The Impact of Nasdaq Index on SSEC: A Highlight on Potential Transmission of Shocks Across International Markets

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Abstract. The Nasdaq Index, which represents the performance of major comprehensive stocks in the United States, is a leading indicator for global trends. The SSEC, on the other hand, represents the growing importance of the Chinese economy in the global financial landscape. The study recognizes the increasingly interconnected nature of global financial markets and the significant role played by major stock indices in transmitting financial disturbances across borders. With various econometric techniques to analyze the relationship between these two indices, the results demonstrate a positive correlation between the Nasdaq index and SSEC. Additionally, the findings suggest that the Nasdaq index has a significant influence on the volatility of SSEC. These results indicate the importance of global financial linkages and the potential transmission of shocks across international stock markets. The study contributes to the existing literature by providing empirical evidence on the impact of the Nasdaq index on the SSEC and highlights the implications for investors and policymakers.

Keywords: Nasdaq index; Shanghai Stock Exchange Composite (SSEC) index; Econometric analysis; Financial linkages; International stock markets; Volatility.

1. Introduction

The stock market plays a crucial role in the global economy by providing a platform for companies to raise capital and investors to allocate their funds. With advancements in increased global connectivity, the influence of international stock exchanges on each other has become more evident. This paper focuses on the relationship between the Nasdaq index and the Shanghai Stock Exchange Composite (SSEC) index and analyzes the impact of the former on the latter.

The Nasdaq index, also known as the Nasdaq Composite, is one of the most significant stock indices in the world. It represents the performance of over 3,000 stocks listed on the Nasdaq stock exchange, comprising various sectors such as technology, biotechnology, and telecommunications. On the other hand, the SSEC index measures the performance of stocks traded on the Shanghai Stock Exchange, the largest domestic stock market in China [1]. As both indices have gained prominence in recent years, understanding the relationship between them is crucial for investors, policymakers, and market participants.

The motivation for this study arises from the increasing interconnectedness and globalization of financial markets, which has intensified the spillover effects between different stock exchanges. By examining the impact of the Nasdaq index on the SSEC, the paper aims to shed light on the transmission mechanisms and potential linkages between these two markets. Moreover, understanding the relationship between these indices could provide valuable insights for investors seeking diversification opportunities and risk management strategies.

Previous research has documented the influence of international stock indices on domestic markets. Studies have analyzed cross-market correlations, volatility spillovers, and other transmission channels to understand how changes in one market affect another. For instance, Wang et al. investigated the spillover effects between the Nasdaq Composite and four Asian markets, including China [2]. Bidirectional volatility spillovers, indicating the significance of the Nasdaq Composite for the Chinese market [3]. Similarly, Wen et al. examined the impact of the Nasdaq Composite on Chinese stock returns through co-integration and vector error correction models [4]. The Nasdaq Composite had a positive and significant influence on Chinese stock prices [5]. These studies provide

a starting point for exploring the relationship between the Nasdaq index and the SSEC and inspire further investigation into the direction and magnitude of their correlation.

In recent years, both the Nasdaq index and the SSEC have experienced significant growth and transformation. The Nasdaq index has been recognized for its comprehensive stocks, attracting global attention and investment [6]. On the other hand, the SSEC has undergone substantial liberalization measures and structural reforms to promote market efficiency and openness. Understanding how the dynamics of these two indices interact with each other is crucial for assessing the potential impact on global financial stability.

Given the importance of these indices and the lack of comprehensive studies focusing on the Nasdaq index's impact specifically on the SSEC, this research would analyze their relationship within the last 33 years to add new insights on the existing literature. By analyzing the recent data, the paper aims to capture any evolving dynamics or changes that might have occurred in the relationship between the Nasdaq index and the SSEC.

The subsequent sections of this paper will first present the data collection methodology and outline the empirical framework used to analyze the relationship between the Nasdaq index and the SSEC. The empirical results will then be discussed with an interpretation of these findings. Lastly, the paper will be concluded with implications for investors, policymakers, and future research directions.

2. Research Design

A comprehensive research design incorporating various econometric techniques will be implemented in order to test the relationship between the two indices. This section outlines the data sources and the methodologies utilized, including the ADF (the abbreviation of Augmented Dickey–Fuller Unit Root) Test, Vector Autoregression (VAR) Model, and ARMA-GARCH Model.

2.1. Data Source

The data used for this study was obtained from Choice Financial Terminal Database. Specifically, historical daily closing prices of the Nasdaq index and the SSEC index from July, 14, 1990 to July, 14, 2023 were collected. Data processing is a must step to determine the relationship between Nasdaq and the SSEC index. The formula $\ln(1+x)$ was used to calculate logarithmic prices and logarithmic returns for the two indices. Due to discrepancies in reporting dates between the two indices, incompatible data were omitted from the analysis. Using the processed data, the statistical analysis tool Stata was used to analyze the data and develop models for further investigation.

2.2. Weak Stationarity Test: ADF

It is critical to confirm the stationary behavior of the variables before undertaking a time series analysis. The ADF test is extensively used to analyze the existence of unit roots in time series data for this purpose. [6]. It provides valuable insights into whether the variables exhibit long-term trends, which are essential for accurate modeling. This test was employed to test for unit roots in the Nasdaq index and the SSEC index. As in the Table 1, the stationarity of the logarithmic original sequence of the SSEC Index and NASDAQ as well as the stationarity of the logarithmic return sequence of the SSEC Index and NASDAQ have been both tested. As the p-values are greater than 0.1, the H0 hypothesis can't be rejected. That is, the stationarity between the two are not statistically significant.

Table 1. Weak Stationarity Test: ADF test

	t	p
	Index	
SSEC	-2.171	0.5062
Nasdaq	-2.267	0.4521
	Return	
SSEC	-53.544	0
Nasdaq	-57.820	0

2.3. VAR Model

The VAR (the abbreviation of Vector Autoregression) model is a suitable methodology to capture the dynamic relationship between variables in a simultaneous equation's framework [7]. In this study, a VAR model was employed to examine the short-term impact of the Nasdaq index on the SSEC index. The VAR model will consider the lagged values of both indices to model their interdependencies and provide insights into the dynamic relationship between the two. Two separate time series variables, denoted by $\mathrm{SSEC_t}$ and $\mathrm{Nasdaq_t}$, are composed of a bivariate VAR(p) model:

$$SSEC_t = \beta_{10} + \beta_{11}SSEC_{t-1} + \ldots + \beta_{1p}SSEC_{t-p} + \gamma_{11}Nasdaq_{t-1} + \ldots + \gamma_{1p}Nasdaq_{t-p} + \varepsilon_{1t} \quad (1)$$

$$Nasdaq_t = \beta_{20} + \beta_{21}SSEC_{t-1} + \ldots + \beta_{2p}SSEC_{t-p} + \gamma_{21}Nasdaq_{t-1} + \ldots + \gamma_{2p}Nasdaq_{t-p} + \varepsilon_{2t} \quad (2)$$

$$\begin{pmatrix} SSEC_t \\ Nasdaq_t \end{pmatrix} = \begin{pmatrix} \beta_{10} \\ \beta_{20} \end{pmatrix} + \begin{pmatrix} \beta_{11} \\ \beta_{21} \end{pmatrix} SSEC_{t-1} + \ldots + \begin{pmatrix} \beta_{1p} \\ \beta_{2p} \end{pmatrix} SSEC_{t-p} + \begin{pmatrix} \gamma_{11} \\ \gamma_{21} \end{pmatrix} Nasdaq_{t-1} + \ldots + \begin{pmatrix} \gamma_{1p} \\ \gamma_{2p} \end{pmatrix} Nasdaq_{t-p} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix} \quad (3)$$

2.4. ARMA-GARCH Model

To account for the potential volatility clustering and time-varying conditional heteroscedasticity in stock market returns, an ARMA-GARCH model was then utilized. The ARMA-GARCH model combines the Autoregressive Moving Average (ARMA) model, which captures a linear dependency in stock returns, and the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model that captures the volatility dynamics [8]. This model allows for a more accurate analysis of the impact of the Nasdaq index on the SSEC index by accounting for conditional volatility.

The ARMA component of the ARMA-GARCH model captures the linear relationships in stock returns based on their lagged values [9]. By considering the past returns of the Nasdaq index and the SSEC index, the ARMA model allows for a better understanding of how the past performance of Nasdaq influences the SSEC.

$$y_t = \emptyset_0 + \sum_{i=1}^{p} \emptyset_i y_{t-i} + \alpha_i - \sum_{i=1}^{q} \emptyset_i \alpha_{t-i} \quad (4)$$

The GARCH component of the ARMA-GARCH model addresses the issue of time-varying volatility by capturing the asymmetric and nonlinear behavior of stock market returns [10]. By incorporating GARCH models, the analysis can account for the volatility clustering often observed in financial markets.

$$\sigma_t^2 = \alpha_{0,1} + \alpha_1 \varepsilon_{t-1}^2 + \beta_t m_t + \gamma_1 \sigma_{t-1}^2 \quad (5)$$

3. Empirical Results and Analysis

3.1. Order of VAR Model

Table 2 shows the likelihood ratio test and the information criteria for different lag specifications of the VAR model. The aim is to determine the optimal lag order that captures the relationship between the Nasdaq index and the Shanghai Stock Exchange Composite (SSEC) index. The p-values indicate the statistical significance of each lag order.

Table 2. Likelihood ratio test and information criterion

Lag	LL	LR	p	FPE	AIC	HQIC	SBIC
0	30651.5		0	7.3e-08	-10.7618	-10.7609	-10.7594
1	30690.7	78.475	0	7.2e-08	-10.7741	-10.7717	-10.7671*
2	30701.3	21.052	0	7.2e-08	-10.7764	-10.7724*	-10.7648
3	30705.3	8.0522	0	7.2e-08	-10.7764	-10.7707	-10.7601

4	30712.4	14.331	0	7.1e-08	-10.7775	-10.7702	-10.7565
5	30721.1	17.233	0	7.1e-08	-10.7792	-10.7702	-10.7535
6	30731.7	21.38	0	7.1e-08*	-10.7815	-10.7709	-10.7512
7	30737.1	10.701	0	7.1e-08	-10.782*	-10.7698	-10.747
8	30740.2	6.1102	0	7.1e-08	-10.7817	-10.7678	-10.742
9	30743.2	6.1125	0	7.1e-08	-10.7813	-10.7659	-10.737
10	30744.4	2.382	0	7.1e-08	-10.7803	-10.7633	-10.7313
11	30747.5	6.2844	0	7.1e-08	-10.78	-10.7613	-10.7264
12	30754.9	14.719*	0	7.1e-08	-10.7812	-10.7609	-10.7229

The likelihood ratio test assesses the overall significance of the VAR model. The null hypothesis assumes that there is no relationship between the variables, while the alternative hypothesis suggests that there is a relationship. As shown in Table 2, the likelihood ratio test statistic for lag 1 is 78.475, indicating strong evidence to reject the null hypothesis of no relationship at the 5% significance level. Therefore, a lag of 1 is chosen as the optimal specification for the VAR model.

Furthermore, various information criteria are presented in Table 2. To measure the quality of fit and complexity of each model, the AIC (the abbreviation of Akaike Information Criterion), HQIC (the abbreviation of Hannan-Quinn Information Criterion), and SBIC (the abbreviation of Schwarz Bayesian Information Criterion) are utilized. These criteria aim to strike a balance between model accuracy and parsimony.

Comparing the values of the information criteria, it can be observed that the AIC, HQIC, and SBIC show a downward trend as the lag specification increases from 0 to 1, but they start to increase when the lag is set to 2. This suggests that the VAR model with a lag of 1 has the best trade-off between fit and complexity, indicating a more parsimonious representation of the data. Moreover, the p-value associated with each lag specification in Table 2 indicates the significance of the respective lag in the VAR model. The p-values for lag 1 and lag 2 in this study are both 0, indicating that there is ample proof of a statistically meaningful association between the Nasdaq index and the SSEC index.

To further test the stationarity of the VAR model, Figure 1 presents the unit root tests for both the SSEC and Nasdaq indices. The variables are non-stationary in their original forms, as indicated by the presence of unit roots. However, when expressed in their first-differenced values, both series exhibit stationarity as all the roots are positioned within the circle, implying that they follow a stationary process. This confirms the suitability of conducting further analysis using this transformed data.

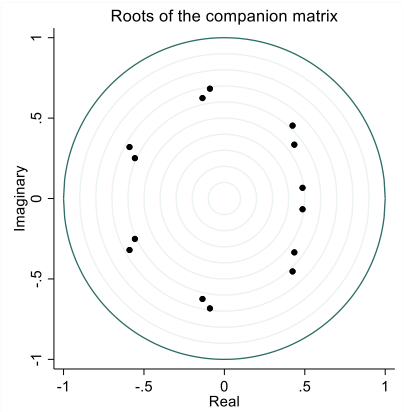

Figure 1. Model stability, Photo credit: Original

3.2. Impulse Response

The impulse response analysis investigates a variable's reaction to a transient stimulus in yet another factor. The impulse response functions for the SSEC and Nasdaq indices are shown in Figure 2. The x-axis displays the impulse variables, while the y-axis displays the response variables. The

response of the SSEC index to a shock in the Nasdaq index appears to be positive but relatively small. This suggests that while the Nasdaq index has some impact on the SSEC index, it is not the sole driver of its movements. On the other hand, the response of the Nasdaq index to a shock in the SSEC index is more pronounced. This implies a stronger influence of the SSEC index on the Nasdaq index.

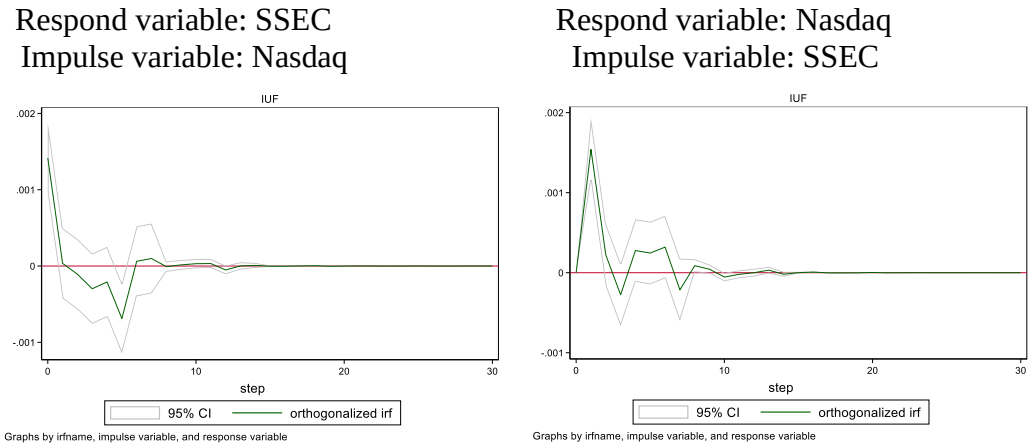

Figure 2. Impulse and response, Photo credit: Original

3.3. ARMA Specification

The ARMA (p, q) identification is obtained by studying the residuals' PACF (the abbreviation of partial autocorrelation function) and ACF (the abbreviation of autocorrelation function). Figure 3 provides the PACF and ACF plots for the SSEC and Nasdaq indices.

Based on the shape of the PACF and ACF plots, an ARMA (7,7) GARCH (1,1) is identified for the Nasdaq index, while an ARMA (6,7) GARCH (1,1) is appropriate for the SSEC index. This indicates that the current values of the indices are influenced by their lagged values.

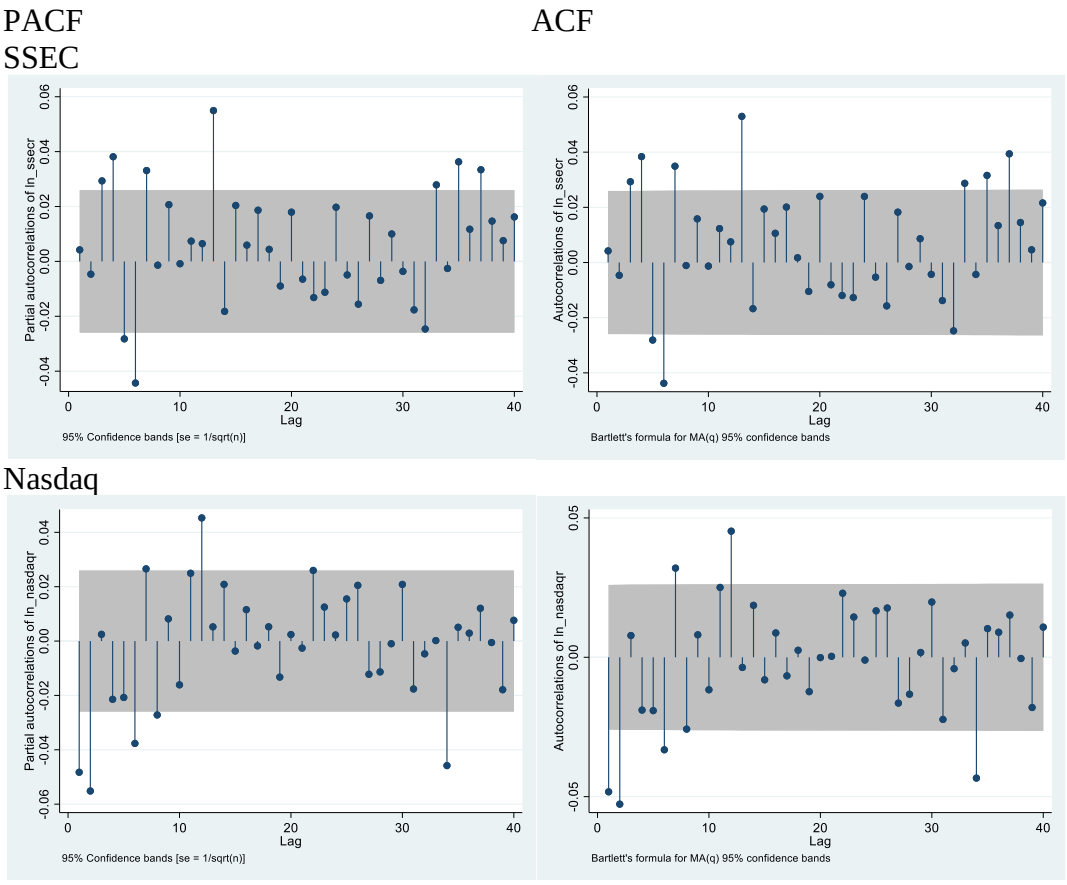

Figure 3. ARMA (p, q) identification, Photo credit: Original

3.4. Estimation Results

The ARMA-GARCHX regression model allows for the estimation of conditional variances, incorporating ARCH and GARCH components. Table 3 shows the estimate findings for the SSEC and Nasdaq indexes' variance equations.

The SSEC variance equation coefficients are statistically significant, demonstrating that the SSEC index's conditional variance is impacted by its own delayed values. The coefficient for the Nasdaq variance equation, on the other hand, is not statistically significant, indicating that the Nasdaq index's conditional variance is not substantially impacted by its own delayed values.

Further evidence of volatility clustering in the data is provided by the computed ARCH and GARCH coefficients for both indices, both of which are statistically significant. This suggests that volatile times often lead to more volatile ones that come after them.

Table 3. Variance equation

	(1)			(2)		
	SSEC			Nasdaq		
	Coef.	P	Std. Err.	Coef.	P	Std. Err.
SSEC, variance				965.951	0	212.2012
Nasdaq, variance	-84.13438	0.638	178.6704			
ARCH	.079791	0	.1303133	.1082117	0	.0059576
GARCH	.9171476	0	.003619	.8815194	0	.0060514
Constant	-13.28948	0	.003271	-12.91485	0	.104939

A considerable, directional association between the Nasdaq index and the SSEC index is confirmed by the empirical findings, in conclusion. In other words, SSEC volatility overflows to Nasdaq, but the reverse is not true. The ARMA-GARCH model is employed to describe the conditioned volatility patterns, and both series are also found to be stationary after differencing. These results show the value of taking market interdependencies into account when assessing stock market movements and provide light on how the Nasdaq index affects the SSEC index.

4. Discussion

The findings of this study have both similarities and differences when compared to the existing literature on the impact of Nasdaq index on SSEC. Similar to prior research, this research supports the existence of a strong correlation that links the Nasdaq index and the SSEC index. This implies that movements in the Nasdaq index do affect the SSEC index, indicating a certain level of interdependence between the two markets. In terms of differences, the current study utilizes more recent data and incorporates advanced econometric techniques, such as the VAR and ARMA-GARCH models. This enables a more thorough investigation of the relationship between the Nasdaq index and the SSEC index, taking into account a variety of elements such lag duration, volatility, and market dynamics. These differences in methodology and data contribute to a more nuanced understanding of the relationship between these two indices, providing valuable insights for further research and analysis. The findings serve as a foundation for future researchers to explore additional dimensions of this relationship, such as the transmission mechanisms and underlying factors driving these impacts.

This study also highlights the importance of considering factors such as lag lengths and volatility when analyzing the relationship between these two indices. Understanding the lagged effects and market dynamics is crucial for investors and policymakers to make informed decisions. For policymakers, the research conclusions of this article underscore the need for increased awareness and monitoring of international market interdependencies. The findings suggest that developments in the Nasdaq index can potentially influence the SSEC index, which may have implications for financial stability and economic policies in China. Policymakers should consider strengthening regulatory measures and risk management frameworks to mitigate the potential spillover effects.

Investors, on the other hand, can utilize the insights from the findings regarding lag lengths and volatility to design trading strategies. Understanding the lagged effects and volatility patterns can assist investors in identifying potential entry and exit points, managing portfolio risks, and optimizing investment returns.

5. Conclusion

In conclusion, using data from the previous 33 years, this research examined the effect of the Nasdaq index on the Shanghai Stock Exchange Composite (SSEC) index. By employing various econometric tools, including the Augmented Dickey-Fuller Unit Root Test, Vector Autoregression model, and ARMA-GARCH model, this study establishes a meaningful connection between the Nasdaq index and SSEC, highlighting the influencing role of the former on the latter. The implications of this research are twofold. First, it highlights the importance of considering global market dynamics when analyzing the behavior of the Chinese stock market. Investors and policymakers need to monitor and understand the impact of international market movements on the domestic market to make informed decisions. Second, the study's conclusions have applications for investors using international investing techniques. It suggests that incorporating information from the Nasdaq index can enhance the forecasting accuracy and risk management strategies for investments in the SSEC index.

Despite the useful information this research has provided, there are a number of limitations that need to be noted. First off, the 33-year research period could not adequately reflect the dynamic nature of the link between the Nasdaq index and the SSEC index. Financial markets are influenced by numerous factors that evolve over time, and analyzing a longer time period or incorporating more recent data could provide a more comprehensive understanding of their interaction. Also, the analysis focused solely on the relationship between the Nasdaq index and the SSEC index, without considering other global or domestic economic factors that may influence their dynamics. The model's explanatory power and ability to provide a more complete picture might be improved by including further variables like interest rates, currency rates, or macroeconomic indices. To further advance the understanding of the Nasdaq-SSEC relationship, future research could explore the impact of specific events or shocks on their interaction. Examining how major global economic events or policy changes affect the linkages between these indices could provide valuable insights for investors and policymakers. Additionally, investigating the role of investor sentiment or market sentiment indicators in shaping the Nasdaq-SSEC relationship could provide a deeper understanding of the psychological aspects influencing investor behavior.

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