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The empirical study about international investor sentiment and its impact on the U.S. stock market

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Abstract

Based on behavioural finance theory and stock market data, this paper studies the contagion of investor sentiment in international markets and its impact on the US stock market. We use monthly data on four indicators (business confidence index, consumer confidence index, the volume of initial public offerings, and trading volume) for eight countries (the United States, Canada, China, Japan, Germany, the United Kingdom, India, and Brazil) from January 2013 to December 2023, we build a composite index to measure investor sentiment within the region through principal component analysis and classify it into an international investor sentiment index and local investor sentiment index, and the analysis found that the investor sentiment indicators of different countries show some synchronisation, especially in countries with close economic ties. After further analysing the Vector Autoregressive (VAR) model for the International Investor Sentiment Index and the S&P500 return of the US stock market, we find that for the US market, stock returns are mainly driven by changes in international investor sentiment, while international sentiment only affects stock returns with a long lag and has little effect in the short term.

Keywords: Investor Sentiment, Principal Component Analysis, Contagious Global Sentiment, Vector Autoregressive (VAR) model

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1.0 Introduction

Since the early 1980s, the validity of market efficiency has been increasingly questioned. Scholars began to challenge the assumptions of standard finance, arguing that these assumptions were overly idealized and stringent. Grossman and Stiglitz (1980), for instance, introduced the theory of information economics, arguing that perfectly efficient markets cannot exist. At the time, psychology and sociology were gaining attention among scholars, who drew inspiration from these disciplines. Building on the Prospect Theory proposed by Kahneman and Tversky（1970）, researchers started to break away from the traditional economic paradigms and frameworks of capital markets. They began to explore the interaction between investors and financial markets, focusing on psychological factors, emotions, and behaviours to understand their impact on investment decisions and broader market fundamentals.

With the rapid development of the global macroeconomy and capital flows, the interconnectedness of stock markets across countries and regions has deepened. Investor behaviour is not only closely tied to a country's economic conditions, political systems, social environment, and cultural background but also potentially influenced by global market sentiment. Today, a substantial body of research in behavioural finance demonstrates that investor sentiment significantly impacts stock markets, both domestically and internationally. Zouaoui, Nouyrigat, and Beer (2011) assessed the relationship between investor sentiment and stock market crises, concluding that irrational sentiments, such as excessive optimism or pessimism, can persistently affect asset prices and ultimately trigger crises. Additionally, researchers like Ho and Hung (2009), and Beer, Watfa, and Zouaoui (2012) emphasized the importance of investor sentiment in asset pricing.

During the subprime mortgage crisis, panic spread not only in the U.S. market, where the crisis originated but also globally, severely affecting stock markets worldwide. Therefore, we found that investor sentiment in any given country can be divided into two components for analysis: local sentiment and international sentiment influenced by contagion. By using the method of literature reading and sorting, this paper mainly reviews the research on the generation and contagion mechanism of investor sentiment, the measurement method of investor sentiment, and the impact of investor sentiment on market returns.

This paper aims to study investor sentiment from a behavioural finance perspective, using sentiment proxy variables from eight global regions and countries. Inspired by the method of constructing composite sentiment indices by Baker and Wurgler (2006), this study applies the principal component analysis technique. We developed a comprehensive index to represent investor sentiment, categorized into international investor sentiment and local investor sentiment.

Investor sentiment in one country is influenced by the sentiment in other markets, showing that investor sentiment has a degree of international contagion. There is a close relationship between overall market sentiment and local investor sentiment. As the world's largest economy, the United States holds a dominant position in global financial markets. We

examine the impact of investor sentiment on U.S. stock market returns. Considering that U.S. market sentiment is influenced not only by domestic economic conditions but also by global market dynamics, international capital flows, and significant international events (such as the European debt crisis), we conduct a correlation analysis of the international investor sentiment index (Senti_Global) and the S&P 500 Index returns (S&P 500 Return). The findings reveal a strong positive correlation between the S&P 500 index and the international investor sentiment index. We then proceeded to conduct a Vector Autoregression (VAR) model, further revealing that stock returns primarily drive changes in market sentiment, rather than market sentiment driving stock returns.

2.0 Related Literature

2.1 Definition of Investor Sentiment

The standard definition of investor sentiment has been interpreted differently by various scholars based on their respective perspectives. Brown and Cliff (2004) describe investor sentiment as the overall pessimistic or optimistic attitude in the stock market. Baker and Wurgler (2006) define investor sentiment as a subjective belief that does not fully reflect the current reality, arising from expectations about investment risk and future cash flows of assets.

2.2 Measurement of Investor Sentiment

Baker and Wurgler (2006) explored how to measure investor sentiment. Generally, there are currently two main approaches to capturing investor sentiment: the "bottom-up" and "top-down" methods. The first approach, "bottom-up," uses psychological biases to explain phenomena like overreaction and underreaction among investors, providing a micro-level foundation for studying changes in investor sentiment. The "top-down" approach, on the other hand, relies on macroeconomic or other aggregate data, focusing on measuring and analyzing overall sentiment and its impact on market returns and individual stocks.

Given that real investors and actual markets are more complex than what current psychological theories can fully explain, most scholars now consider the "top-down" method to be more reliable. This approach uses various proxy variables to represent market upswings or downturns and examines their interactions with market activity. Current research on sentiment measurement generally categorizes investor sentiment indicators into three main types: explicit indicators, implicit indicators, and composite indicators.

Subjective indicators, also known as explicit indicators, are derived from methods like surveys that gather data on investors' expectations or outlooks regarding the future market, whether bullish or bearish. These indicators subjectively reflect changes in investor sentiment.

1. Consumer Confidence Index (CCI)

The Consumer Confidence Index (CCI) is an indicator that measures consumer confidence in the current economic situation and future expectations. It is typically calculated through surveys of consumers' views on economic conditions, income changes, and purchasing intentions. Qiu and Welch (2006) found that the Consumer Confidence Index (CCI) is a better

measure of investor sentiment than the Closed-End Fund Discount (CEFD) due to its stronger correlation with actual sentiment, superior predictive power, more robust theoretical foundations, and empirical validation. Lemmon and Portniaguina (2006) observed that the CCI is particularly effective in predicting returns for stocks with low institutional ownership and small-cap stocks. Schmeling (2009) used the CCI to study the relationship between investor sentiment and stock market returns across 18 industrialized nations. Additionally, Ho and Hung (2009), Yu and Yuan (2012), Finter et al. (2012), and Bathia and Bredin (2013) also supported the use of the CCI as an indicator of investor sentiment.

Otoo (1999) found a contemporaneous relationship between stock returns and changes in the CCI. Zouaoui and Nouyrigat (2011) used the CCI to examine the impact of investor sentiment on markets prone to overconfidence, low institutional ownership, and herd behaviour. Research by Charoenrook (2003), Lemmon and Portniaguina (2006), and Qiu and Welch (2006) further suggested that the CCI could be used to predict excess returns or future stock returns.

2. Business confidence index (BCI)

The business confidence index (BCI) is a standardized confidence indicator providing an indication of future developments in business, based upon opinion surveys on developments in production, orders and stocks of finished goods in the manufacturing sector. Karl Taylor and Robert McNabb（2007）found that both consumer and business confidence indicators are effective in predicting GDP movements and economic downturns across the business cycle for four European economies. These indicators are procyclical, meaning they rise during economic expansions and fall during recessions. They not only help forecast economic downturns but also provide quantitative estimates of economic activity.

Objective indicators, also known as implicit or indirect indicators, do not rely on the subjective feelings of market participants. Instead, they use market statistics, which, after processing or calculation, objectively reflect changes in investor sentiment through market activity.

1. IPO-Related Indicators

Researchers such as Ljungqvist and Wilhelm (2002), Lowry (2003), Ljungqvist et al. (2006), and Kaustia and Knüpfer (2008) have suggested that investor sentiment significantly influences initial public offerings (IPOs) and their pricing. International scholars like Brown and Cliff (2004; 2005), Baker and Wurgler (2006; 2007), Yu and Yuan (2011), and Finter et al. (2012) have used IPO-related indicators as variables to measure sentiment in their studies. Many other studies also utilize IPO volume and IPO returns to construct sentiment indices. For example, Finter et al. (2012) and Baker and Wurgler (2006) used IPO volume and first-day IPO returns as indicators to build investor sentiment indices. Similarly, Brown and Cliff (2004) and Ljungqvist and William (2002) provided evidence supporting this approach. However, research by Choe, Masulis, and Nanda (1993), as well as Bayless and Chaplinsky (1996), argued that IPO volume may not be a reliable indicator of investor sentiment.

2. Market liquidity related indicators

Turnover reflects how often shares are traded in the stock market over a specific period. It is calculated by dividing the total trading volume by the number of outstanding shares. This variable indicates the market's liquidity and activity levels. Scheinkman and Xiong (2003) found that different investors have different market valuations. The greater the difference in valuations, the smaller the value reflected in the trading volume. Baker and Stein (2004) analyzed the relationship between market liquidity and investor sentiment through modelling. Finter, Niessen-Ruenzi and Ruenzi (2012), Corredor, Ferrer and Santamaria (2013), and Chen et al. (2013) also believe that trading volume or liquidity is an effective indicator of investor sentiment.

Objective indicators are derived from publicly available market data. Compared to the subjective feelings of market participants, they are generally more accurate and objective. However, since these indicators do not directly reflect investors' confidence or expectations regarding the future stock market, their authenticity is sometimes questioned. There are numerous types of objective indicators, and they vary in their ability and accuracy to reflect investor sentiment. Typically, objective indicators are retrospective, making it challenging to use them for predictive purposes. Additionally, these indicators may be influenced by macroeconomic factors, leading to potential biases. Therefore, relying on a single objective indicator may not accurately or effectively capture the true sentiment of investors in the market.

Compared with a single indicator, a comprehensive or composite indicator can depict or reflect the psychology and behaviour of investors more objectively and realistically, and the research results obtained from it are more credible.

Baker and Wurgler (2006) selected six basic indicators, including the turnover rate of New York Stock Exchange stocks, the discount of closed-end funds, the dividend premium, the proportion of new stock issuance, the number of IPOs and the first-day return, and established a composite index through principal component analysis, and eliminated the influence of macroeconomic factors. They used the constructed composite index to explore the cross-sectional impact of emotions on stock market returns and finally found that stocks with high speculation, difficulty in arbitrage and high subjective valuation are more susceptible to emotional factors. It should be said that the research method of Baker and Wurgler (2006) has been widely recognized in the academic community and has been widely disseminated. Until now, most of the research on constructing composite indexes is still based on this method. Bathia and Bredin (2010) constructed a composite index using the consumer confidence index, stock fund flows, closed-end stock fund discounts and stock buying and selling ratios. Finter et al. (2012) used the same construction method and constructed a German investor sentiment index (GSI) based on the characteristics of the German securities market. Baker, Wurgler and Yuan (2012) selected data from six major stock markets around the world and established a global investor sentiment index and six local indexes.

2.3 The Impact of Investor Sentiment on the Stock Market

There is extensive literature on the relationship between investor sentiment and the stock

market. In an international study, Bathia and Bredin (2013) explored the role of investor sentiment in the market returns of seven countries, finding that high (low) investor sentiment often precedes low (high) stock market returns. Zouaoui, Nouyrigat, and Beer (2011) assessed the relationship between investor sentiment and stock market crises, concluding that irrational sentiments, such as excessive optimism or pessimism, can persistently affect asset prices and ultimately trigger crises. Additionally, researchers like Ho and Hung (2009), and Beer, Watfa, and Zouaoui (2012) emphasized the importance of investor sentiment in asset pricing. Tetlock (2007), Bollen et al. (2011), and Da, Engelberg, and Gao (2015) explored the relationship between investor sentiment and the stock market using alternative data sources, such as the Internet and newspapers.

Most analysts suggest that sentiment does indeed influence the stock market, Brown and Cliff (2004), Qiu & Welch (2006) and Baker & Wurgler (2006, 2007) believe that the impact of sentiment on market returns may be delayed, that is, it takes some time for changes in sentiment to be reflected in market returns. Barberis, Shleifer, and Vishny (1998) suggest that when market sentiment deviates from fundamentals, prices will deviate from their true value, but over time, market prices will gradually return to fundamentals, reflecting the regression effect of sentiment. Brown and Cliff (2004; 2005) discovered a strong correlation between the sentiment of both individual and institutional investors and contemporaneous stock market returns. In the short term, this relationship is positive, while in the long term, it becomes negative. They also identified sentiment as a systemic factor influencing the stock market.

However, some scholars are sceptical of these findings. For example, Solt and Statman (1988) investigated the relationship between institutional investor sentiment and Dow Jones Industrial Average returns, finding that sentiment had an insignificant impact on subsequent stock market returns. Chen, Kan, and Miller (1993) argued that the Closed-End Fund Discount (CEFD) is not a reliable proxy for investor sentiment and does not significantly affect the prices of small-cap stocks.

2.4 Contagion of Investor Sentiment

To date, the academic community has differing views on the precise definition of contagion, which can be summarized into three main categories: Firstly, the spread of volatility from the country where a crisis originated to other countries or regions. Secondly, an increase in the likelihood of one country experiencing risk when another country faces a crisis. Thirdly, excess comovement, where the price changes in multiple markets become overly synchronized during a crisis, which cannot be fully explained by market fundamentals.

Both global and local market sentiment can influence stock prices, and sentiment itself can be contagious. There are two possible pathways for this contagion. The first is that optimism about a country's investment prospects leads to increased holdings of that country's stocks. This is within the scope of local sentiment. An increase in local sentiment is associated with factors such as local volatility premiums, IPO volume, first-day IPO returns (opening prices), and stock turnover. These factors reflect capital market activity, which could originate from either foreign or local investors. Studies by Klibanoff, Lamont, and Wizman (1998), as well as Hwang (2011), support this idea. The second pathway is that optimism among investors in

one country may lead them to hold more risk assets, including international stocks. In this case, local sentiment can influence another target country, making it insufficient to measure only local sentiment. Chang et al. (2009) found that in environments with high-quality information and legal frameworks, the contagion of sentiment is common and significant. However, a well-managed corporate environment can effectively slow the spread of investor sentiment to some extent.

2.5 Discussion and Contribution

Firstly, regarding the similarities in all the literature we reviewed, we refer to Baker and Wurgler (2006) and similarly divide investor sentiment into local and international components. This approach allows for a better macro-level understanding of sentiment itself and the functioning of capital markets. Through empirical analysis, we can better explore the contagion of sentiment and its impact on the U.S. stock market, providing a more accurate explanation of market anomalies.

However, considering that the Chinese stock market has only emerged over the past 20 years, it is dominated by numerous inexperienced individual investors, with herd behaviour being quite prevalent, leading to a more irrational market. Therefore, when constructing the composite investor sentiment index, the selection of proxy indicators must be more timely and high-frequency. Unlike Baker and Wurgler (2006), who selected annual indicators, this paper exclusively uses monthly frequency data. Using annual data would fail to capture the variations in investor sentiment within a year, leading to inaccurate summaries and descriptions of investor sentiment.

Secondly, while Baker and Wurgler (2006) focused only on six developed countries, this paper includes a broader range of countries and regions, also considering the stock markets of developing and emerging countries. Additionally, the data in this paper is updated until December 2023, making it highly timely and historically relevant. Moreover, most of the references are based on subjective indicators for analysis, whereas this paper incorporates more objective indicators, making the analysis more accurate and objective compared to relying solely on the subjective feelings of market participants.

Last but not least, we also considered the limitations of this paper. When selecting proxy indicators, commonly used indicators like the number of IPOs and first-day IPO returns are often used by domestic and foreign scholars to analyze the impact of investor sentiment and its international contagion on the Chinese stock market. However, due to the frequent suspension of IPOs in China, the data is discontinuous, which is insufficient to reflect investor sentiment in the market, thus introducing some errors.

It is worth noting that before the start of this paper, the key issues the research aimed to address were:

1. How can investor sentiment be measured?
2. Is investor sentiment contagious? Does it spread between different markets around the world?

3. Does international investor sentiment affect stock market returns in a particular country? In an example of the United States, what is the relationship between them and US market returns?

These questions have been answered accordingly. The study of measurement and contagion aligns with previous scholars, but this paper offers a different perspective on how global investor sentiment and returns influence the U.S. stock market. Specifically, it finds that stock returns have a direct and significant impact on changes in market sentiment, while the short-term impact of market sentiment on stock returns is not significant. However, there is some influence in the long term. This indicates that investor sentiment's response to market performance is delayed and exhibits a self-sustaining, mean-reverting trend.

3.0 Data Analysis and Results

3.1Construction of a Composite Investor Sentiment Index

3.1.1 Indicator Selection and Data Sources

Based on the literature review, there is no perfect single indicator to measure investor sentiment. Therefore, after considering various practical factors, including the timeliness, continuity, and availability of data, we have decided to select four sentiment indicators from the following eight countries: China (CN), Japan (JP), Brazil (BR), Canada (CA), the United States (US), Germany (DE), the United Kingdom (UK), and India (IN). Using the Principal Component Analysis (PCA) method, we will construct a composite investor sentiment index, SENTI_Total, to measure investor sentiment across these regions.

The first indicator we use is the Business Confidence Index, labelled BCI. Its definition has been explained earlier. The BCI data for various countries is sourced from the OECD database: OECD Data.

The second indicator is the Consumer Confidence Index, labelled CCI. Its definition has also been explained earlier. The data for CCI is sourced from Passport and the OECD database: Euromonitor Passport and OECD Data.

The third indicator is the Volume of IPOs, which refers to the total number or amount of initial public offerings (IPOs) conducted within a specific period, labelled IVOL. The data is sourced from Bloomberg.

The fourth indicator is Trading Volumes, labelled TVOL. "Trading volumes" refers to the total quantity of shares, contracts, or units traded in a financial market over a specific period. It is a measure of market liquidity. The data is sourced from Bloomberg.

Following the requirement of frequency of data and synchronization between different datasets, we have used monthly data of the stock market from January 2013 to December 2023, a total of 132 periods, to construct the model.

3.1.2 Descriptive statistics and correlation analysis

The results of the descriptive statistical analyses of the selected indicators for the eight countries are shown in Table 1 and the results of the correlation analyses in Table 2.

Table 1. Descriptive Statistics of All Indicators

Indicators	count	mean	std	min	25%	50%	75%	max
China								
BCI	132.00	109.24	12.40	85.50	102.53	108.50	121.35	127.00
CCI	132.00	98.78	0.87	94.31	98.27	98.78	99.51	100.17
IVOL	132.00	97.82	71.36	17.00	48.75	73.00	116.25	346.00
TVOL	132.00	109.24	12.40	85.50	102.53	108.50	121.35	127.00
Japan								
BCI	132.00	38.82	4.88	21.30	36.05	40.10	42.63	46.00
CCI	132.00	100.56	0.76	97.93	100.41	100.68	100.85	101.71
IVOL	132.00	17.41	10.47	1.00	10.00	15.50	22.25	51.00
TVOL	132.00	189.22	36.83	121.96	156.69	192.86	212.09	271.60
Brazil								
BCI	132.00	86.28	12.81	58.20	77.78	84.85	91.68	121.10
CCI	132.00	99.42	1.70	94.97	98.37	99.75	100.56	102.94
IVOL	132.00	5.13	4.00	0.00	2.00	4.00	7.00	19.00
TVOL	132.00	21124.20	4114.66	10103.52	18808.12	21264.13	23719.81	30089.87
Canada								
BCI	132.00	51.71	3.70	35.60	50.08	52.70	54.20	57.10
CCI	132.00	99.93	1.81	95.75	98.62	99.91	100.95	104.18
IVOL	132.00	165.28	57.16	57.00	121.50	160.00	198.25	327.00
TVOL	132.00	12913.52	1833.23	9137.13	11687.23	12494.80	14216.21	17537.38
United States								
BCI	132.00	83.88	13.31	50.00	73.65	87.05	95.75	101.40
CCI	132.00	100.16	0.97	98.19	99.44	100.22	100.95	101.98
IVOL	132.00	123.86	52.39	55.00	95.75	113.00	136.00	434.00
TVOL	132.00	2890.19	949.94	1498.11	2067.81	2708.51	3791.82	4769.83
Germany								
BCI	132.00	-5.18	7.26	-29.40	-7.90	-2.35	-0.10	2.80
CCI	132.00	100.94	1.27	97.64	100.25	100.79	101.87	103.55
IVOL	132.00	5.08	3.04	0.00	3.00	5.00	7.00	13.00
TVOL	132.00	13909.60	2267.40	9995.15	12101.93	13460.07	15446.67	18856.96
United Kindom								
BCI	132.00	-11.34	10.34	-43.50	-16.78	-8.10	-4.48	1.80
CCI	132.00	101.23	2.14	93.96	100.04	101.39	102.53	105.52
IVOL	132.00	40.79	13.76	13.00	31.00	40.00	49.00	85.00
TVOL	132.00	9527.69	903.18	7032.10	9029.93	9578.25	9993.05	11533.49
India								
BCI	132.00	99.86	3.57	91.85	97.85	100.92	102.52	105.16

CCI	132.00	99.05	2.86	90.73	97.69	98.44	99.65	105.19
IVOL	132.00	16.15	10.16	2.00	10.00	14.00	21.00	56.00
TVOL	132.00	533.06	148.64	279.49	418.19	508.79	666.26	868.04

This table presents the descriptive statistics of sentiment indicators for eight countries: China, Japan, Brazil, Canada, the United States, Germany, the United Kingdom, and India. The indicators include the Business Confidence Index (BCI), Consumer Confidence Index (CCI), IPO Volume (IVOL), and Trading Volume (TVOL), covering 132 periods from January 2013 to December 2023. The statistics provided include the mean, standard deviation, minimum, median, and maximum values.

Table 2. Correlation Analyses of all Indicators

	Correlation with sentiment indicators				**P-values**			
	BCI	CCI	IVOL	TVOL	BCI	CCI	IVOL	TVOL
China								
BCI	1.00	0.24	0.04	0.40		0.01	0.65	0.00
CCI	0.24	1.00	0.00	0.03	0.01		0.99	0.75
IVOL	0.04	0.00	1.00	0.24	0.65	0.99		0.01
TVOL	0.40	0.03	0.24	1.00	0.00	0.75	0.01	
Japan								
BCI	1.00	0.60	0.13	-0.48		0.00	0.13	0.00
CCI	0.60	1.00	0.09	-0.14	0.00		0.32	0.11
IVOL	0.13	0.09	1.00	0.03	0.13	0.32		0.70
TVOL	-0.48	-0.14	0.03	1.00	0.00	0.11	0.70	
Brazil								
BCI	1.00	0.48	0.00	0.66		0.00	0.97	0.00
CCI	0.48	1.00	0.43	0.62	0.00		0.00	0.00
IVOL	0.00	0.43	1.00	0.20	0.97	0.00		0.02
TVOL	0.66	0.62	0.20	1.00	0.00	0.00	0.02	
Canada								
BCI	1.00	0.38	-0.40	-0.04		0.00	0.00	0.68
CCI	0.38	1.00	0.18	0.53	0.00		0.04	0.00
IVOL	-0.40	0.18	1.00	0.11	0.00	0.04		0.20
TVOL	-0.04	0.53	0.11	1.00	0.68	0.00	0.20	
United States								
BCI	1.00	0.24	-0.02	-0.59		0.01	0.84	0.00
CCI	0.24	1.00	0.37	0.02	0.01		0.00	0.79
IVOL	-0.02	0.37	1.00	0.18	0.84	0.00		0.04
TVOL	-0.59	0.02	0.18	1.00	0.00	0.79	0.04	
Germany								
BCI	1.00	0.16	0.23	-0.26		0.06	0.01	0.00
CCI	0.16	1.00	0.12	0.40	0.06		0.15	0.00
IVOL	0.23	0.12	1.00	0.10	0.01	0.15		0.23
TVOL	-0.26	0.40	0.10	1.00	0.00	0.00	0.23	
United Kindom								
BCI	1.00	0.27	0.39	0.37		0.00	0.00	0.00

CCI	0.27	1.00	0.08	0.55	0.00		0.38	0.00
IVOL	0.39	0.08	1.00	0.06	0.00	0.38		0.52
TVOL	0.37	0.55	0.06	1.00	0.00	0.00	0.52	
India								
BCI	1.00	-0.25	0.16	-0.21		0.00	0.07	0.01
CCI	-0.25	1.00	0.38	0.71	0.00		0.00	0.00
IVOL	0.16	0.38	1.00	0.39	0.07	0.00		0.00
TVOL	-0.21	0.71	0.39	1.00	0.01	0.00	0.00	

Table2 presents the correlation coefficients and their p-values between sentiment indicators (BCI, CCI, IVOL, TVOL) for eight countries (China, Japan, Brazil, Canada, USA, Germany, UK and India).

Table 1 highlights significant differences in sentiment indicators across the eight countries. Taking the mean for example, the Business Confidence Index (BCI) is highest in China (109.24), while it is lowest in Germany and the United Kingdom (-5.18 and -11.34, respectively), and these differences may be related to the statistical methodology and scaling of each country; Consumer Confidence Index (CCI) is highest in the United Kingdom (101.23), while it is lower in Brazil (99.42), which may be related to differences in survey design, data processing, or differences in market and economic environments across countries; IPO Volume (IVOL) is highest in Canada (165.28), while it is lower in Brazil and Germany (5.13 and 5.08, respectively), reflecting differences in market activity; Transaction Volume (TVOL) is highest in Brazil (21, 124.20) and lowest in India (533.06), and these differences may be influenced by market size and statistical methodology. These results suggest that international comparisons need to take into account different statistical methods and scales and may require further standardisation.

Correlation analyses of investor sentiment indicators reveal a strong positive correlation between the Business Confidence Index (BCI) and Consumer Confidence Index (CCI), as well as between the Consumer Confidence Index (CCI) and Trading Volume (TVOL). This indicates some level of synchronization between business confidence and consumer confidence, as well as between consumer confidence and market activity. However, in countries like Japan, the US, and Germany, a negative correlation between BCI and TVOL is observed, reflecting the complex dynamics of market sentiment, especially during periods of economic volatility. Many of these correlations are statistically significant (p-values less than 0.05), suggesting that these relationships are unlikely to have occurred by chance.

3.1.3 Principal Component Analysis (PCA)

Through correlation analysis, we found that the four sentiment proxy indicators are not independent of each other, and there is inevitably overlapping information among them. Based on this, we chose to use the Principal Component Analysis (PCA) method to further process these indicators in order to obtain the overall investor sentiment index for each country. After standardizing the Business Confidence Index (BCI), Consumer Confidence Index (CCI), Volumes of IPO (IVO), and Trading Volume (TVOL) indicators for each country, we conducted PCA, with the results shown in the table 3 below.

Table 3. Principal Component Analysis (PCA) Results

	Loadings						
	BCI	**CCI**	**IVOL**	**TVOL**	**Eigenvalues**	**Explained Var**	**Cumulative Var**
China							
PC1	0.31	0.63	0.33	0.63	1.54	0.38	0.38
PC2	-0.67	-0.27	0.64	0.27	1.09	0.27	0.65
PC3	-0.61	0.32	-0.65	0.32	0.87	0.22	0.87
PC4	-0.28	0.65	0.27	-0.65	0.52	0.13	1.00
Japan							
PC1	-0.56	-0.67	-0.14	0.46	1.87	0.46	0.46
PC2	0.16	-0.01	0.88	0.45	1.04	0.26	0.72
PC3	-0.61	-0.03	0.45	-0.65	0.83	0.21	0.93
PC4	0.53	-0.74	0.09	-0.40	0.29	0.07	1.00
Brazil							
PC1	-0.57	-0.51	-0.28	-0.58	2.30	0.57	0.57
PC2	0.21	-0.47	0.84	-0.19	1.07	0.27	0.84
PC3	0.74	-0.48	-0.47	-0.07	0.35	0.09	0.92
PC4	0.30	0.54	0.04	-0.79	0.31	0.08	1.00
Canada							
PC1	-0.72	-0.33	-0.10	-0.60	1.65	0.41	0.41
PC2	0.01	-0.67	0.70	0.25	1.44	0.36	0.77
PC3	-0.27	-0.39	-0.60	0.64	0.70	0.17	0.94
PC4	0.64	-0.53	-0.37	-0.41	0.24	0.06	1.00
United States							
PC1	-0.17	-0.70	0.11	0.68	1.65	0.41	0.41
PC2	0.69	0.11	0.69	0.18	1.43	0.35	0.76
PC3	-0.64	0.00	0.71	-0.28	0.60	0.15	0.91
PC4	0.29	-0.70	0.00	-0.65	0.36	0.09	1.00
Germany							
PC1	0.68	0.07	0.36	0.64	1.47	0.37	0.37
PC2	-0.06	-0.77	-0.48	0.42	1.30	0.32	0.69
PC3	-0.49	-0.38	0.77	0.13	0.83	0.21	0.90
PC4	0.54	-0.51	0.20	-0.64	0.42	0.10	1.00
United Kindom							
PC1	-0.54	-0.54	-0.32	-0.57	1.91	0.47	0.47
PC2	-0.41	0.37	0.75	-0.37	1.13	0.28	0.75
PC3	0.52	-0.66	0.52	-0.16	0.57	0.14	0.90
PC4	0.53	0.38	-0.26	-0.71	0.42	0.10	1.00
India							
PC1	0.62	-0.21	0.42	0.62	2.06	0.51	0.51
PC2	-0.08	0.81	0.57	-0.04	1.16	0.29	0.80

PC3	-0.31	-0.54	0.70	-0.35	0.52	0.13	0.93
PC4	-0.71	-0.04	0.00	0.70	0.29	0.07	1.00

This table presents the results of Principal Component Analysis (PCA) for the Business Confidence Index (BCI), Consumer Confidence Index (CCI), Volumes of IPOs (IVOL), and Trading Volume (TVOL) across China, Japan, Brazil, Canada, the United States, Germany, the United Kingdom, and India. It includes the loadings of each principal component (PC1 to PC4) for the four indicators, eigenvalues, explained variance, and cumulative variance for each country.

Using principal component analysis, we find that the principal components of the sentiment indicators show significant differences across countries. China's first principal component (PC1) shows positive loadings on BCI, CCI, IVOL, and TVOL, indicating that it captures an overall positive market sentiment factor; on the contrary, China's second principal component (PC2) shows negative loadings on BCI and CCI, and positive on IVOL. Japan's first principal component (PC1) exhibits predominantly negative loadings, suggesting that market sentiment in Japan is skewed towards the negative; its second principal component (PC2) has higher loadings on IVOL, emphasising the importance of market activity. Brazil's first principal component (PC1) also shows negative sentiment, while its second principal component (PC2) has a significant positive loading on IVOL, highlighting the impact of the number of IPOs. Principal component analyses for Canada and the UK show a similar pattern of negative sentiment, while the emphasis on market activity varies across principal components. Germany's first principal component exhibits positive loadings on BCI and TVOL, suggesting a positive market sentiment bias, while the second principal component's negative loadings on CCI indicate a different sentiment dynamic. India's first principal component shows overall positive sentiment, exhibiting positive loadings on all indicators, while the second principal component highlights the importance of consumer confidence in particular. These results suggest that the principal components of market sentiment in different countries exhibit their unique patterns of sentiment and market behaviour, providing valuable insights into understanding international market sentiment.

Eigenvalues reflect the importance of each principal component in explaining the variance of the data, the larger the value, the more variance in the data is explained by the principal component. We usually select principal components with eigenvalues greater than 1 according to Kaiser's criterion. Eigenvalues greater than 1 indicate that the element explains more variance than the variance of an original variable, and these components are usually more important. From the table, it can be observed that all eight countries have two eigenvalues greater than 1; however, the cumulative contribution of these two eigenvalues does not exceed 85%. To obtain more comprehensive information, we followed the approach of Wang (2017), selecting the first three principal components based on the criterion that the cumulative variance explained exceeds 85%. These three components, which account for nearly 90% of the information, were used to construct the composite sentiment index, **Senti_Total**. The composite sentiment indices for the eight countries are labelled respectively as **Senti_Total_CN, Senti_Total_JP, Senti_Total_BR, Senti_Total_CA, Senti_Total_US, Senti_Total_DE, Senti_Total_UK,** and **Senti_Total_IN**.

Using the United States as an example, the first three principal components can be expressed as follows:

$$F1 = -0.17BCI - 0.7CCI + 0.11IVOL + 0.68TVOL$$
$$F2 = 0.69BCI + 0.11CCI + 0.69IVOL + 0.18TVOL$$
$$F3 = -0.64BCI + 0.00CCI + 0.71IVOL - 0.28TVOL$$

Following the approach of Wang (2017) again, we constructed the total sentiment index, **Senti_Total**, by using the explained variance of each principal component as weighted factors, i.e

$$Senti\_Total\_US = 0.41FI + 0.35F2 + 0.15F3$$
$$Senti\_Total\_US = 0.08BCI - 0.25CCI + 0.40IVOL + 0.30TVOL$$

The construction of the composite investor sentiment index, **Senti_Total**, eliminates the impact of extreme values in single variables. It provides a practical quantitative tool for analyzing investor sentiment and aids in further research on the relationship between investor sentiment and the stock market.

3.2 Construction of international and local investor sentiment indices

3.2.1 Descriptive statistics and correlation analysis

We conducted descriptive statistics and correlation analysis on the composite investor sentiment indices for the eight countries: **Senti_Total_CN, Senti_Total_JP, Senti_Total_BR, Senti_Total_CA, Senti_Total_US, Senti_Total_DE, Senti_Total_UK,** and **Senti_Total_IN**. The results are shown in table 4、5 and 6 below.

Table 4. Descriptive Statistics of Senti_Total

Senti_Total	count	mean	std	min	25%	50%	75%	max
China	132.00	0.00	0.59	-1.07	-0.42	-0.07	0.41	1.54
Japan	132.00	0.00	0.71	-1.02	-0.56	-0.17	0.42	2.27
Brazil	132.00	0.00	0.91	-2.36	-0.59	-0.05	0.42	2.06
Canada	132.00	0.00	0.69	-1.25	-0.49	-0.16	0.36	2.76
United States	132.00	0.00	0.68	-0.97	-0.48	-0.28	0.49	2.92
Germany	132.00	0.00	0.61	-0.93	-0.50	-0.17	0.58	1.27
United Kindom	132.00	0.00	0.73	-1.32	-0.50	-0.01	0.30	2.37
India	132.00	0.00	0.80	-1.43	-0.55	-0.21	0.53	2.79

This table presents the descriptive statistics for the composite sentiment index, Senti_Total, across eight countries.

Table 5. Correlation Analysis of Senti_Total

Senti_Total	China	Japan	Brazil	Canada	United States	Germany	United Kindom	India
China	1.00	0.43	0.33	0.04	0.44	0.40	0.17	0.06
Japan	0.43	1.00	0.12	0.53	0.71	0.55	0.64	0.10
Brazil	0.33	0.12	1.00	0.44	-0.03	-0.05	0.22	-0.13
Canada	0.04	0.53	0.44	1.00	0.11	0.01	0.72	-0.09

United States	0.44	0.71	-0.03	0.11	1.00	0.82	0.24	0.47
Germany	0.40	0.55	-0.05	0.01	0.82	1.00	0.14	0.68
United Kindom	0.17	0.64	0.22	0.72	0.24	0.14	1.00	-0.04
India	0.06	0.10	-0.13	-0.09	0.47	0.68	-0.04	1.00

This table provides the correlation coefficients among the Senti_Total indices for the eight countries, and shows how the sentiment indices of different countries are related to each other.

Table 6. The P-value of Correlation Analysis of Senti_Total

Senti_Total	**China**	**Japan**	**Brazil**	**Canada**	**United States**	**Germany**	**United Kindom**	**India**
China		0.00	0.00	0.64	0.00	0.00	0.05	0.52
Japan	0.00		0.18	0.00	0.00	0.00	0.00	0.25
Brazil	0.00	0.18		0.00	0.75	0.58	0.01	0.15
Canada	0.64	0.00	0.00		0.20	0.91	0.00	0.29
United States	0.00	0.00	0.75	0.20		0.00	0.00	0.00
Germany	0.00	0.00	0.58	0.91	0.00		0.12	0.00
United Kindom	0.05	0.00	0.01	0.00	0.00	0.12		0.62
India	0.52	0.25	0.15	0.29	0.00	0.00	0.62	

This table displays the p-values associated with the correlation coefficients presented in Table 5. These p-values indicate the statistical significance of the observed correlations.

From Table 4, the mean value of Senti_Total across countries is zero, indicating a relatively consistent central tendency of the sentiment index. However, differences in standard deviations reflect the volatility of market sentiment across countries. Brazil and India have the largest standard deviations, suggesting that market sentiment is more volatile in these countries, while Germany and China have relatively smaller standard deviations, indicating that market sentiment volatility is more stable in these countries. The difference between the maximum and minimum values across countries also reflects the extreme volatility of market sentiment in each country.

Theoretically, there should not be significant correlations between the investor sentiment indices (SENTI) of different countries. However, the empirical results of correlation analysis in Table 5 and Table 6 contradict this expectation, showing that investor sentiment in most countries is somewhat correlated, especially among countries with close economic ties. For example, the correlation coefficient between the investor sentiment indices of the United States and Germany is as high as 0.82, with a p-value of 0.00. This indicates a strong correlation between market sentiments in these two countries, reflecting their interdependence in economic activities and market sentiment. Similarly, the United States and Japan, likely due to their significant roles in the global economy and strong market linkages, have a correlation coefficient of 0.71, with a p-value of 0.00, indicating a significant correlation.

Additionally, the correlation coefficient between the investor sentiment indices of the United

Kingdom and Canada is 0.72, with a p-value of 0.00, which may reflect the similarities or high interconnectedness of their economies and financial markets. Other pairs of countries, such as Germany and Japan (correlation coefficient of 0.55, p-value of 0.00) and Germany and India (correlation coefficient of 0.68, p-value of 0.00), despite significant differences in geographic location and economic background, still show moderate correlations in their sentiment indices. This may be due to common influencing factors in the global market.

Although a few countries (such as India, China, and Brazil) may exhibit low or insignificant correlations, possibly due to higher independence or different market drivers, overall, the correlation coefficients between most countries are significant at the 99% confidence level. This suggests that there is indeed overlapping information among the investor sentiment indices of different countries, influenced by common factors. It also further indicates that investor sentiment in one country is driven by market sentiment in others, highlighting the international contagion of investor sentiment.

3.2.2 Constructing an International Investor Sentiment Index

In the previous section, we found that there is indeed information overlap between the investor sentiment indices of different countries through correlation analysis, based on which we apply principal component analysis again here. The results of the principal component analysis are shown in Tables 7 and 8.

Table 7. Loadings on Principal Components for Sentiment Index by Country

Loadings	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Senti_Total_CN	0.32	-0.01	0.67	-0.31	-0.51	-0.29	0.07	0.07
Senti_Total_JP	0.49	0.14	-0.14	-0.32	0.24	-0.08	-0.08	-0.74
Senti_Total_BR	0.13	0.38	0.57	0.54	0.29	0.33	0.00	-0.13
Senti_Total_CA	0.27	0.51	-0.25	0.28	0.08	-0.66	-0.01	0.29
Senti_Total_US	0.47	-0.26	-0.01	-0.15	0.42	0.15	0.59	0.38
Senti_Total_DE	0.43	-0.37	0.01	0.12	0.10	0.08	-0.75	0.28
Senti_Total_UK	0.33	0.41	-0.33	-0.05	-0.51	0.57	0.02	0.15
Senti_Total_IN	0.23	-0.44	-0.16	0.63	-0.38	-0.11	0.27	-0.31

This table displays the loadings of the sentiment indices for China, Japan, Brazil, Canada, the United States, Germany, the United Kingdom, and India on the first eight principal components.

Table 8. Eigenvalues and Explained Variance of Principal Components

	Eigenvalues	Explained Var	Cumulative Var
PC1	3.27	0.41	0.41
PC2	2.08	0.26	0.66
PC3	1.09	0.13	0.80
PC4	0.80	0.10	0.90
PC5	0.37	0.05	0.94
PC6	0.21	0.03	0.97
PC7	0.13	0.02	0.99
PC8	0.11	0.01	1.00

This table lists the eigenvalues and the proportion of variance explained by each principal component.

Table 7 presents the loadings of sentiment indices on various principal components for different countries. PC1 is the most significant component, showing positive loadings for most countries, reflecting a global common sentiment. For example, China has a loading of 0.32, Japan 0.49, and the U.S. 0.47. PC2 exhibits both positive and negative loadings, indicating diverse sentiment dimensions; for instance, Canada's loading is 0.51, while India's is -0.44. PC3 and PC4 capture additional sentiment variations, with Brazil's PC3 loading at 0.57 and India's PC4 loading at 0.63, highlighting different national responses to sentiment changes.

Table 8 summarizes the eigenvalues and variance explained by each principal component. PC1 has an eigenvalue of 3.27, explaining 41% of the variance, underscoring its role in capturing global sentiment. PC2, with an eigenvalue of 2.08, explains 26% of the variance, bringing the cumulative variance explained to 66%. PC3, with an eigenvalue of 1.09, accounts for 13% of the variance, and with PC4's 10%, the cumulative explained variance reaches 90%. These results confirm that PC1 is the main component of common investor sentiment across countries, while PC2 to PC4 highlight specific national sentiment dynamics.

Following Baker, Wurgler, and Yuan (2012), we use the first principal component to construct the "International Investor Sentiment Index." The index is derived from this global common sentiment component. The international investor sentiment index can be expressed as follows.

$$\begin{aligned} Senti\_Global = {} & 0.32 Senti\_Total\_CN + 0.49 Senti\_Total\_JP + 0.13 Senti\_Total\_BR \\ & + 0.27 Senti\_Total\_CA + 0.47 Senti\_Total\_US + 0.43 Senti\_Total\_DE \\ & + 0.33 Senti\_Total\_UK + 0.23 Senti\_Total\_IN \end{aligned}$$

3.2.3 Construction of a Local Investor Sentiment Index

Following the methodology of Baker, Wurgler, and Yuan (2012) once again, after obtaining the total investor sentiment index for each country (**Senti_Total**) and the international investor sentiment index (**Senti_Global**), we performed a regression of the international sentiment index (**Senti_Global**) on the national sentiment index (**Senti_Total**). The residuals from this regression were used as the "local sentiment index" (**Senti_Local**). The formula is as follows:

$$Senti\_Total = a + b Senti\_Global + \varepsilon$$
$$\varepsilon = Senti\_Local$$

We conducted descriptive statistics on the international investor sentiment index (**Senti_Global**) and the local sentiment indices (**Senti_Local**) obtained from the decomposition. We also performed a correlation analysis between each country's local sentiment index (**Senti_Local**) and the overall sentiment index (**Senti_Total**). The results are shown in the table below.

Table 9. Descriptive Statistics of Local Sentiment Indices

Senti_Local	count	mean	std	min	25%	50%	75%	max
China	132.00	-0.00	0.49	-0.97	-0.34	-0.01	0.40	1.12

Japan	132.00	-0.00	0.34	-0.63	-0.26	-0.04	0.21	1.02
Brazil	132.00	-0.00	0.88	-2.10	-0.56	-0.19	0.42	2.15
Canada	132.00	-0.00	0.60	-1.55	-0.37	0.01	0.34	2.14
United States	132.00	-0.00	0.38	-1.12	-0.23	-0.04	0.18	1.45
Germany	132.00	-0.00	0.39	-1.05	-0.25	0.05	0.30	0.89
United Kindom	132.00	-0.00	0.57	-1.43	-0.37	-0.01	0.38	1.53
India	132.00	-0.00	0.73	-2.01	-0.45	-0.06	0.48	2.42
Senti_Global	132.00	0.00	1.23	-1.88	-0.94	-0.45	1.02	3.16

This table provides descriptive statistics for local sentiment indices across eight countries and also for the global sentiment index.

Table 10. Correlation Analysis of Senti_Total, Senti_Local, and Senti_Global

Senti_Total	**China**	**Japan**	**Brazil**	**Canada**	**United States**	**Germany**	**United Kindom**	**India**
China	0.84	-0.07	0.23	-0.28	-0.03	-0.03	-0.21	-0.21
Japan	-0.12	0.47	-0.22	0.17	-0.06	-0.28	0.20	-0.57
Brazil	0.20	-0.11	0.97	0.32	-0.24	-0.25	0.07	-0.24
Canada	-0.28	0.10	0.36	0.86	-0.36	-0.44	0.47	-0.35
United States	-0.04	-0.05	-0.43	-0.57	0.55	0.32	-0.49	0.21
Germany	-0.04	-0.20	-0.37	-0.59	0.28	0.64	-0.53	0.55
United Kindom	-0.22	0.12	0.08	0.51	-0.35	-0.43	0.78	-0.39
India	-0.19	-0.30	-0.26	-0.34	0.13	0.39	-0.34	0.91
Senti_Global	0.55	0.88	0.25	0.51	0.83	0.77	0.62	0.42

This table presents the correlation coefficients between the total sentiment indices (Senti_Total) for eight countries. Additionally, the table includes the correlation coefficients between the global sentiment index (Senti_Global) and both the total sentiment indices (Senti_Total) and local sentiment indices (Senti_Local) for each country.

As shown in Table 9, the mean values of the local sentiment indices across countries are close to zero, reflecting the fact that the central tendency of sentiment remains relatively consistent across countries. However, the size of the standard deviation and the range of maximum and minimum values reflect differences in the volatility of market sentiment across countries. Sentiment volatility is highest in Brazil and India, with large standard deviations and ranges, while it is more stable in Japan and Germany. The volatility of the global sentiment index (Senti_Global) is significantly higher than that of the local sentiment indexes of each country, indicating a wider range of volatility in global market sentiment.

Table 10 shows the correlation coefficients between the international investor sentiment index (**Senti_Global**) and the sentiment indices of various markets (**Senti_Total**). It reveals that the investor sentiment indices for Japan, the United States, Germany, and the United Kingdom have the highest correlations with the international investor sentiment index (all exceeding 0.6). This reflects the dominant role of these countries' markets in global sentiment changes. Given their significant economic influence, the market sentiment of these countries is closely

aligned with global investor sentiment.

Other countries, such as China, Canada, and India, exhibit moderate correlations with international investor sentiment (ranging between 0.4 and 0.6), indicating that their markets have a noticeable but less pronounced impact on global sentiment compared to the major economies mentioned above. Brazil's market index shows a lower correlation with international investor sentiment, with a coefficient of only 0.25, suggesting that its market sentiment is more influenced by local economic conditions and unique factors, with less synchronization with global sentiment.

The data in Table 10 also shows that, for most countries, the local investor sentiment (**Senti_Local**) exhibits a strong positive correlation with the overall sentiment index (**Senti_Total**). This indicates a close relationship between overall market sentiment and local investor sentiment. This connection is particularly pronounced in countries like Brazil, India, and China, suggesting that market sentiment in these countries is mainly driven by domestic factors.

In contrast, Japan and the United States exhibit relatively lower correlations between **Senti_Local** and **Senti_Total**, which may reflect a greater influence of international factors on these countries' market sentiments. As a highly internationalized economy, Japan's financial markets and economic activities are closely linked to the global economy. Frequent participation of international investors and significant impacts of international capital flows on Japan's market suggest that international factors may have a larger effect on local market sentiment. Similarly, as the world's largest economy, the United States' financial markets play a dominant role globally. U.S. market sentiment is influenced not only by domestic economic conditions but also by global market dynamics, international capital flows, and major international events (such as the European debt crisis). These international factors may weaken the impact of domestic factors on U.S. market sentiment, resulting in a lower correlation between **Senti_Local** and **Senti_Total**.

3.3The Impact of International Investor Sentiment on the U.S. Stock Market

3.3.1 Trend analysis and correlation analysis

After obtaining the international investor sentiment index, we investigated its validity and explored the relationship between international investor sentiment and the stock market using the U.S. market as an example.

To align with the sentiment indicators, we selected monthly data for the S&P 500 from January 2013 to December 2023 to represent the U.S. stock market, with data sourced from the ECB Data Portal. The S&P 500 index includes 500 large companies, covering most major sectors of the U.S. economy. Compared to other indices, it provides a more accurate reflection of overall market performance. The S&P 500 also has a long historical record and reliable public data, which aids in detailed and accurate analysis. Since the international investor sentiment index data obtained earlier was standardized, we also standardized the S&P 500 index to facilitate direct comparison between international investor sentiment and stock market trends.

Figure 1. Time Series of International Investor Sentiment Index and S&P 500 Index

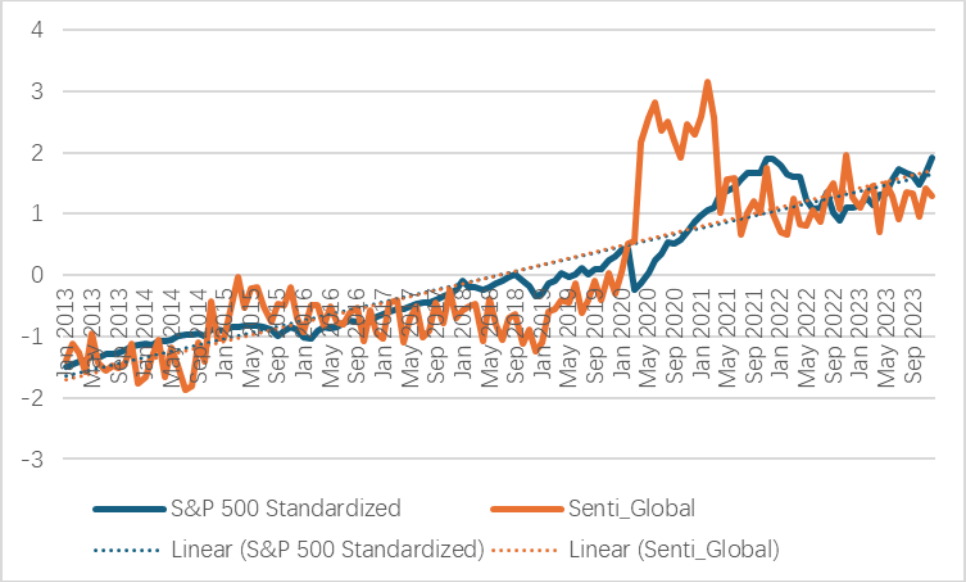


Figure 1 illustrates the time series data for the "International Investor Sentiment" index and the "S&P 500 Index" from January 2013 to December 2023. The orange solid line represents the "International Investor Sentiment" index, with its trend line shown as the orange dashed line. The blue solid line denotes the "S&P 500 Index," with the trend line indicated by the blue dashed line.

The comparison in the figure provides a visual representation of how international investor sentiment trends align with the performance of the U.S. stock market, highlighting the relationship between global sentiment and market movements. We can see that over the entire period from January 2013 to December 2023, the trend lines of the international investor sentiment index (**Senti_Global**) and the S&P 500 index are closely aligned, indicating a strong overall consistency between the two. However, between January 2020 and May 2021, although both exhibited similar overall trends, there were notable differences in their detailed movements.

Firstly, during the period from January to March 2020, the international investor sentiment showed a sharp upward trend, whereas the S&P 500 index exhibited a downward trend. This divergence was likely due to sudden economic shocks and policy responses, leading to a short-term mismatch between market sentiment and actual market performance. In March 2020, the rapid spread of COVID-19 triggered significant global economic uncertainty and a liquidity crisis in financial markets. Investors sold off risk assets to increase liquidity and shifted towards safer assets like government bonds and gold, exacerbating the downward pressure on the S&P 500. Meanwhile, global monetary policy easing was a major driver of rising international investor sentiment. During the same period, the Federal Reserve and other major

central banks quickly implemented large-scale interest rate cuts and quantitative easing measures, injecting substantial liquidity into the market. Despite short-term market declines due to panic, investors likely remained optimistic about the long-term effects of policy support, which boosted sentiment. Large-scale fiscal stimulus measures by governments, such as the U.S. CARES Act passed in March 2020, provided significant aid to businesses and individuals, directly supporting the recovery of consumption and investment activities.

Between January 2020 and February 2021, while international investor sentiment was generally high, the growth rate of the S&P 500 did not completely synchronize with the rise in sentiment. This discrepancy might be due to the continued negative impact of the pandemic on the global economy, with some sectors (such as energy and traditional manufacturing) remaining weak, which moderated the S&P 500's growth compared to the surge in investor sentiment. However, by late 2020 and early 2021, the successful development and global distribution of COVID-19 vaccines greatly boosted market confidence. Investors anticipated a rapid economic recovery following widespread vaccination, further driving up market sentiment. Thus, although the S&P 500 performed strongly during this period, its drivers and the underlying factors behind the surge in international investor sentiment were not entirely aligned. The S&P 500's performance was more influenced by U.S. domestic economic conditions and specific sector performance, while international investor sentiment more broadly reflected global economic recovery expectations, monetary policy easing, and vaccine progress.

Finally, from February to May 2021, despite a decline in international investor sentiment, the S&P 500 index continued to rise steadily. This phenomenon suggests the presence of complex factors in the market that led to a disconnect between market sentiment and actual economic data. Early in 2021, concerns about the Delta variant of COVID-19, which might have higher transmissibility or affect the efficacy of existing vaccines, introduced uncertainty and increased investor sentiment volatility. Despite this, U.S. economic data showed strong recovery signs, with improved economic activity indices, consumer spending, and manufacturing and service sector data. Early corporate earnings reports also showed strong profit growth for many companies, especially in technology and other growth sectors, driving the S&P 500's rise. Therefore, even though investor sentiment was poor, actual economic data and policy support provided strong backing for the market, allowing the S&P 500 to maintain its upward trajectory.

In summary, although there were different trends between the international investor sentiment index and the S&P 500 index during certain periods, they generally exhibited strong consistency overall. Based on this, we conducted a correlation test to analyze the relationship between international investor sentiment and the U.S. stock market. The correlation coefficient between the S&P 500 index and international investor sentiment was found to be 0.79647834, with a p-value of 0.0000, which is significant at the 99% confidence level, indicating a strong positive correlation between the S&P 500 index and the international investor sentiment index (**Senti_Global**).

3.3.2 VAR model regression analysis

To investigate how international investor sentiment affects the U.S. stock market, we will conduct a regression analysis between the international investor sentiment index (**Senti_Global**) and the return of the S&P 500 index (**S&P 500 Return**). The reason for choosing returns over index values is that index values are usually non-stationary, whereas return data is stationary and provides a more accurate analysis. The formula for calculating returns is as follows:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} =$$

Both the international investor sentiment index and the return of the S&P 500 index are time series data. One of the basic assumptions for conducting classical regression analysis is the stationarity of the time series. Only when the time series is stationary are the predictive results valid. If the time series data are non-stationary, it undermines the "consistency" of the sampling statistics obtained under large samples, and any inferences or predictions based on non-stationary time series become invalid. Therefore, it is necessary to conduct stationarity tests for all time series before performing empirical analysis.

Table 11. Stationarity Test Results for S&P 500 Return and Senti_Global

	ADF Statistics	P-Value	KPSS Statistics	P-Value
S&P500 Return	-8.80	0.00	0.05	0.10
Senti_Global	-1.67	0.45	1.46	0.01

This table presents the results of the Augmented Dickey-Fuller (ADF) test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test used to assess the stationarity of the S&P 500 return and the international investor sentiment index (Senti_Global).

We used the Augmented Dickey-Fuller (ADF) test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test to assess the stationarity of the international investor sentiment index (**Senti_Global**) and the return of the S&P 500 index (**S&P 500 Return**). According to the results in Table 10, the ADF statistic for the S&P 500 return is -8.80, with a p-value of 0.00, which is well below 0.05, indicating that the S&P 500 Return series is stationary. The KPSS test statistic is 0.05, with a p-value of 0.10, also suggesting that the S&P 500 Return meets the stationarity requirement. This indicates that no further transformation is needed for the S&P 500 Return data.

In contrast, the ADF test statistic for the **Senti_Global** index is -1.67, with a p-value of 0.45, and the KPSS test statistic is 1.46, with a p-value of 0.0100. Both tests indicate non-stationarity of the **Senti_Global** series. Therefore, differencing is required to make the **Senti_Global** index data stationary.

Table 12. Stationarity Test Results for Differenced Senti_Global

	ADF Statistics	P-Value	KPSS Statistics	P-Value
Senti_Global_diff	-3.15	0.02	0.11	0.10

This table shows the results of the stationarity tests for the differenced international investor sentiment index (Senti_Global_diff).

After performing first-order differencing on **Senti_Global**, we obtained a new series, **Senti_Global_diff**. The stationarity test results for the differenced series are shown in Table 11. The ADF statistic is -3.15 with a p-value of 0.02, and the KPSS statistic is 0.11 with a p-value of 0.10, indicating that the differenced series **Senti_Global_diff** meets the stationarity requirements.

Our goal is to investigate the impact of international investor sentiment on the S&P 500 return. However, previous research has shown that the relationship between sentiment and market performance may be bidirectional. For instance, Brown and Cliff (2004) discussed the impact of investor sentiment on market volatility and indicated that market responses could further influence investor sentiment. Baker and Wurgler (2006) also examined the impact of investor sentiment on stock market volatility and explored the possibility of a bidirectional relationship. Given the potential dynamic relationship between sentiment and market returns, we have chosen to use a Vector Autoregression (VAR) model for analysis. The model is as follows:

$$\begin{bmatrix} Senti\_Global_t \\ R_t \end{bmatrix} = \alpha + \beta_1 \begin{bmatrix} Senti\_Global_{t-1} \\ R_{t-1} \end{bmatrix} + \beta_2 \begin{bmatrix} Senti\_Global_{t-2} \\ R_{t-2} \end{bmatrix} + \cdots + \beta_m \begin{bmatrix} Senti\_Global_{t-m} \\ R_{t-m} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \end{bmatrix}$$

where α is a two-dimensional column vector, β_1, β_2 , ⋯ , β_m is the matrix of coefficients to be estimated, m=1, 2, 3, ⋯

The VAR model is capable of capturing the dynamic relationships among multiple time series variables and providing forecasts for future data. The selection of the lag order is a crucial step in constructing a VAR model. Typically, information criteria such as the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), or the Hannan-Quinn Information Criterion (HQIC) are used to determine the optimal lag length. In this study, we used the Akaike Information Criterion (AIC) to determine the lag order for the VAR model., the lowest AIC value can be observed at lag 5 in Table 13, suggesting it is the optimal choice for the VAR model.

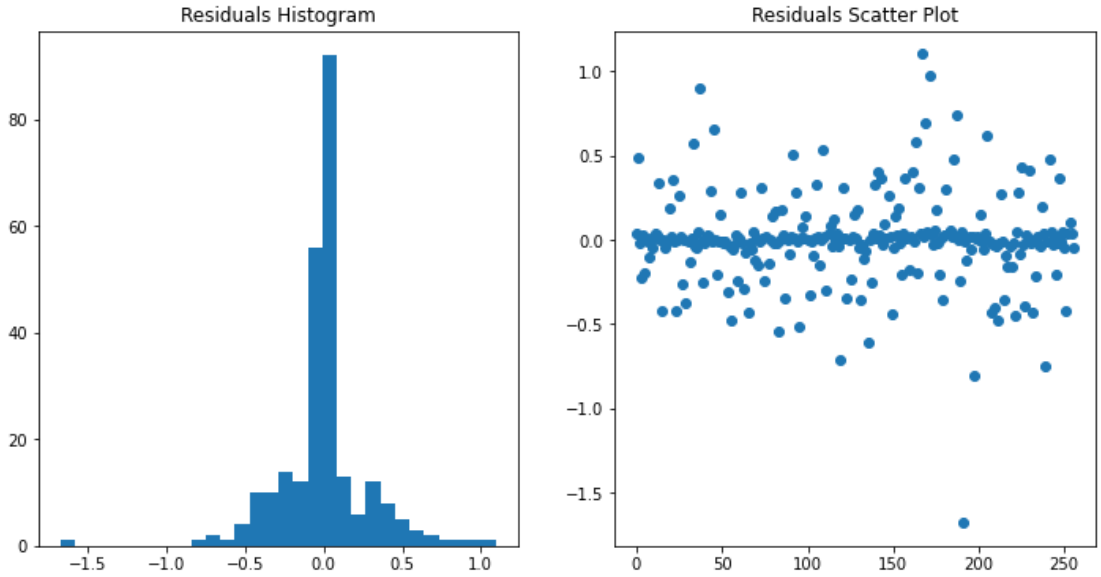
Table 13. Akaike Information Criterion (AIC) for VAR Model Lag Selection

Lag	AIC
1	-8.54
2	-8.59
3	-8.61
4	-8.56
5	-8.62
6	-8.59
7	-8.60
8	-8.60
9	-8.58
10	-8.59

11	-8.53
12	-8.46
13	-8.46
14	-8.47
15	-8.43

This table lists the Akaike Information Criterion (AIC) values for various lag lengths in the Vector Autoregression (VAR) model.

Figure 2. Residual Analysis of VAR Model



This figure shows the histogram and scatter plot of residuals from the VAR model. The histogram checks for normality, and the scatter plot assesses the randomness of residuals relative to fitted values.

After the preliminary regression, we used the Ljung-Box test and the Breusch-Pagan test to examine whether the residuals exhibit autocorrelation and heteroscedasticity. The Ljung-Box test results indicate that the p-values for S&P 500 Return and **Senti_Global_diff** are both much greater than 0.05, suggesting that there is no significant autocorrelation in the residuals within a lag of 5. However, the Breusch-Pagan test results are less favourable, with p-values for S&P 500 Return and **Senti_Global_diff** both less than 0.05, indicating significant heteroscedasticity in the residuals, which may affect the model's validity. Therefore, we used HC3 robust standard errors to control for heteroscedasticity, making the coefficient estimates more reliable.

The final bivariate vector autoregression results for the monthly time series of **Senti_Global_t** and **R_t** within the sample period are shown in the following table 14.

Table 14. VAR Results for S&P 500 Return Equation

Variable	Coefficient	Std. Error	t-stat	p-value
const	0.01	0.00	2.44	0.02
L1.S&P 500 Return	0.07	0.09	0.73	0.47
L1.Senti_Global_diff	0.01	0.01	-0.21	0.84

L2.S&P 500 Return	-0.16	0.10	-1.62	0.10
L2.Senti_Global_diff	0.00	0.01	0.22	0.82
L3.S&P 500 Return	-0.10	0.10	-0.98	0.33
L3.Senti_Global_diff	0.01	0.01	1.05	0.30
L4.S&P 500 Return	0.02	0.10	0.18	0.86
L4.Senti_Global_diff	0.00	0.01	0.35	0.73
L5.S&P 500 Return	0.08	0.10	0.82	0.41
L5.Senti_Global_diff	0.01	0.01	1.67	0.09

This table presents the results of the vector autoregression (VAR) model for the S&P 500 return equation. It includes coefficients, standard errors, t-statistics, and p-values for the lagged values of the S&P 500 return and the international investor sentiment index.

First-order lag of S&P 500 Return (L1.S&P 500 Return): The coefficient is 0.07 with a p-value of 0.47, indicating that the impact of the first-order lag of S&P 500 return on the current return is not significant. This suggests that short-term persistence in market returns is weak, possibly due to high market volatility and uncertainty.

First-order lag of sentiment index (L1.Senti_Global_diff): Although the coefficient is 0.01 with a p-value of 0.84, showing that the direct short-term impact of sentiment on market returns is not significant, the positive direction suggests that changes in sentiment might influence market returns through other channels or with a lag.

Second-order and third-order lags of sentiment index (L2.Senti_Global_diff, L3.Senti_Global_diff): The coefficient for the second-order lag of sentiment is 0.00 with a p-value of 0.82, and for the third-order lag of sentiment, the coefficient is 0.01 with a p-value of 0.30, both of which are not significant. This indicates that the impact of sentiment on market returns is neither strong nor evident in the short to medium term.

Fifth-order lag of sentiment index (L5.Senti_Global_diff): The coefficient is 0.01 with a p-value of 0.09, approaching significance at the 90% confidence level. This result suggests that changes in sentiment may require a longer period to affect market returns

Table 15. VAR Model Results for the Senti_Global_diff Equation

Variable	Coefficient	Std. Error	t-stat	p-value
const	0.09	0.04	2.21	0.03
L1.S&P 500 Return	-3.63	1.04	-3.48	0.00
L1.Senti_Global_diff	-0.34	0.09	-3.78	0.00
L2.S&P 500 Return	-1.80	1.09	-1.65	0.10
L2.Senti_Global_diff	-0.12	0.10	-1.21	0.23
L3.S&P 500 Return	-1.84	1.11	-1.66	0.10
L3.Senti_Global_diff	0.21	0.10	2.16	0.03
L4.S&P 500 Return	1.22	1.11	1.10	0.27
L4.Senti_Global_diff	-0.02	0.10	-0.20	0.85
L5.S&P 500 Return	-0.84	1.11	-0.75	0.45
L5.Senti_Global_diff	-0.25	0.08	-2.90	0.00

This table presents the VAR model results for the Senti_Global_diff equation, including coefficients, standard errors, t-statistics, and p-values.

First-order lag of S&P 500 Return (L1.S&P 500 Return): The coefficient is -3.63 with a p-value of 0.00, indicating a highly significant result. This suggests a strong negative correlation between the previous period's S&P 500 return and current sentiment changes, possibly due to the reversal of investor sentiment following prior market performance. This phenomenon aligns with some behavioural finance theories, such as the overreaction and reversal effects (DeBondt and Thaler, 1985; Qiu & Welch, 2006). After experiencing extreme market performance (whether a significant rise or fall), investors often exhibit a reverse emotional reaction. For instance, following a market surge, investors may worry about overheating and thus experience a drop in sentiment; conversely, after a market downturn, investors might perceive the market as bottoming out, leading to a rebound in sentiment.

Third-order lag of sentiment index (L3.Senti_Global_diff): The coefficient is 0.21 with a p-value of 0.03, indicating a significant positive correlation. This suggests that sentiment changes three periods ago have a positive impact on the current sentiment index, which may reflect a delayed effect or persistence of sentiment. This delayed impact of investor sentiment aligns with the sentiment cycle theory, which posits that changes in sentiment may affect the market over a longer period. This is consistent with the sentiment reversion theory proposed by Barberis, Shleifer, and Vishny (1998), which suggests that market sentiment may influence investor behavior after a certain delay.

First-order and fifth-order lags of sentiment index (L1.Senti_Global_diff and L5.Senti_Global_diff): Both are significantly negative. This indicates that, beyond a certain level of persistence, sentiment changes exhibit a countervailing self-adjustment mechanism. If the previous period's sentiment change was negative, current sentiment might rebound; if the previous period's sentiment change was positive, current sentiment might decline. This negative correlation reflects the return effect of market sentiment and the adjustment process in investor behaviour. The model proposed by Barberis, Shleifer, and Vishny (1998) also suggests that when market sentiment deviates excessively from its fundamentals, it tends to revert over time. This reversion effect explains why first-order and fifth-order lags of sentiment changes have a negative impact on current sentiment changes.

Overall, the results of the analyses suggest that stock returns primarily drive changes in market sentiment, rather than market sentiment driving stock returns. Specifically, the significant negative coefficient of the first-order lag of S&P 500 returns on changes in sentiment suggests that current stock returns have a strong influence on future market sentiment. The effect of market sentiment on stock returns is not significant in the short run and shows some significance only at longer lags. This result emphasises that investor sentiment reacts to recent stock performance and that this reaction has a delayed effect. Although market sentiment shows some persistence and mean reversion trends, it is mainly current stock returns that influence subsequent market sentiment.

4.0 Conclusions

The core objective of this study is to construct a composite international investor sentiment index (SENTI_Global) and investigate its relationship with U.S. S&P 500 index returns. By analyzing monthly data from January 2013 to December 2023, we developed a composite investor sentiment index, SENTI_Total, using principal component analysis (PCA). This index integrates four sentiment indicators from eight countries: business confidence index (BCI), consumer confidence index (CCI), number of initial public offerings (IPOs), and trading volume (TVOL). Our findings reveal a significant positive correlation among these sentiment indicators and suggest that market sentiment across countries is somewhat synchronized, particularly among countries with strong economic ties.

Further applying PCA, we extracted common components of international investor sentiment to construct the SENTI_Global index. The results indicate significant synchronization of investor sentiment indicators across different countries, especially in those with strong economic connections, such as Japan, the U.S., Germany, and the U.K. These countries show a high correlation with the international sentiment index. Conversely, China, Canada, and India display moderate correlations, while Brazil has a low correlation, suggesting that sentiment in Brazil is more influenced by local economic conditions and specific factors.

We then employed a vector autoregressive (VAR) model to explore the impact of global sentiment on U.S. stock market performance, using SENTI_Global and S&P 500 returns as variables. The analysis shows that market sentiment has a dual role: stock returns have a direct and significant impact on changes in market sentiment, while market sentiment has a non-significant short-term impact on stock returns but some influence in the long term. This implies that investor sentiment responds to market performance with a lag and exhibits a self-perpetuating, mean-reverting trend.

A major strength of this study is the use of monthly data, which offers higher frequency and timeliness compared to annual data. This allows for a more accurate capture of short-term fluctuations in market sentiment and stock market performance. The study covers a ten-year period, from 2013 to 2023, providing insights into market sentiment across different economic cycles and its long-term effects on the stock market.

Another strength is the international scope of the data, including both developed and emerging market countries like China, Brazil, and India. This broad coverage reflects global market sentiment diversity and offers a more comprehensive perspective. By incorporating a variety of sentiment indicators—both subjective (e.g., Consumer Confidence Index, Business Confidence Index) and objective (e.g., number of IPOs, trading volume)—the study provides a more nuanced measure of market sentiment.

However, there are limitations. The choice of sentiment indicators might not be optimal due to data availability and consistency issues. Despite using diverse indicators, we may not fully capture all important sentiment factors or market-specific characteristics. Additionally, the study does not delve deeply into local investor sentiment differences within countries and their specific impacts on market performance.

Future research could address these limitations by exploring the specific effects of local investor sentiment on market performance, especially comparing emerging and developed markets. Expanding the analysis to include more countries and regions with significant global financial influence could provide further insights. Additionally, incorporating non-linear and time-varying dynamic models, such as non-linear autoregressive models, structural change models, or deep learning methods, may offer a deeper understanding of the sentiment-stock market relationship. Finally, integrating economic cycle theory and policy analysis could enhance our comprehension of market sentiment's role in various economic environments. These extended studies would offer investors and policymakers more precise market insights.

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