we proposed Hypothesis 2: Investor sentiment has a moderating effect on the impact of investor attention on stock returns, with increased investor sentiment enhancing the positive impact of attention on stock returns.

We chose the weekly data of 463 US-listed companies that are included in the S&P 500 from January 4, 2021, to May 2, 2022, as the sample for the empirical study in order to test these hypotheses. Based on the studies of Da (2011) and Zhou et al. (2021), this work ran the regression using the Google search index (GSVI) and popularity index (AR) as proxies for

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investor attention and sentiment, respectively. We first put solely investor attention into the regression to test Hypothesis 1. Subsequently motivated by Boeker and Goodstein (2017), we tested the moderating effect by adding moderating variables (investor sentiment) and the interaction term between investor attention and investor sentiment into the regression equation. Our regression results showed that investor attention has a significant positive impact on stock returns. In other words, we indirectly confirmed that the "attention-driven trade hypothesis" is more influential than the "risk compensation hypothesis". In addition, the coefficient of the interaction term is also significantly positive, which indicated that our assumption is correct, that is, the increase in investor sentiment will expand the extent to which investor attention will affect the stock returns.

The incorporation of investor sentiment into the process of investor attention on the impact on stock returns in this study partly filled the gap in the body of existing literature and opened up new paths for related research. The findings of our study also have some importance in terms of application. In practice, companies should not only pay attention to the changes in the macro environment, but also the high-frequency changes in investor attention. At the same time, companies should also consider the impact of investor sentiment on investors' behaviour, which helps companies to adjust their financial strategies on time. In terms of the impact on investors, studying the link between investor attention and stock returns as well as the potential effects of investor sentiment will enable investors to make more informed trading decisions, which in turn will have a significant impact on how prices and returns are correctly shaped.

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