Journal of Statistics & Applied Sciences, Issue -10
ISSN 2718-0999

Research Article

Received: date:24.04.2024
Accepted: date:10.09.2024
Published: date:31.12.2024

Long-run Relationship Between Türkiye and SHANGHAI Cooperation Organization Stock Markets: Cointegration Analysis

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Abstract: This study investigates the presence of long-run cointegration relationships between the Turkish Stock Market and the stock markets of the Shanghai Cooperation Organisation (SCO) member countries. In a period of stagnation in the EU membership negotiations, Türkiye's shift towards Eastern markets is noteworthy. Using a dataset covering the period from January 2014 to December 2023, this research applies various econometric analysis techniques such as Augmented Dickey-Fuller test, Johansen Cointegration Test and Granger Causality Test to examine the dynamic relationships between these markets. The findings from these analyses indicate that there is a significant long-run cointegration relationship between Borsa Istanbul and Moscow and Shanghai Stock Exchanges. This highlights the opportunities for strategic investment and portfolio diversification in these regions.
Keywords: Cointegration, Causality, Shanghai Cooperation Organisation, International Equity Indices

1. Introduction

The collapse of the USSR and the transformation of the USA into the sole superpower in the world pushed Russia and China to be on the same side and act together. As a result of this unity, firstly, border problems were solved, the Shanghai Five was founded, and then the Shanghai Cooperation Organisation (SCO) was founded.

The five countries of the region - China, Russia, Kazakhstan, Kyrgyzstan and Tajikistan - came together to resolve border issues, held talks on economic, military, cultural and energy issues, and reached common consensus decisions [1].

The name of the Shanghai Five was changed with the invitation of Uzbekistan to the meeting held in Shanghai on 15 June 2001. With the joint declaration of the participating countries, it was announced that the Shanghai Cooperation Organisation (SCO) was established with the inclusion of Uzbekistan as a member of the organisation. The main objective of the SCO is to solve the problems of terrorism, separatist movements and extremism that threaten international and regional peace and security [2].

In the current process, the total number of members of the organisation has increased to 9 with the membership of India and Pakistan in 2017 and Iran in 2023. While Afghanistan, Mongolia and Bulgaria are observer countries in the organization, 14 countries, including Türkiye, have participated in the organization as dialogue partners [3].

With its expansion, the SCO has come to dominate almost 75 per cent of the Eurasian space. Considering the population of the member states, the SCO has approximately 45% of the world population. These two aspects are very important for the organization to have effective power in the international community [4].

Since joining the organization in 2012 as a dialogue partner, Türkiye's negotiations to become a member of the organization have become an agenda item today. At a time when the EU membership process has come to a standstill, Türkiye is expanding its cooperation with the SCO in different fields, especially in the economic field. Türkiye has put the development of relations with Asia, which is the focal point of

Citation: S. Huseynova and M. Charkasov, "Long-run relationship between Turkey and Shanghai Cooperation Organization Stock Markets: Cointegration analysis," Journal of Statistics and Applied Sciences, no 10, pp 1-9 Dec. 2024. doi:10.52693/jsas.1472756

the new century, at the forefront of its foreign policy agenda due to the shift of capital from the West to the East after the economic crises in the West, and has turned its attention to the East and sought cooperation with the SCO, which it sees as an effective organisation in the region.

In this context, it is of great importance to examine the relations between Türkiye and the financial markets of the member countries of this organisation. Considering the lack of studies in this field in the literature, it is important to examine the long-run relationships between the markets of different countries in order to fill this gap. Investigating the co-movement or dependence between multiple stock markets in different countries is usually based on cointegration and causality analyses. Overall, this research is designed to contribute significantly to the existing literature on international stock market relations by focusing on a relatively less researched area - the linkages between the Turkish Stock Exchange and the stock exchanges of the SCO countries. Through its comprehensive analysis and practical implications, the study aims to be a valuable resource for both academic researchers and practitioners in the field of international finance and investment.

The study consists of four main headings. In the literature review section, a summary of important studies that are similar to the subject is given. In the next section, the data and methodology to be used are mentioned. Finally, the findings are evaluated and the results are discussed.

2. Literature Review

There are various studies that have been published in the academic literature that investigate the interaction between stock markets by employing different methodologies. Korkmaz and İsmail (2008) used the Johansen cointegration test to examine the cointegration relationship between the Istanbul Stock Exchange and the stock exchanges of 12 developed and 22 developing nations. The analytical results indicate that the Turkish stock market is cointegrated with the stock markets of 7 developed countries and 5 developing countries. After identifying the cointegrated stock markets, portfolios were constructed according to different scenarios using the Markowitz mean-variance model. These findings suggest that a better understanding by Turkish portfolio managers of the extent to which developed and emerging stock markets are integrated would be effective in asset allocation and risk minimization [5]. Mukherjee and Bose (2008) examine whether the Indian equity market moves in tandem with other markets in Asia and the United States and whether foreign investors continue to be interested in this market. According to the results of this study using cointegration and causality tests, US indices do not affect the integration of Asian markets, but Japan plays an important role in the integration of Asian markets. In addition, returns on the Indian market significantly impact the returns on major Asian markets [6].

İbicioğlu and Kapusuzoğlu (2011) conducted a study using 1922 daily data from January 2002 to January 2010. The study aimed to analyze the relationship between the Istanbul Stock Exchange (ISE) and the stock exchanges of Mediterranean countries (France, Italy, Spain, Greece, Malta, and Croatia) that are part of the European Union. The Johansen cointegration test, Granger causality analysis, variance decomposition, and impulse-response analyses confirm the existence of a long-run relationship among the stock markets of the examined countries. Specifically, the French Stock Exchange is identified as a driving force that influences other stock exchanges. However, no stock exchange is found to have a causal relationship with ISE [7].

Assidenou (2011) tested the coherence of major stock markets in OECD, Pacific, and East Asian countries by analyzing the daily closing values of market indices from September 2 to August 31, 2009. As a result of the study, he found that Asian major indices are co-integrated and demonstrated that even while certain regional stock markets are not accessible to global investors, they are nonetheless influenced by fluctuations in global markets [8].

Bulut and Özdemir (2012) analysed the relationship between Istanbul Stock Exchange and Dow Jones Industrial using weekly closing prices from 05.01.2001 to 30.12.2010. The causality relationship between the series; Granger method and cointegration analyses were performed using Johansen and Vector Error Correction models. The results of the research indicate that DJI is the three-lag Granger cause of ISE. Based on the findings of the cointegration analysis, it can be concluded that the series exhibit a long-

term relationship and are considered to be cointegrated. The error correcting term works in the short run and has a significant effect on the ISE for three periods [9].

Benli (2014) analysed the long-run relationship between the Turkish stock market and the stock markets of developing countries. Emerging markets was categorised according to Morgan Stanley Capital International (MSCI). The long-run relationship between Türkiye and these countries was analyzed with the Johansen cointegration method. An examination of the enduring connection between Türkiye and these markets was conducted using the Johansen cointegration test, covering the time span from December 30, 1994, to September 30, 2013. The results indicate a significant long-run relationship between the stock markets of Türkiye and Colombia, as well as Türkiye and Mexico. However, there is no noteworthy relationship between Türkiye and other emerging market markets. Therefore, there is a opportunity to achieve portfolio diversification and arbitrage by investing in these markets, as they are not closely related to Türkiye in the long term [10].

Gözbaşı (2015) examined the relationship between the Istanbul Stock Exchange (ISE) and the stock markets of seven emerging economies, namely Argentina, Brazil, Mexico, India, Malaysia, Hungary, and Egypt. For this purpose, cointegration and causality analyses were conducted using weekly data for the period 1995 - 2008. The findings indicate a sustained relationship between the ISE and the stock markets of Brazil, India, and Egypt in the long term. Additionally, there is a short-term interaction between the ISE and the stock markets of these three nations, as well as the stock markets of Mexico and Hungary. Accordingly, the ISE is still a stock exchange that is independent from some emerging market stock markets and can offer international diversification opportunities to investors [11].

Ünal and İçigen (2020) investigate the co-integration relationships among the stock indices of the MIST countries (Mexico, Indonesia, South Korea, and Turkey) during the 2000–2016 period using Johansen's co-integration and Vector Error Correction Model (VECM) causality analyses. Their findings reveal a long-term equilibrium relationship among these economies' stock markets. Additionally, they highlight a one-way causality from Indonesia to South Korea and from Turkey to Mexico. These results indicate that the integration level among MIST economies limits portfolio diversification and arbitrage opportunities for investors in the long run. However, the dynamic nature of short-term causality relationships emphasizes the influence of varying timeframes on market interactions, suggesting a need for further exploration of these dynamics in future research [12].

Huseynova and Ganbarli (2024) analysed the trade and economic processes between the stock index indicators of the US, Japan and China based on data from 1995 to 2022. A multivariate regression model was created in the study, and its adequacy was assessed using the F-Fisher test and Student's t test. The stability of the parameters of the regression model was checked using the CUSUM test. As a result, econometrically sound proposals have been developed that allow dynamic analyses to effectively regulate economic processes, integration, international trade and foreign investment operations between the three countries. Subsequently, a VECM model was constructed to depict the long-term equilibrium relationship between the analyzed indicators. During the modelling, all essential statistical procedures were implemented to ascertain and appraise the model's parameters, as well as to verify its sufficiency and the precision of both short-term and long-term forecast values utilizing Eviews 8 tools. The findings demonstrate the significance of government monitoring using the vector error correction model approach for both the states examined in this study and for every country. This monitoring is crucial for ensuring efficient regulation of foreign commerce and for active participation in regional and global integration processes [13].

3. Data and Methodology

This study encompasses the examination of 521 weeks of index values spanning from January 2014 to December 2023. Such a long observation period is chosen to enhance the reliability and applicability of the findings. The data for this research is sourced from investing.com, a widely used platform for financial data. Since all index values are expressed in the local currency of the respective country, all index values are converted into US dollars to harmonise all index values in a common currency. Within the scope of the study, all analyses will be performed via Eviews 13 software [14].

In the methodology section of this scientific article, a three-stage approach will be employed to analyze the data. Initially, the study will utilize the Augmented Dickey-Fuller test, to investigate the stationarity of the variables under consideration. The Augmented Dickey-Fuller test was developed by Said and Dickey (1984) and is a widely used test in time series analysis [15]. In this study, we follow the methods proposed by Gujarati and Porter (2009) for the application of the test [16]. This method is critical as it helps in determining whether the variables exhibit a time-dependent trend or are stable over time, which is essential for ensuring the validity of further statistical analysis.

Following the stationarity analysis, the research will proceed to the second stage, where the Johansen Cointegration Test will be applied. This test, developed by Johansen (1988), is a powerful method for analyzing long-run equilibrium relationships [17]. Cointegration analysis is crucial for determining if variables exhibit a shared long-term movement, indicating a common stochastic tendency.

Finally, the third stage of the methodological framework involves the application of the Granger Causality Test [18]. This test is used to detect the direction of relationships between variables. It helps in identifying whether one variable can be used to predict another, thus providing insights into potential causal relationships. Unlike traditional causal analysis, the Granger Causality Test does not imply a cause-effect relationship in the strict sense but rather indicates predictability from one time series to another.

Within the scope of the study, the indices in Table 1 are used to represent stock market indices. And Figure 1 shows the graphs of the price levels of the country indices to be included in the research for the last 10 years.

Table 1. Stock Market Indices Used in the Study

Country	Stock Market	Index	Code
China	Shanghai Stock Exchange	Shanghai Composite	SHCOMP
India	National Stock Exchange of India	Nifty 50	NSEI
Kazakhstan	Kazakhstan Stock Exchange	KASE Index	KASE
Pakistan	Karachi Stock Exchange	KSE-100 Index	KSE
Russia	Moscow Stock Exchange	MOEX Russia	IMOEX
Türkiye	Borsa Istanbul	BIST 100	XU100

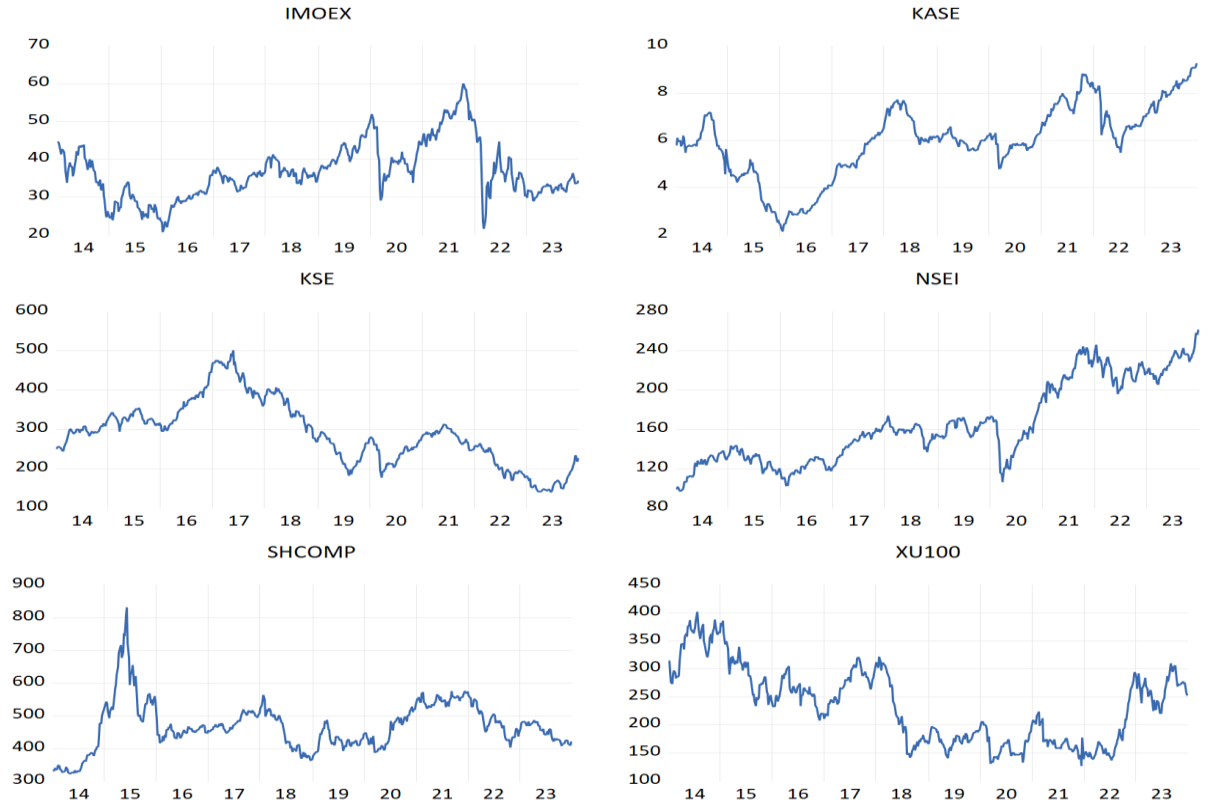

Figure 1. Graphs of Indices at the Level

Firstly, logarithmic series were created by taking the natural logarithms of the weekly closing prices of the stock market values expressed in US dollars and analyses were made over the logarithmic series. Table 2 displays the descriptive statistics for the logarithmic index series.

Table 2. Descriptive Statistics at Log Level

Series	LIMOEX	LKASE	LKSE	LNSEI	LSHCOMP	LXU100
Mean	3.584682	1.746857	5.631319	5.079089	6.137844	5.413889
Std. Dev.	0.198601	0.299346	0.292852	0.244732	0.154414	0.293710
Skewness	0.035603	-1.057209	-0.363772	0.175417	0.142087	-0.027498
Kurtosis	2.931438	3.687109	2.609556	1.924960	3.847025	1.771496
Jarque-Bera	0.212116	107.3018	14.80003	27.76050	17.32773	32.82836
Probability	0.899373	0.000000	0.000611	0.000001	0.000173	0.000000

The probability values of the J-B test statistics of the variables in the table give an idea about the normal distribution of the series. LIMOEX series is normally distributed, while other series are not.

Table 3. Correlation Coefficients among Series

	LIMOEX	LKASE	LKSE	LNSEI	LSHCOMP	LXU100
LIMOEX	1					
LKASE	0.6169	1				
LKSE	-0.0974	-0.4400	1			
LNSEI	0.4015	0.7502	-0.5375	1		
LSHCOMP	-0.0352	-0.0338	0.1914	0.2780	1	
LXU100	-0.4390	-0.2333	0.2998	-0.3859	-0.0759	1

Table 3 highlights that among the pairs analyzed, the stock markets of India and Kazakhstan exhibit the highest degree of correlation, standing at a significant 75.02%. This strong positive correlation indicates a close relationship between the two markets, suggesting that they often move in tandem.

On the other hand, the correlation table also reveals a markedly different relationship between the Pakistani and Indian stock markets. Here, the correlation is not only lower but distinctly negative, recorded at -53.75%. This negative correlation indicates that these two markets often move in opposite directions.

Mostly stationarity at level values is an exception. The results of analyses on non-stationary series may lead to misleading forecasts. For this reason, stationarity is very important and the series must be stationary before the analysis is performed [19].

Using the ADF test, the stationarity of the modeling variables was examined. The testing results indicate that both the original series and their first differences demonstrate stationarity. These results are presented in Table 4:

Table 4. ADF Test Results

Stock Market Indexes	ADF (Level)		ADF (1st Difference)	
	H0: Series has a unit root		H0: The first difference of the series has a unit root.	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
LIMOEX	-2.7177	-3.6103	-12.8888	-12.8789
LKASE	-0.8649	-2.0432	-14.3277	-14.3751
LKSE	-1.2348	-2.3457	-19.2398	-19.2410
LNSEI	-1.1774	-2.8472	-21.4096	-21.3890
LSHCOMP	-2.9803	-2.8737	-20.8832	-20.9111
LXU100	-1.8348	-2.2581	-25.3654	-25.3613
Test Critical Values				
%1	-3.4427	-3.9758	-3.4427	-3.9758
%5	-2.8669	-3.4185	-2.8669	-3.4185
%10	-2.5696	-3.1317	-2.5696	-3.1317

It is observed that all the index series applied ADF test contain unit root at level I(0) both in the model with constant term and in the model with constant term and trend, in other words, they are non-stationary. Non-stationary series become stationary when their first order differences are taken. Since

the stationarity level of the data is I(1), Johansen cointegration analysis can be performed between these data.

In order to provide comprehensive information for the research, it is important to conduct an analysis of the reaction of impulse functions. Impulse response functions, as proposed by Sims (1980), are widely utilized to analyze the dynamic responses of systems to shocks [20]. In this study, the methods recommended by Lütkepohl (2005) have been employed [21]. These functions provide the median estimate, along with a 90% confidence range, of the endogenous variable for each positive shock of one standard deviation of the exogenous variable. They also reflect the amount of time it takes to return to the equilibrium path. The confidence intervals were derived using the bootstrapping method with 100 replications, as outlined in. Figure 2 presents the test results for a period of 10 years.

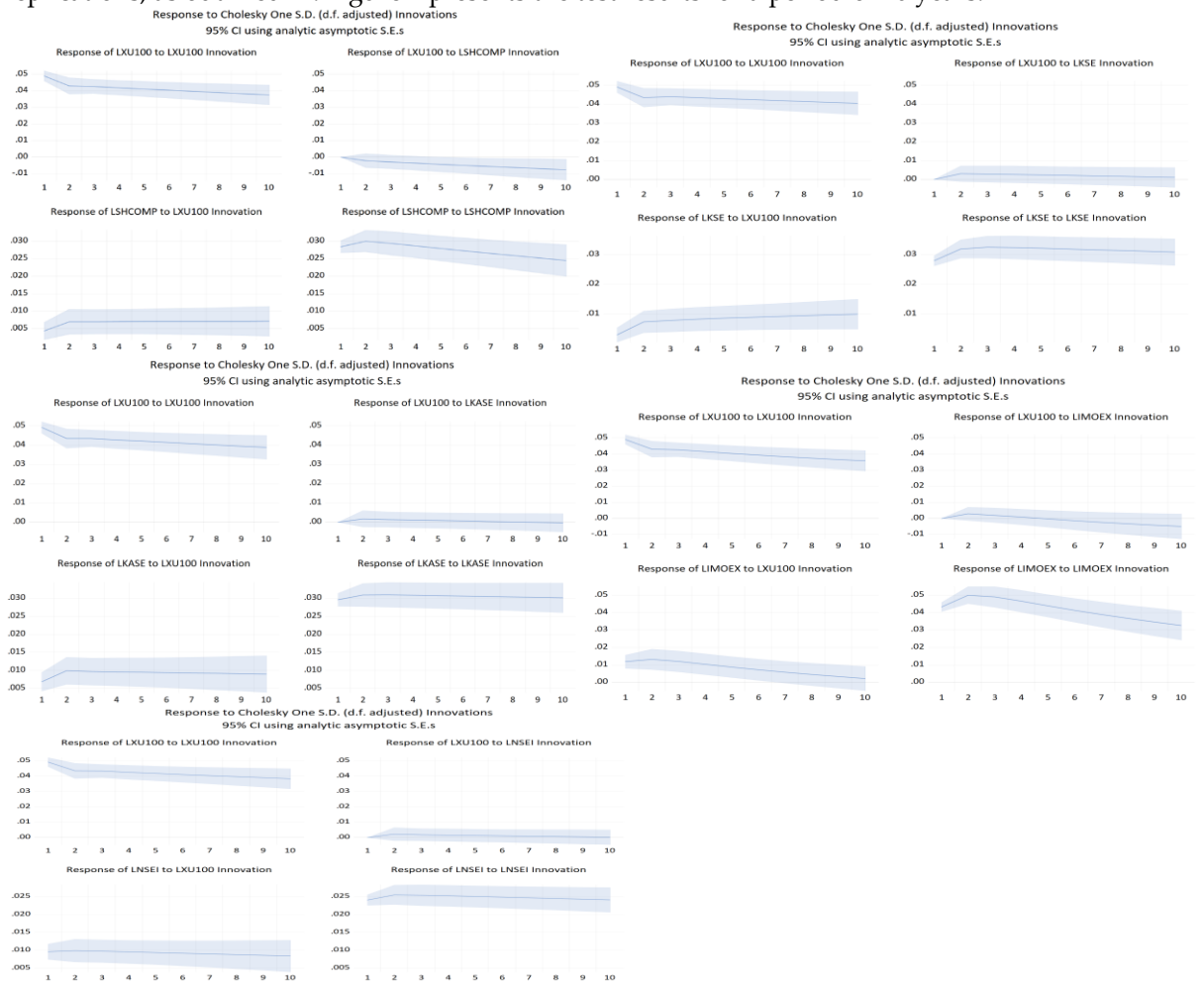

Figure 2. Results of Impulse Response Function

Figure 2 clearly demonstrates that the variables' response to deviations from the main stochastic trend varies. When responding to shocks, the endogenous variable moves partially towards equilibrium.

In order to examine the impact of external factors on an internal factor in the coming decade, the econometric technique of decomposition of forecast error variances was employed. This method assesses the extent to which changes in a specific variable contribute to its own forecast error variance, as well as the variance of other variables. Upon analyzing the control findings of the relevant tests, it is evident that the yearly forecast LXU100, shocks, and LSHCOMP exhibit the most substantial inconsistencies. The error rates for these inconsistencies are 99.88% over a two-year period and 93.14% over a ten-year period, respectively. Yearly forecast LXU100, the largest errors fall on the shocks and LKSE, in the amounts of 99.78% over a two-year horizon and 93.91% over a ten-year horizon; yearly forecast LXU100, the largest errors fall on the shocks and LKASE, in the amounts of 99.93% over a two-year horizon and 91.72% over a ten-year horizon; yearly forecast LXU100, the largest errors fall on the shocks and LIMOEX, in the amounts of 99.81% over a two-year horizon and 95.88% over a ten-year

horizon; yearly forecast LXU100, the largest errors fall on the shocks and LNSEI, in the amounts of 99.87 % over a two-year horizon and 88.87% over a ten-year horizon.

Table 7. Results of the Granger Causality Test

Null Hypothesis	F-Statistic	Prob.
DLIMOEX → DLXU100	1.30811	0.2712
DLXU100 → DLIMOEX	0.08349	0.9199
DLKASE → DLXU100	1.81712	0.1635
DLXU100 → DLKASE	2.01294	0.1346
DLKSE → DLXU100	0.89036	0.4111
DLXU100 → DLKSE	5.67884	0.0036*
DLNSEI → DLXU100	0.57593	0.5625
DLXU100 → DLNSEI	1.63526	0.1959
DLSHCOMP → DLXU100	0.92311	0.3979
DLXU100 → DLSHCOMP	2.12942	0.1200

**indicates the significance at %1*

In the Granger causality test, first order differences of logarithmic series were taken. The outputs of the causality test can be found in Table 7. In these tests, which are considered as bivariate model, the null hypothesis is "There is no Granger causality from the independent variable to the dependent variable.". Based on the data in the table, it can be concluded that the null hypothesis between the Borsa Istanbul and other markets, excluding the Karachi Stock Exchange, is rejected. It can be observed that there is a unidirectional causality relationship from Borsa Istanbul to Karachi Stock Exchange.

3.1. Cointegration Analysis

In this phase of the research, we will report the findings of the Johansen Cointegration Test regarding the presence of a long-term relationship among Borsa Istanbul and the stock exchanges of Shanghai Cooperation Organization member countries.

Before proceeding with this test, it should be determined with how many week lags the interaction between the series emerges. The optimal lag lengths were determined using VAR analysis. The optimal lag lengths obtained according to the Akaike, Schwarz and Hannan-Quinn information criteria are presented in Table 5.

Table 5. Optimal Lag Lengths of the Series

	Lag Length	AIC	SC	HQ
LXU100 - LIMOEX	2	-6.603596*	-6.520940*	-6.571198*
LXU100 - LKASE	2	-7.368301*	-7.285644	-7.335902*
LXU100 - LKSE	2	-7.476937*	-7.394280*	-7.444538*
LXU100 - LNSEI	2	-7.775153*	-7.692497	-7.742754
LXU100 - LSHCOMP	2	-7.448794*	-7.366138	-7.416396*

** denotes lag order chosen by the relevant criterion*

Among the lag lengths, the one that is most validated by the information criteria is selected. According to the results obtained, the two-week lag length is determined as the most appropriate between the XU100 index and all other indices.

The table below presents the results of the cointegration test including the specified lag lengths.

Table 6. Results of the Johansen Cointegration Test

Indices	Hypotheses	Trace Stat.	Critical Value	P-value	Max-Eigen Stat.	Critical Value	P-value
LXU100 - LIMOEX	r=0	20.50751	15.49471	0.0081	18.47027	14.26460	0.0102
	r≤1	2.037240	3.841465	0.1535	2.037240	3.841465	0.1535
LXU100 - LKASE	r=0	5.699265	15.49471	0.7307	5.144069	14.26460	0.7235
	r≤1	0.555196	3.841465	0.4562	0.555196	3.841465	0.4562
LXU100 - LKSE	r=0	9.013486	15.49471	0.3641	6.000739	14.26460	0.6131
	r≤1	3.012746	3.841465	0.0826	3.012746	3.841465	0.0826
LXU100 - LNSEI	r=0	6.533325	15.49471	0.6324	4.796692	14.26460	0.7673
	r≤1	1.736633	3.841465	0.1876	1.736633	3.841465	0.1876
	r=0	16.56916	15.49471	0.0343	11.13770	14.26460	0.1475

LXU100 - LSHCOMP	r≤1	5.431467	3.841465	0.0198	5.431467	3.841465	0.0198

In the literature, it is accepted that there is a cointegration relationship when the critical value probabilities of any of the Trace and Maximum Eigenvalue statistics is below 0.05. The results indicate a significant cointegration relationship between the Borsa Istanbul and Moscow Stock Exchange, as confirmed by both the Trace test statistic and the Max-Eigen value test statistic. A significant cointegration relationship was found between Borsa Istanbul and Shanghai Stock Exchange only according to the Trace test statistics.

4. Conclusions

The primary aim of this research is to examine whether cointegration relationships exist between the Turkish Stock Exchange and the major stock exchanges operating in the member countries of the Shanghai Cooperation Organization (SCO). This study is particularly important given the increasing economic bilateral relations among emerging markets and the growing importance of the SCO in global economic dynamics. By examining these cointegration relationships, the study aims to uncover any long-run equilibrium linkages that may exist between these disparate but economically important markets.

The results of the Johansen Cointegration Test confirm the existence of long-term equilibrium relationships between BIST and the Moscow and Shanghai stock exchanges. The Granger Causality Test results indicate a unidirectional causality relationship between Borsa Istanbul and the Karachi Stock Exchange, suggesting that changes in BIST can predict changes in the Karachi market.

There was no statistically significant long-term relationship observed between the Borsa Istanbul and stock markets in other countries at a 5% probability level. This situation can be considered as a favourable situation for international investors. In particular, international portfolio diversification is possible due to the lack of a long-term relationship among stock exchanges.

These results align with previous studies, such as Benli (2014) and Gözbaşı (2015), which emphasized the diversification opportunities presented by the weak integration of the Turkish stock market with other emerging markets. In this context, the findings contribute to the growing body of literature on international finance by highlighting the potential of Turkey's financial market as an independent component in global investment strategies.

More research should be conducted on Türkiye's financial relationships with other SCO member countries to identify potential long-term cointegration relationships. Policies should be developed to enhance economic cooperation between Türkiye and SCO countries, promoting financial market integration and improving the investment climate. Future studies should use broader datasets and diverse analytical methods to increase the reliability of the findings, with a detailed examination of mutual relationships with other SCO member stock markets.

Author Contributions: "Conceptualization, S.H. and M.C.; methodology, S.H. and M.C.; software, S.H.; validation, M.C.; formal analysis, writing - revising and editing, S.H. and M.C.

Funding: This research was not financially supported by external sources.

Conflicts of Interest: The authors declare no conflict of interest.

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