ISSN 2090-3359 (Print)
ISSN 2090-3367 (Online)

Advances in Decision Sciences

Volume 25
Issue 4
December 2021

Michael McAleer

Editor-in-Chief
University Chair Professor
Asia University, Taiwan

Published by Asia University, Taiwan

ADS@ASIAUNIVERSITY

Existence of Cointegration between the Public and Private Bank Index: Evidence from Indian Capital Market

Satyaban Sahoo*

Department of Management, Central University of Rajasthan,

India

E-Mail: satyabans40@gmail.com

ORCID ID: https://orcid.org/0000-0002-5545-6289

Sanjay Kumar

Department of Management, Central University of Rajasthan,

India

*Corresponding Author

Abstract

Purpose: The study aims to examine both long-run and short-run causal relationships among the public and private bank indices of the Indian capital market.

Design/methodology/approach: The paper employs Johansen's cointegration approach and Granger Causality test, which allows measuring long-run relationships and causality among the public and private bank indices.

Findings: The empirical analysis indicates that long-run cointegrating relationships exist between public and private bank indices. On the other hand, Granger Causality reveals that the private bank index plays a dominant role; Granger causes public bank index. So, long-run diversification may not be possible due to common factors; however, short-run portfolio diversification is possible due to unidirectional causality running from private bank index to public bank index.

Originality/value: Investors often create portfolios by allocating funds to public and private bank stocks based on the performance and projected development of the bank. In recent decades, there has been a surge in interest in banking sector unification. So, the transfer of information between private and public banks witnessed a boom. To fill this research gap, the study contributes to the literature by investigating the cointegration and causality between Nifty PSU Bank and Nifty PVT Bank indices in the Indian capital market.

Implications: The study's findings have implications for investors while maximizing return on investment when diversifying capital among public and private bank stocks. The findings significantly impact traders' judgments when using hedging and arbitration strategies, guide portfolio managers when managing risk, and help policymakers assess the market stability.

Keywords: Public Bank Index, Private Bank Index, Johansen's Cointegration Test, Granger Causality Test

JEL Classification: C58 N25 O16

Introduction

The growth of a nation depends primarily on the existence of an advanced financial sector, which promotes industry, agriculture, education through financing and loans. This aim is fulfilled by banks' presence, which facilitates capital creation and promotes public deposits. The significance of the banking sector in supplying stability and boom to an economic system is something that even a non-professional can intuitively recognize. Among their several functions, trade & business support and consumption are most significant for an investor.

India's large-scale banking system is fundamental in nature as it constitutes the lifeline of rural and urban economic activities. The banking sector has played a critical role in socio-economic development in the economic system. Public and private sector banks have played significant roles in developing the nation's economy and the lives of individuals. This sector has experienced significant changes, and investors anticipate this being a sector with future growth and success. The country's central bank, the Reserve Bank of India, supervises the banking industry and guarantees economic and monetary stability. The majority of banks have reached a stage where additional capital is necessary to support the development and expansion objectives of the banks. A way of circumventing these restrictions is to go public. The banks improve their shareholders' base and develop credibility by listing on the stock exchange. Every bank listed on the stock exchange is relatively liquid, and the majority are available in the F&O segment (future and options). The stock exchanges in India have introduced different banking indices to keep track of the performance of the banking sector. Nifty Bank, Nifty PSU Bank, and Nifty PVT Bank are examples of various indices related to India's banking sector at the National Stock Exchange (NSE).

Usually, a hedger uses an index like Nifty or Nifty bank to compensate for risk due to volatility in banking stocks. In the context of banking disruptions, traders will want to take advantage of price volatility. The banking sector has been the leading sector for the market for a long time: The performance of the Nifty Bank Index has outperformed the performance of the Nifty 50 Index for the last three years. The charge has been headed by many big private sector banking institutions like HDFC Bank, Axis Bank, and ICICI Bank. Not unexpectedly, during the last three years, the Nifty Private Bank Index has outperformed the Nifty 50 index and the Nifty Bank index. However, India's public banking sector is also not lagging; they have the advantage of solid loan growth and improvement in risk management. Although with their current colossal branch network, the public sector banks have increased their IT expenditures to improve operating efficiencies in the last few years, the core

profitability of public sector banks has continued to grow. In the past years, the consolidation of public sector banks further strengthened the competitive advantage of banks in foreign and domestic services against their private competitors; this led the Indian banking business to change dynamically. So NSE introduced the Nifty PSU bank index to capture the performance of the public sector banks. Any policy changes by the regulatory bodies in banks, whether private or public, may create disruption. So, there is a need to understand the linkages between the private bank and the public bank stock index.

The primary motive behind the study is the investigation of the structural links among public and private bank indices from the investment point of view. A thorough grasp of the inter-sectoral connectivity might be useful in building a favorable and acceptable investment plan. The integration of indices has been a significant problem in finance literature due to its huge repercussions for many parties involved. However, few studies have addressed the interrelationship among public and private bank indices in a particular country. The interest in the study related to the integration of various banking sector indices has increased among academic and financial fraternity in the last decades. The transmission of information between the private and public banks indices is an interesting topic for research. Therefore, to address the gaps in existing literature, this study examines the integration of the Nifty PSU Bank and Nifty PVT Bank index. Investors frequently construct a portfolio by allocating funds to public and private bank assets depending on the bank's performance and predicted growth. However, if both public and private bank indices are cointegrated in the long run, there will be less room for diversification into these indices. The best return from a portfolio may be obtained if an investor can detect links between different financial market sectors (Patra & Poshakwale, 2008). Therefore, if both indices are not cointegrated in the long-run, market participants will have more room for investment diversification into both public and private banks. A brief discussion on both the Nifty PSU Bank index and Nifty PVT Bank index has been stated below:

Nifty PSU Bank: The performance of public sector banks is measured by the Nifty PSU Bank Index. It is useful for benchmarking, launching index funds and ETFs. The index is consists of 13 public sector banks.

Nifty PVT Bank: The performance of private sector banks is measured by the Nifty PVT Bank. It is useful for benchmarking, launching index funds and ETFs. The index is consists of 10 private sector banks.

This study has contributed to the body of literature in several respects. First, the paper used total return index data, which reflects both price movements and dividend distribution in index constituent stocks. Second, unlike the previous studies, this study investigates the long-run relationship between the public and private bank indices. The employed Johansen's cointegration test was proven to be superior when compared to other time-series methodologies. This method benefits by establishing a stronger cointegrating relationship in large samples. Thirdly, the study also used the Granger causality test to identify the causal relationship between the public and private bank index of the Indian capital market. Thus, the study is significant for the Indian capital market as it provides a detailed empirical examination of cointegrating relationships between the indices, particularly when investors search for investment avenues for best portfolio diversification.

In this paper, the researchers have looked at the possible existence of the banking index integration. Section 2 of this paper presents the literature review; Section 3 presents the research objectives; data and analytical framework are discussed in section 4; and, lastly, section 5 and the final section presents the analysis and the paper's discussion and conclusion.

Review of Literature

Numerous studies have used cointegration approaches to investigate the long-run relationship among different foreign stock markets. Batareddy et al. (2012) studied the stable long-run relationship among the emerging stock market of Asia and developed stock markets using ten-year index data. Johansen's cointegration test confirms that Asian markets have a more vital linkage with the USA market. Meric et al. (2008) studied the impact of co-movements in the USA, UK, German, French, and Japanese stock markets on both bull and bear markets to assess the benefit of portfolio diversification. In a bull market, the authors believe that investors in the same area invest in different countries rather than in different sectors in a single country; investors can gain more advantage from international diversification than domestic diversification. The sectors of the bear market tend to be closely linked, and the possibilities for country diversification are limited. Many research focused on structuring the empirical and theoretical context of cointegration between different markets' spot and futures prices. Allen et al. (2018) investigated the cointegration between the spot and futures prices of agricultural commodities, ethanol, and crushing crude oil. The Engle-Granger pairwise cointegration and partial cointegration have been used. The pair of spot and future series are found to be cointegrated. Several studies have examined the degree of capital

market integration with macroeconomic indicators across time and markets. These studies also look at other aspects of capital market interconnectedness, such as short and long-term interdependence. Lee et al. (2020) investigated the relationship between time deposit rates, interest rates, real rates, inflation, and risk premium using the cointegration approach. Both short and long relationships between inflation and economic growth in Kenya have been analyzed using Autoregressive Distributed Lag (ARDL) Bounds test and Granger causality test (Saungweme & Odhiambo, 2019). In the works of Phiri (2015), the causality relationship tested between financial development and South Africa's economic growth. Bhuvaneshwari & Ramya (2017) used the Augmented Dickey-Fuller test (ADF test), and Phillips-Perron test (PP test) unit root test, Johansen's approach for long-run equilibrium, and Granger Causality test are applied to check the causality among India's stock prices and exchange rate. The banking sector has always been the backbone of the countries' financial ecosystem, and it holds the dominant role in supporting the economies of the countries. Furthermore, the fundamental performance of these banking companies, whether public or private, have a significant impact on their stock prices. These banking companies have helped India to be one of the fastest-growing economies.

The Indian banking system has seen substantial structural changes in the post-liberalization period. The consequences of these changes have caused several financial and operational problems to both public and private banks, such as increased NPAs, poor capital adequacy, increasing frauds, delayed financial inclusion, among others. So the researchers have contributed to identifying and addressing these problems. Vardar et al. (2012) tried to establish the long and short-run relationship among the banking, chemistry, trade, basic metal, telecommunication, and holding & investment index of the Istanbul stock exchange. With the help of Johansen's cointegration test and granger causality test, the authors found a bidirectional long-run causality among all indices except banking and holding & investment. The authors also found that the banking index plays a leading and dominant role. The causal linkage of the sectoral index of NSE has been analyzed using the Granger causality test (Aravind, 2017). The study found a bi-directional causal linkage between the private bank index and Nifty. The author also found a significant bidirectional relationship between banking stocks regardless of shareholding structure. Using the Granger causality test, Arun Kumar Sharma (2014) found unidirectional causality running from the Nifty Bank index to Nifty Auto and Nifty Metal. Narayan & Reddy (2017) investigated the causal relationship among stock return, volume, and turnover across a sectoral index of NSE. The authors found

a weak relationship between the stock returns and turnover in the Nifty Bank index and Nifty private Bank index; however, the study also found a significant impact of turnover on stock returns in the case of the Nifty Bank index. Both long and short-run relationships among the Athens Stock exchange stock index have been investigated using Johansen's cointegration test and Granger Causality test (Patra & Poshakwale, 2008). The results suggest that, while the sector indices do not exhibit a consistent and strong long-term relationship, the banking sector appears to have a considerable effect on the returns and volatility of other sectors, at least in the short run. Since the banking sector plays such an important role, changes in the banking sector index might be utilized to forecast short-term moves. The ordinary least square method and Johansen's cointegration approach have been used to test whether the sectoral index of India provides the hedge against inflation (Islam & Goyal, 2017). The result suggested that the NSE's PSU Bank index and NSE's PVT bank index are providing a partial hedge against inflation. Nateson et al. (2013) employed the GARCH model in their study to measure the volatility transmission and found a volatility transmission from BSE Sensex to BSE Bankex index. The banking index has been more volatile during the sub-prime crises than COVID-19 (Bhatia & Gupta, 2020). The authors suggested that investors employ the diversification technique to protect their portfolio values against global shocks. Jagotra (2018) attempts to measure the volatility and risk associated with the banking companies in the BSE banking index by considering their daily returns. The authors found that the banking companies have higher volatility than the market index. The relationship between returns and volatility of the Bank index stocks and Nifty has been investigated (Konanki & Basaiah, 2018). The authors found that Bank index stocks are doing well compared to the Nifty index. Mohanty & Krishnankutty (2018) aim to determine the performance of the variables that drive the banks' return on assets. The authors used panel generalized methods of movements estimation to analyze the profitability of 46 Indian banks for 17 years. The authors found that the capital adequacy ratio and solvency ratio have a significant positive effect on the return on assets while the expenses ratio has a negative effect. M & Hemalatha (2018) analyzed the volatility of the three banking companies from each of the Nifty PVT Bank and Nifty PSU Bank indices using mean, standard deviation, and correlation. The study shows that private sector banks have a greater growth rate than public sector banks, while the share price of the public sector banks is more volatile than the private sector banks. Both private and public sector banks correlate with their respective indices. Rohith (2017) also attempts to examine the volatility of the Nifty Bank index with the comparison with Nifty. The results show that the Nifty Bank index is more volatile than the Nifty. Babu (2014) analyzed the financial

performance of the two big private banks, I,e. ICICI and HDFC bank. After comparing the different ratios, the author found that ICICI bank performs better than the HDFC bank. The impact of corporate social responsibility (CSR) on corporate sustainability (CS) in Indian Banking industries has been investigated by (Saxena & Kohli, 2012). With the analysis of various financial indicators, the study found no concrete relationship between CSR and CS. Mohan & Ray (2004) analysed the efficiency and productivity growth of public, private and foreign banks in India and found that public banks do better than private and foreign banks. According to (Cyano et al., 2018) the investors should evaluate banking sector reforms before investing in stocks of Nifty PSU bank index and Nifty PVT bank index.

In the above discussion of the previous literature, it can be seen that several studies evaluated the performance, productivity, and relationship between the Bank index and the broad market index. However, no such studies have investigated the integration of India's public and private bank stock index. So, there is a greater need to understand the integration and the causality relationship between the public and private bank stock index.

Objectives of the Study

This research is unique because it explores the cointegration between India's public and private bank stock indices. So, the objectives of the current studies are stated as follows:

1. To investigate the long-run relationship between India's public bank and the private bank stock index.

2. To investigate the causal relationship between India's public bank and the private bank stock index.

Research Design

Data

The secondary data has been used in the study. The daily prices of total return index data of Nifty PSU Bank and Nifty PVT Bank have been collected from the websites of the Nifty indices for 11 years from 1st Jan 2010 to 31st Dec 2020. Total return index data reflects price movements, and any dividend distributed from the index constitutes stocks. Hence, it provides stockholders with a more realistic view of an index. The total return index was created to improve transparency, precision, and credibility. The series is transformed into the natural log to obtain more robust t-statistics (Gujarati, 2004).

Unit root test and Lag selection

The ADF test and PP test investigate the non-stationary properties of both series. The unit root test is used to test the level of integration to select the appropriate model. The ADF test includes the lagged terms of dependent and independent variables to eliminate the autocorrelation in the time series (Dickey & Fuller, 1979). The null hypothesis of the unit root test says that the series is non-stationary. If the calculated value is greater than the absolute critical value, the null hypothesis of non-stationarity is rejected (Batareddy et al., 2012). The following regression equation is estimated for the ADF test.

$$\Delta Y_t = a_0 + a_1 Y_{t-1} + \sum_{j=1}^{k} \beta_j \Delta Y_{t-j} + \varepsilon_t \qquad (1)$$

The PP test is a non-parametric test that corrects the results of t-test statistics for dealing with strong autocorrelation in error terms without requiring the addition of a lagged differenced term (Phillips & Perron, 1988). The following regression equation is estimated for the PP test

$$\Delta Y_t = a_0 + \beta Y_t + \varepsilon_t \qquad (2)$$

To test the cointegration between the variables, they should be in their level form (Chowdhury & Masih, 2015). The correct lag choice is sensitive to the cointegration and Granger causality tests (Gujarati, 2004, p.696); the paper uses Akaike Information Criterion (AIC) to choose the optimal lag.

Cointegration Test

According to economic theory, different times series datasets will move together, oscillating around a long-run equilibrium. The idea of cointegration is used in econometrics and statistics to evaluate and assess this long-run equilibrium. Cointegration tests are beneficial when dealing with data that are not stationary and investigating the long-term relationship. The unit root tests attempt to evaluate the presence of stochastic time series trends (Phillips & Perron, 1988; Ramirez, 2000), and cointegration tests look for a common stochastic trend between the variables (Chan et al., 1997; Lee et al., 2020; Mishkin, 1992). The existence of a cointegrating relationship among the variables could lead to the existence of a cointegrating vector (Lv et al., 2019). Hence, the paper uses Johansen's cointegration test to test long-run relationships because it allows multiple cointegrating vectors in a VAR

system. Johansen proposes a maximum likelihood approach to determine the presence of cointegrating vectors (Johansen & Juselius, 1990), which is stated as follows:

$$\Delta Y_t = \theta + \sum_{k=1}^{n-1} \Gamma_k \Delta Y_{t-k} + \prod Y_{t-n} + \varepsilon_t \qquad (3)$$

Where Y_t is a vector of non -stationary variable, θ is the constant and n is the lag length based on AIC, Δ is the difference operator, Π and Γ is the matrix of parameters to be estimated. The Π determines the long-run relationship indicating α and β contain adjustments and cointegrating vectors (Soni, 2014). The test is based on the two test statistics (Rastogi, 2013), which are computed by using the following formula:

$$\lambda_{trace} = -T \sum_{j=r+1}^{n} \ln(1 - \lambda j) \qquad (4)$$

$$\lambda_{max} = -T \ln(1 - \lambda_{r+1}) \qquad (5)$$

The null hypothesis of *r* cointegrating vectors tested against *n* cointegrating vectors in trace test while the null hypothesis of *r* cointegrating vectors tested against *r+1* cointegrating vectors in maximum eigenvalue test (Gupta & Guidi, 2012) (Ali & Gupta, 2011). The error assures the system will reverse to its long-run equilibrium following short-run diversions (Ratanapakorn & Sharma, 2007) so that VECM modeling can be carried out for further investigation.

VEC Granger Causality Test

The Granger Causality test has been used to analyze the causal relationship between the variables. The Granger approach (1969) carried out to predict how much the current value of one variable is explained by the other variable's past values (Abhijit Sharma & Panagiotidis, 2005). If the series are cointegrated, the standard Granger Causality test is not suitable; so, the causal relationship is estimated in VECM (Engle & Granger, 1987). The following equations answer whether X series granger causes Y series or Y series granger causes X series.

$$\Delta X_t = \theta_x + \sum_{i=1}^{n} \gamma_{x,i} \Delta X_{t-i} + \sum_{i=1}^{n} \beta_{x,i} \Delta Y_{t-i} + \varphi_x ECT_{x,t-i} + \varepsilon_{xt} \qquad (6)$$

$$\Delta Y_t = \theta_y + \sum_{i=1}^{n} \gamma_{y,i} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{y,i} \Delta X_{t-i} + \varphi_y ECT_{y,t-i} + \varepsilon_{yt} \qquad (7)$$

Where ε_{xt} and ε_{yt} are the are random error terms and n is the maximum number of lags. Y_i and β_i are parameters, θ_x and θ_y are constants.

Analysis and Results

Descriptive Statistics

Table 1 presents the descriptive statistics of the daily total return index. The critical components of the descriptive statistics examined during the study include mean, median, standard deviation, skewness, kurtosis, and Jarque-Bera. The mean of the private bank index has been greater than the public bank index; it signifies that investor shows positive behavior towards the private bank stocks during the study period. The standard deviation reflects the variation of the data set. The private bank index variation is double of the public bank index. The statistical theory says that the lower the variation, the better it is. Both private and public bank indices are negatively skewed, having a long left tail. The threshold value of kurtosis is three, implying that the public bank index is leptokurtic, has a higher peak than the normal distribution (Moslehpour et al., 2022), while the private bank is platykurtic, has a lower peak than the normal distribution. The probability value of Jarque-Bera indicates the normality of the data set. From the results, it can be interpreted that none of the series is normally distributed.

Table 1. Descriptive Statistics of PSU Bank and PVT Bank Indices

Descriptive Statistics	LOGPSUBANK	LOGPVTBANK
Mean	8.226030	9.127387
Median	8.282778	9.251514
Maximum	8.744991	9.925332
Minimum	7.253378	8.151578
Std. Dev.	0.266361	0.526061
Skewness	-1.381418	-0.147572
Kurtosis	5.075279	1.589456
Jarque-Bera	1357.185	236.0567
Probability	0.000000	0.000000
Observations	2728	2728

Source: Author's calculation

Stationarity Test Results

The stationarity of the data set is presented in table 2. Both ADF and PP test for stationarity indicates that series is non-stationary in their level form. However, the p-value at the first difference of the selected series indicates that the series does not contain a unit root, which indicates that the series are integrated at order one, which is necessary for carrying out the cointegration test. The optimal lag is selected as three based on the lower AIC value. The lower the criterion's value, the better the model is (Kharbanda & Singh, 2017).

Table 2. Unit Root Test

Sectoral Index	Augmented Dickey-Fuller (ADF)		Phillips-Perron (PP)	
	At Level	At First Difference	At Level	At First Difference
LOGPSUBANK	-2.6915	-13.6579***	-2.4032	-49.6019***
	(0.2402)	(0.0000)	(0.3777)	(0.0000)
LOGPVTBANK	-2.8744	-14.1065***	-2.7261	-48.4834***
	(0.1711)	(0.0000)	(0.2259)	(0.0000)

Source: Author's calculation

Cointegration Test Results

The results of trace statistics and Max-Eigen Statistic of Johansen's cointegration test are reported in table 3. The computed value of both trace statistics and Max-Eigen Statistic is greater than the corresponding critical value indicating that at least one cointegrating vector exists. However, the computed value of both trace statistics and Max-Eigen Statistic are lower than the corresponding critical values for more than one cointegrating vector, so only one cointegrating vector exists between the public and private bank index; this indicates that long-run relationships exist among the variables. So, the VECM model can be further carried out based on the cointegrating relationship.

Table 3 Johansen's cointegration results (Trace test and Maximum Eigen Value)

Hypothesized No. of CE(s)	Unrestricted Cointegration Rank Test (Trace)				Unrestricted Cointegration Rank Test (Maximum Eigenvalue)			
	Eigen value	Trace Statistic	Critical Value at 0.05	Prob.**	Eigen value	Max-Eigen Statistic	Critical Value at 0.05	Prob.**
None *	0.0084	29.1105	25.8721	0.0191	0.0084	23.2505	19.3870	0.0130
At most 1	0.0021	5.8594	12.5179	0.4784	0.0021	5.8594	12.5179	0.4784

Trace test and Max-eigen value test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's calculation

VECM Results

The results of the cointegrating equation are presented in table 4. The equation shows that the long-run coefficient is negative and significant shows long-run causality between the public and private banks. The negative sign of coefficient indicates the ability to bounce back to the equilibrium. Each percentage increase in the private bank index will cause a decline of 1.49 percent in the public bank index.

Table 4 Results of Cointgrating Equation

Cointegrating Eq:	CointEq1
LOGPSUBANK(-1)	1.000000
LOGPVTBANK(-1)	-1.495668 (0.11995) [-12.4687]
@TREND	0.001123 (8.0E-05) [14.0119]
C	3.893290

Source: Author's calculation

Table 5 shows the estimation of the VECM model. The error correction coefficients show the speed of adjustments within which the model will bounce back to its equilibrium after any disturbances. The public bank index's error correction coefficient is negative and insignificant, indicating a lack of convergence from short-run dynamics to the long-run equilibrium. In the private bank index, the adjustment coefficient is positive and not significant, indicating a lack of significant adjustment towards long-run equilibrium in case of any disequilibrium situation.

Table 5 VECM Estimation and Results

Error Correction:	Δ(LOGPSUBANK)	Δ(LOGPVTBANK)
CointEq1	-0.008083 (0.00424) [-1.90650]	0.006009 (0.00322) [1.86731]
Δ(LOGPSUBANK(-1))	-0.004331 (0.02661) [-0.16274]	-0.042783 (0.02020) [-2.11796]
Δ(LOGPSUBANK(-2))	0.019134 (0.02659) [0.71959]	0.015013 (0.02018) [0.74388]
Δ(LOGPSUBANK(-3))	-0.021413 (0.02656) [-0.80610]	-0.005678 (0.02016) [-0.28163]
Δ(LOGPVTBANK(-1))	0.102734 (0.03514)	0.117499 (0.02668)

	[2.92318]	[4.40474]
	0.005512	-0.047036
Δ(LOGPVTBANK(-2))	(0.03516)	(0.02669)
	[0.15674]	[-1.76227]
	0.045663	0.013754
Δ(LOGPVTBANK(-3))	(0.03517)	(0.02669)
	[1.29841]	[0.51525]
	-0.000295	0.000552
C	(0.00040)	(0.00030)
	[-0.74103]	[1.82495]

Source: Author's calculation

VEC Granger Causality Test

The existence of cointegration among the variables implies causality (Owyong et al., 2015), so the Granger Causality test is applied. Since a cointegrating relationship exists, the paper has employed the Granger causality test under the VEC framework. The results of the VEC Granger Causality test are presented in table 6. The results show that the private bank index is causing the public bank index but not the other way around. So, it can be interpreted that unidirectional causality exists between the variables, and it runs from the private bank index to the public bank index.

Table 6 VEC Granger Causality Test Results

Dependent	Independent	
	Wald χ^2 Statistics	
	ΔLOGPSUBANK	ΔLOGPVTBANK
ΔLOGPSUBANK	-	9.8853 (0.0196)
ΔLOGPVTBANK	5.0267 (0.1698)	-

Source: Author's calculation

Discussion and Conclusion

The Indian capital market offers a diverse range of financial products and rewards to investors in a multitude of ways. However, investors must be aware of specific investment opportunities. The purpose and successes of several market indices might assist investors in identifying a more powerful way to grow their funds. The information exchange between private and public banks index became the research subject. As a result, to fill gaps in the literature, the study examines the long-run relationship between the public bank index and the private bank index of the Indian capital market with the 11 years time-series data. Nifty PSU Bank and Nifty PVT Bank are the indices selected for the study. The study employed four

steps to analyze the data: the stationarity test using the ADF and PP test, followed by lag length selection for more vigorous results. Johansen's cointegration test is used to examine the long-run association followed by VECM to check the speed of short-run dynamics. Finally, the Granger causality test was applied to examine the short-run causality among both indices. The researchers found evidence of a long-run equilibrium relationship indicating the violation of a weak form of market efficiency. The Granger causality test shows that the Nifty PVT Bank index causes the Nifty PSU Bank index. This finding follows the economic perception that the private and public bank stock indices are evolved in the same direction in the long run in a particular economy. The existence of a long-run relationship fulfills the assumption of economic theory, which says that the series which moves together may have a long-run cointegrating relationship. According to the results, it is not likely to benefit in the long run due to the existence of common factors (Wong et al., 2004). However, the Granger causality test results show that the short-run relationship is considerably limited, specifically unidirectional causality running from the private bank index to the public bank index, so it is still possible to benefit from short-run portfolio diversification.

The current study contributed to the existing body of literature by investigating the long-run relationship between the public and private bank index of the Indian capital market. The study also attempted to identify the causal relationship between the public and private bank index. The use of superior methodologies such as Johansen's cointegration test and Granger causality test makes the study's findings more robust and adds them to the literature, providing an accurate representation of the results. The empirical findings of this study are intended to provide a clear analytical framework that will contribute to the continuing discussion on the public and private bank index relationship and inform Indian investors on the topic.

The study's main goal is to investigate the structural relationships between public and private bank indices from an investing perspective. A solid understanding of banking index connectedness may be necessary for developing a favorable and acceptable investment strategy. In changing market conditions, an individual investor anticipates optimal risk and return. Before making any investment, the investor is continuously looking for solutions to questions such as where to invest, how much to invest, how long to invest, and how to manage the assets. The study's findings recommend that investors employ the portfolio stock selection strategy to address these asset management questions. These findings have an impact on the maximization of return on investment to diversify their capital across public

and private bank stocks. The findings substantially affect traders' decisions in implementing hedging and arbitration strategies, portfolio managers in risk management, and policymakers in market stability assessment. Furthermore, it provides traders with information about the prospective price movements on the public bank index, which influences the future activities of the traders. Therefore, it is worth mentioning the critical implication of the study that both private and public bank indices are more or less influenced by the fundamentals of the economy and financial market that bring these indices together in the long run.

In contrast to the shift in economic sentiment, investors' focus is on short-term gains, which causes markets to be very volatile. After the economic mood is discounted, the markets are in an upward trend, indicating a correction. As a result, before investing, investors should examine the bank's fundamentals and the industry and consider valuing individual stocks. The study is limited to the indices of NSE of the Indian capital market, and the result may be different from indices of other stock exchanges. Although it is outside the scope of this research, a formal evaluation of the long-run relationship among the different public and private bank indices of developed and emerging stock markets would be a good topic for further research. It would also be helpful if future studies examine public and private bank index integration during the various financial crises.

Conflicts of interest

No conflicts of interest

Funding Statement

No funding was received

References

Ali, J., & Gupta, K. B. (2011). Efficiency in agricultural commodity futures markets in India Evidence from cointegration and causality tests. *Agricultural Finance Review*, *71*(2), 162–178.

Allen, D. E., Chang, C., McAleer, M., & Singh, A. K. (2017). A cointegration analysis of agricultural, energy and bio-fuel spot, and futures prices. *Applied Economics*.

Aravind, M. (2017). The Dynamic linkage among Sectoral Indices : Evidence from Indian

Stock Market. *Rajagiri Management Journal*, *12*(1).

Babu, G. S. (2014). A Comparative Study of Financial Performance Stability Of Two Private Commercial Banks (ICICI And HDFC) and Their Subsidiary Companies In India. *International Journal of Business, Management and Allied Sciences*, *1*(3), 365–373.

Batareddy, M., Gopalaswamy, A. K., & Huang, C. H. (2012). The stability of long-run relationships A study on Asian emerging and developed stock markets (Japan and US). *International Journal of Emerging Markets*, *7*(1), 31–48.

Bhatia, P., & Gupta, P. (2020). Sub-prime Crisis or COVID-19: A Comparative Analysis of Volatility in Indian Banking Sectoral Indices. *FIIB Business Review*, *9*(4), 286–299.

Bhuvaneshwari, D., & Ramya, K. (2017). Cointegration and Causality between Stock Prices and Exchange Rate: Empirical Evidence from India. *SDMIMD Journal of Management*, *8*(1), 31–38.

Chan, K. C., Gup, B. E., & Pan, M. S. (1997). International stock market efficiency and integration: A study of Eighteen nations. *Journal of Business Finance and Accounting*, *24*(6), 803–813.

Chowdhury, M. A. F., & Masih, M. (2015). Socially responsible investment and Shariah-compliant investment compared: Can investors benefit from diversification? An ARDL approach. *Munich Personal RePEc Archive Socially*.

Cyano, P., Babu, M., & Hariharan, C. (2018). Impact of Digitalisation on Indian Banking Sector: An Empirical Study. *International Journal of Scientific Research in Computer Science Applications and Management Studies*, *7*(5), 5–8.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the Estimators for Autoregressive Time Series With a Unit Root. *Journal of the American Statistical Association*, *74*(366), 427.

Engle, R. F., & Granger, C. W. . (1987). Co-integration and Error correction: Representation, Estimation and Testing. *Econometrica*, *52*(2), 251–276.

Gujarati, D. N. (2004). Basic Econometrics. In *The McGraw-Hill Companies*.

Gupta, R., & Guidi, F. (2012). Cointegration relationship and time varying co-movements among Indian and Asian developed stock markets. *International Review of Financial*

Analysis, *21*, 10–22.

Islam, K. U., & Goyal, M. M. (2017). Examining the Fisher Effect in Short and Long Run: A Study of NSE Sectoral Indices. *International Journal of Financial Management*, *7*(2&3), 20–29.

Jagotra, S. (2018). Identifying Financial & Operating Issues and Measuring Systematic & Unsystematic Risks: A Study of Indian Banking Sector. *International Journal of Banking, Risk and Insurance*, *6*(2), 46–53.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration—with appucations to the demand for money. *Oxford Bulletin of Economics and Statistics*, *52*(2), 169–210.

Kharbanda, V., & Singh, A. (2017). Lead-lag relationship between futures and spot FX market in India. *International Journal of Managerial Finance*.

Konanki, J., & Basaiah, P. (2018). A Study on Comparative Analysis of Risk and Return with Reference to Stocks of Bank Nifty. *International Journal of Advance Research, Ideas And Innovations In Technology*, *4*(1), 66–76.

Lee, S. P., Isa, M., & Auzairy, N. A. (2020). The relationships between time deposit rates, real rates, inflation and risk premium The case of a dual banking system in Malaysia. *Journal of Islamic Accounting and Business Research*, *11*(5), 1033–1053.

Lv, Z., Chu, A. M. Y., McAleer, M., & Wong, W. K. (2019). Modelling Economic Growth, Carbon Emissions, and Fossil Fuel Consumption in China: Cointegration and Multivariate Causality. *International Journal of Environmental Research and Public Health*, *16*(21).

M, S. S., & Hemalatha, A. V. (2018). Comparative Study on the volatility of share price of private and public sector Banking Companies. *Journal of Emerging Technologies and Innovative Research*, *5*(10), 138–149.

Meric, I., Ratner, M., & Meric, G. (2008). Co-movements of sector index returns in the world's major stock markets in bull and bear markets: Portfolio diversification implications. *International Review of Financial Analysis*, *17*(1), 156–177.

Mishkin, F. S. (1992). Is the Fisher effect for real?. A reexamination of the relationship between inflation and interest rates. *Journal of Monetary Economics*, *30*(2), 195–215.

Mohan, T. T. R., & Ray, S. (2004). *Productivity Growth and Efficiency In Indian Banking: A Comparison Of Public, Private, And Foreign Banks* (Issue September).

Mohanty, B. K., & Krishnankutty, R. (2018). Determinants of Profitability in Indian Banks in the changeing scenario. *International Journal of Economics and Financial Issues*, *8*(3), 235–240.

Moslehpour, M., Al-Fadly, A., Ehsanullah, S., Chong, K. W., Xuyen, N. T. M., & Tan, L. P. (2022). Assessing Financial Risk Spillover and Panic Impact of Covid-19 on European and Vietnam Stock market. *Environmental Science and Pollution Research*.

Narayan, P., & Reddy, Y. V. (2017). Exploring the Causal Relationship Between Stock Returns, Volume, and Turnover across Sectoral Indices in Indian Stock Market. *Metamorphosis*, *16*(2), 122–140.

Nateson, C., Palanisamy, R., Renukadevi, P., & Suganya, D. (2013). Spillover Effect of Volatility in BSE Sensex on BSE Sectoral Indices. *International Journal of Management & Business Studies*, *3*(1), 92–95.

Owyong, D., Wong, W. K., & Horowitz, I. (2015). Cointegration and Causality among the Onshore and Offshore Markets for China's Currency. *Journal of Asian Economics*, *41*, 20–38.

Patra, T., & Poshakwale, S. S. (2008). Long-run and short-run relationship between the main stock indexes: Evidence from the Athens stock exchange. *Applied Financial Economics*, *18*(17), 1401–1410.

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335–346.

Phiri, A. (2015). Asymmetric cointegration and causality effects between financial development and economic growth in South Africa. *Studies in Economics and Finance*, *32*(4), 464–484.

Ramirez, M. D. (2000). Foreign direct investment in Mexico: A cointegration analysis. *Journal of Development Studies*, *37*(1), 138–162.

Rastogi, S. (2013). Long-term Association of Stock Markets of Different Nations: An Empirical Study. *Vision*, *17*(4), 303–313.

Ratanapakorn, O., & Sharma, S. C. (2007). Dynamic analysis between the US stock returns and the macroeconomic variables. *Applied Financial Economics*, *17*(5), 369–377.

Rohith, U. J. (2017). A Study on the Volatility and Return with Reference to Stocks of Bank Nifty. *Academia*, *4*(1), 66–76.

Saungweme, T., & Odhiambo, N. M. (2019). Inflation and Economic Growth in Kenya: An Empirical Examination. *Advances in Decision Sciences*, *23*(December).

Saxena, M., & Kohli, A. S. (2012). Impact of Corporate Social Responsibility on Corporate Sustainability: A Study of the Indian Banking Industry. *IUP Journal of Corporate Governance*, *11*(4), 39–54.

Sharma, Abhijit, & Panagiotidis, T. (2005). An Analysis of Exports and Growth in India: Cointegration and Causality Evidence (1971-2001). *Review of Development Economics*, *9*(2), 232–248.

Sharma, Arun kumar. (2014). Relationship between the Selected Sectoral Indices and Nifty. *International Journal of Business and General Managament*, *3*(3), 117–124.

Soni, T. K. (2014). Cointegration, linear and nonlinear causality: Analysis using Indian agriculture futures contracts. *Journal of Agribusiness in Developing and Emerging Economies*, *4*(2), 157–171.

Vardar, G., Tunc, G., & Aydogan, B. (2012). Long-Run and Short-Run Dynamics among the Sectoral Stock Indices: Evidence from Turkey. *Asian Economic and Social Society*, *2*(2), 347–357.

Wong, W. K., Penm, J., Terrell, R. D., & Lim, K. Y. C. (2004). The Relationship Between Stock Markets of Major Developed Countries and Asian Emerging Markets. *Journal of Applied Mathematics and Decision Sciences*, *8*(4), 201–218.